Shot by Brown
the gift of his Father
18 January 1846
on my return to America
A DICTIONARY OF ARTS AND SCIENCES.

BY G. GREGORY, D.D.


IN TWO VOLUMES.

VOL. II.

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1807.

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TO THE RIGHT HONOURABLE

THOMAS, LORD ERSKINE,
BARON ERSKINE OF RESTORMEL CASTLE, IN THE COUNTY OF CORNWALL,
LORD HIGH CHANCELLOR OF GREAT BRITAIN,

&c. &c. &c.

MY LORD,

THOUGH a Dedication is in general an expression of gratitude from an Author to his Patron, or of friendship from one literary character to another, yet I cannot but be of opinion, that there should be some accord between the character of the Work and that of the Patron to whom it is presented.

In this point of view the world will see the propriety of a Work which professes to treat of the Sciences and the Arts in general, being inscribed to a Nobleman who unites in himself more various, as well as more splendid talents, more general knowledge, and more diversified taste, than any other public character of the present age; who, deservedly filling the chair of Bacon, possesses the same excursive and expanded genius; but whose public duties, being more onerous than they were in the time of that great man, alone preclude him from gratifying and enlightening the Public by researches out of the line of his profession.

VOL. I.
DEDICATION.

If a private sentiment might be indulged on such an occasion, the Editor would add, that your Lordship's unremitted zeal for true Religion, and your tried and disinterested Patriotism, must for ever endear the name of Erskine to every friend of liberty, piety, and active virtue.

That your Lordship may long continue to serve your country, and promote the best interests of humanity, in the arduous situation to which the Divine Providence has been pleased to call you, is the fervent prayer of,

My Lord,

Your Lordship's

Ever faithful humble servant,

G. GREGORY.

West Ham, Jan. 20, 1807.
PREFACE.

FROM the time of Chambers, Dictionaries of Arts and Sciences have been increasing in magnitude, without (it is to be feared) a proportionable increase of utility. The authors appear to have regarded it as a kind of sacrilege to retrench, while they have equally thought it their duty to add every thing that came within their reach. Hence not only obsolete terms, but obsolete sciences, as magic, alchemy, and astrology, have been retained even in works of high character, and otherwise of distinguished merit. Hence, that which was new even in the living sciences, has been combined with what had been long since exploded: a practice calculated not only to confuse but to mislead.

It was upon this view of the subject it occurred to the editor of this work, that in framing a new Dictionary, selection was a more urgent duty than accumulation; that perspicuity, not less than convenience, would be consulted by reducing the size; and that whatever is practically useful in science and in art might be compressed within a smaller compass than had been commonly imagined. However deficient he may have been in the execution of his plan, he has the satisfaction to say, that in this idea he was not deceived or disappointed.

A dictionary of this kind is intended for two purposes: first, as a book of reference, to lie on the table of a man of letters, for occasional consultation where recollection has failed, or where a subject occurs in reading or conversation which had not previously come within the course of his studies. The second is, to serve as an introductory or elementary work for students, or for those who may not have leisure to bestow on the great works of science, or to travel through the many volumes which at this time almost every branch of knowledge includes.

The first of these ends it is Humbly presumed will be sufficiently answered by the present publication. Most of the technical terms in science and the arts, are inserted with a proper definition or explanation, in the alphabetical order; or should there be a casual omission, the word will still be found under the head of the science to which it belongs, and probably in the index to the treatises at the end of each volume. To some sciences it was found necessary to attach a glossary. The technical phrases, however, in anatomy, surgery, &c. are generally referred to those branches of science expressly treating of them, that nothing may appear, on casually opening the book, to offend the most modest or delicate reader. Terms also which now constitute a part of common colloquial language, and which, therefore, every person must understand, have been omitted.

With respect to the second object, no pains have been spared in preparing those articles which treat of the respective sciences. In a work of this nature it cannot be expected that the whole should be original, nor could it in that case answer so well the ends for which it is designed. An Encyclopedia is in its nature a compilation; and its best commendation is, that it amasses together the best,
information from the best sources. Yet in this work there is much original composition; and such is the progress of science, that it contains scarcely any articles of importance which are to be found in any similar publication.

In order also to facilitate as much as possible the study of the sciences, every attention, consistent with the nature of the work, has been paid to method; and the student will not be much at a loss to distinguish the order in which the several parts of each science are to be read. Thus, under Natural History, he will find a synopsis of the several branches, the classes and orders, and under these the names of the genera; under Zoology, again, he will not only meet the classes and orders, but also an immediate reference to the genera. Under Chemistry, he will find the outlines of the science, and references to the different branches, which are treated more at large in other parts of the work. Thus under Furnace and Laboratory, is included the whole of the apparatus; and he will then turn to Air, and the simple substances as they stand enumerated there, or under the word Elements. Astronomy and Mineralogy, he will see, have similar references. Electricity, Hydrostatics, Hydraulics, Magnetism, Mechanics, Meteorology, Optics, Pneumatics, and the Medical Branches, are complete in themselves. Those articles which relate to the Arts are also complete. Those which treat of the different subjects of Trade and Commerce are also complete, and contain all the new information which could be obtained on those important topics.

The Editor cannot conclude this address without frankly stating, that whatever may be thought of the merits of the new Dictionary of Arts and Sciences, they are more to be attributed to the very able assistance with which he has been favoured from different quarters, than to his own exertions. He wishes he could make his acknowledgments in terms equal to his sense of the obligation. To his industrious and truly able coadjutor, the Rev. Mr. Joyce, he is indebted for much general assistance, and for the exclusive superintendence of all the mathematical and astronomical articles. A similar acknowledgment is due to his friend and neighbour, Luke Howard, Esq. particularly for his attention to all those articles connected with the almost new, and important science, Meteorology.

The public will estimate better than he can point out the extent of his and their obligations to Mr. Grellier, of the Royal Exchange Assurance-Office, when he mentions, that all the articles relative to Trade, Commerce, Political Economy, Finance, and Revenue, were drawn up by that gentleman.

The Medical and Physiological articles were written by Dr. Uwins, of Somers Town; Husbandry and Surveying by Mr. Crocker, of Froome; Rhetoric by Dr. Thomson, well known as the Continuator of Watson’s History; Architecture by Mr. Henderson, the plates by Mr. Moore; Exchanges by Mr. P. Hamsbrow; Farriery by Mr. Lawrence; and Anatomy by Mr. A. Walker.

Those articles which are connected with History and Antiquities, have been furnished by a distinguished scholar, as will be easily perceived; those relative to the Fine Arts, by a gentleman well known in the literary world; Poetry by a lady, who, like Vida, has asserted her title to the character of a critic, by having excelled in the art itself; the Military articles are the production of a literary gentleman who was educated in that profession; and some of the principal Law articles are by a member of one of the inns of court. Besides these, the editor has been favoured with single communications from Dr. Mavor, Mr. M. Smart, and several correspondents who desire their names to be concealed.
DICTIONARY
OF
ARTS AND SCIENCES.

JAC

I, the ninth letter of the alphabet, used as a numeral, signifies no more than one, and stands for so many units as it is repeated times: thus, I, one; II, two; III, three, &c., and when put before a higher numeral, it subtracts itself, as IV, four; IX, nine, &c., but when set after it, so many are added to the higher numeral, as there are Ps added: thus VI is 5 + 1, or six; VII, 5 + 2, or seven; VIII, 5 + 3, or eight. The ancient Romans likewise used C for 100, CL for 100, CXC for 200, CC for 300, CCC for 500, and CCCCL for 100, 000. Farther than this, as Pliny observes, they did not go in their notation; but when necessary, repeated the last number, as CCCCLXX, CCCCLXXX, CCCCLXXXX, and so on.

JACK, in mechanics, an instrument in common use for raising heavy timber, or very great weights of any kind, being a powerful combination of teeth and pinions, and the whole inclosed in a strong wooden stock or frame BC, and moved by a winch or handle HP; the outside appearing as in Plate Miscel. fig. 131. In fig. 132, the wheel or rack work is shown, being the view of the inside when the stock is removed. Though it is not drawn in the just proportions and dimensions, for the jack AB must be supposed at least four times as long in proportion to the wheel Q, as the figure represents it; and the teeth, which will be then four times more in number, to have about three in the inch. Now if the handle HP is seven inches long, the circumference of this radius will be 44 inches, which is the distance or space the power moves through in one revolution of the handle; but as the pinion of the handle has but four leaves, and the wheel Q supposes 20 teeth, or five times the number, therefore to make one revolution of the wheel Q, it requires five turns of the handle, in which case it passes through 5 times 44 or 220 inches; but the wheel having a pinion R of three leaves, these will raise the rack three teeth, or one inch, in the same space. Hence, then, the handle or power moving 220 times as fast as the weight, will raise or balance a weight of 220 times its own energy.

And if this is the hand of a man who can sustain 50 pounds weight, he will, by the help of this jack, be able to raise or sustain a weight or force of 11000 pounds, or about 5 tons weight.

This machine is sometimes open behind from the bottom almost up to the wheel Q, to let the lower claw, which in that case is turned up as B, draw up any weight. When the weight is drawn or pushed sufficiently high, it is kept from going back by hanging the end of the hook S, fixed to a staple, over the curved part of the handle at H.

The Society of Arts rewarded Mr. Moock of Southwark, with a premium of 20 guineas, for his contrivance to prevent a jack from taking a retrograde course whenever the weight by any accidental circumstance overbalances the power. The improved jack only differs from those in common use in this respect, that it has a pall or clock, and ratchet, applied in such manner as to stop the motion of the machine as soon as it begins to run back again. As the difference in the mechanism is very trifling, the improvement may be easily applied to any common jacks already made.

JACK is also the name of a well-known engine in the kitchen, used for turning a spit. Here the weight is the power applied, acting by a set of pulleys; the friction of the parts, and the weight with which the spit is charged, are the forces to be overcome; and a steady uniform motion is maintained by means of a fly.

The common worm-jack is represented at Plate Miscel. fig. 136. ABC is the barrel round which the cord QR is wound; KL the main wheel, commonly containing 60 teeth; N the worm-wheel of about thirty teeth, cut obliquely; LM the pinion, of about 15; O the worm or endless screw, consisting of two spiral threads, making an angle of sixty or seventy degrees with its axis; X the stud, and Z the loop of the worm-spiral; P a heavy wheel or fly, connected with the spindle of the endless screw to make the motion uniform; DG the struck wheel fixed to the axis FD; S, S, S, are holes in the frame, by which it may be nailed to a board, and thence to any wall, the end D being permitted to pass through it; HI the handle going upon the axis ET, to wind up the weight when it has run down. R is a box of fixed pulleys, and V a corresponding one of moveable, pulleys carrying the weight. The axis ET is fixed in the barrel AC, which axis being hollow, both it and the barrel turn round upon the axis FD, which is fixed to the wheel KL, when it turns in the order BT3; but cannot move in the contrary way, by reason of a catch nailed to the end AB, which lays hold of the cross-bars in the wheel IK.

The weight by means of the cord QR, in consequence of its descent, carries about the barrel AB, which by the action of the catch carries the wheel KLM, and this moves the pinion LM and wheel N, the latter moving the worm O and the fly P. Also the wheel LM carries the axis FD with the wheel DG, which carries the cord or chain that goes around the wheel or pulley at the head of the spit. But when the handle H gives motion to the axis in a contrary order to that given by the weight, the catch is depressed; so that although the barrel BC moves and winds the cord upon it, the wheel DG continues at rest. The time which the jack will continue in motion depends upon the number of pulleys, at R and V; and as these increase or decrease, so must the weight which communicates the motion, in order to perform the same work in the same time.

JACK, smoke, is an engine used for the same purpose as the common jack; and is so called from its being moved by means of the smoke, or red-heat air, ascending the chimney, and striking against the sides of the horizontal wheel AB (Plate Miscel. fig. 129), which being inclined to the horizon, is moved about the axis of the wheel, together with the pinion C, which carries the wheels, D and E; and E carries the chain F, which turns the spit. The wheel AB should be placed in the narrow part of the chimney, where the motion of the smoke is swiftest, and where also the greatest part of it must strike upon the sides. The force of this machine depends upon the draught of the chimney, and the strength of the fire.

Smoke-jacks are sometimes moved by means of spiral flyers, rolling about a vertical
axe; and at other times by a vertical wheel with sails like the float-boards of a mill; but the above is the more customary construction.

JACK-FLAG, in a ship, that hoisted up at the stern in the normal head.

JACKALL. See CANTS.

JACOB'S STAFF, a mathematical instrument otherwise called cross-staff. See Cross.

JACOBITISM, in church history, a sect of Christians in Scotland, and Mesopotamia; so called either from Jacob, a Syrian, who lived in the reign of the emperor Marcus; or from one Jacob, a monk, who flourished in the year 510.

JACOBUS, an ancient gold coin worth twenty-five shillings.

JACQUINIA, a genus of the monogyria order, in the hexadactyla class of plants; and in the natural method ranking with those of which the order is doubtful. The corolla is deciduous; the seed is inserted into the receptacle; the berry monomerosus. There are four species, shrubs of South America.

JADE-STONE, lapis nephriticus, or Jasper-chalcedony, a genus of siliceous earths. It gives fire with ease, and is transparent like flint. It does not harden in the fire, but melts in the focus of a burning-glass into a transparent green glass with some bubbles. A kind brought from the river of the Amazons in America, and called circumcension stone, melts more easily in the focus into a brown opaque glass, far less hard than the stone itself. The jade-stone is unctuous to the touch; whence Mr. Kirwan seems to suspect, that it contains a portion of argillaceous earth, or rather magnesia. The specific gravity is from 2.970 to 3.399; the texture granular, with a greasy look, but exceedingly hard, being superior in this respect even to quartz itself. It is infusible in the fire, nor can it be dissolved in acids without a particular management; though M. Sarsme seems to have extracted iron from it. Sometimes it is met with a whitish milky colour from China; but mostly of a deep and pale green from America. The common lapis nephriticus is of a grey, yellowish, or olive colour. It has its name from a supposition of its being capable of giving cause of vomiting by being applied externally to the loins. It may be distinguished from all other stones by its hardness, senilpelliuvity, and specific gravity.

According to Hopper it is composed of,

<table>
<thead>
<tr>
<th>Substance</th>
<th>Percentage</th>
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<tbody>
<tr>
<td>47 silica</td>
<td></td>
</tr>
<tr>
<td>38 carbonat of magnesia</td>
<td></td>
</tr>
<tr>
<td>9 iron</td>
<td></td>
</tr>
<tr>
<td>4 alumina</td>
<td></td>
</tr>
<tr>
<td>2 carbonat of lime</td>
<td></td>
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100.

JALAP, jadapa, in botany, a plant of the psuedantra monogyria class. See Convolvulus, and Materia Medica.

JAMHIC, in ancient poetry, a sort of verse, so called from its consisting, either wholly or in great part, of tactuals.

JAMBUS, in ancient poetry, a simple foot consisting of short and long syllables.

JAMES, or knights of St. James, a military order in Spain, first instituted about the year 1170, by Ferdinand II. king of Leon and Galicia.

JANIZARIES, an order of the Turkish infantry, reputed the grand signior's guards, and the main strength of the Ottoman army.

JANSENSISTS, in church-history, a sect of the Roman catholicks in France, who followed the Jansenius, viz a Jesuit of Ypres, and doctor of divinity of the universities of Louvain and Douay, nearly those of Calvin, in relation to grace and predestination.

JAPANNING is properly the art of varnishing and painting ornaments on wood, in the same manner as is done by the natives of Japan in the East Indies.

The substances which admit of being japanned are almost every kind that are dry and rigid, or not too flexible; as wood, metals, leather, and paper, prepared for the purpose.

Wood and metals do not require any other preparation, but to have their surfaces perfectly even and clean; but leather should be securely strained, either on frames or on boards; as its bending, or forming folds, would otherwise crack and force off the coats of varnish. Paper should be treated in the same manner, and have a previous strong coat of size; but it is made the subject of japanning till it is converted into paper mache, or wrought by other means into such form, that its original state, particularly with respect to flexibility, is changed.

One principal variation from the method formerly used in japanning is, the omitting any priming, or undercoat, on the work to be japanned. In the older practice, such a priming was always used; the use of which was to save in the quantity of varnish, by filling up the inequalities in the surface of the substance to be varnished. But there is a great inconvenience arising from the use of it, that the Japan coats are constantly liable to be cracked, and peeled off, by any violence, and will not endure near so long as the articles which are japanned without any such priming.

Of the materials of Japan grounds.—When a painting is to be japanned, the work should first be prepared by being well smoothed with fishskin or glass-paper, and being made thoroughly clean, should be brushed over once or twice with a mixture of three parts of water, two of third's varnish, in it is of the common strength. The priming should then be laid on as even as possible, and should be formed of a size, of a consistency between the common kind and glue, mixed with as much whiting as will give it a sufficient body of colour to hide the surface of whatever is laid upon, but not more. This must be repeated till the inequalities are completely filled up, and then the work must be left off with Dutch-rushes, and polished with a wet rag.

When wood or leather is to be japanned, and no priming is used, the best preparation is to lay two or three coats of coarse varnish, composed in the following manner.

Take of rectified spirit of wine one pint, and of coarse seed-lac and resin each two ounces; dissolve the seed-lac and resin in the spirit, and then strain off the varnish.

This varnish, as well as all others formed of spirit of wine, must be laid on in a warm place; and it can be conveniently managed, the piece of work to be varnished should be made warm likewise; and for the same reason, all dampness should be avoided; so either cold or moisture will hinder this kind of varnish, and prevents its taking proper hold of the substance on which it is laid.

When the work is so prepared, or by the priming with the composition of size and varnish, the proper Japan ground must be laid on, which is the best formed of seed-lac varnish, and the colour desired, except white, which requires a peculiar treatment; and if brightness is wanted, then also other means must be pursued.

The colours used with the shell-lac varnish may be any pigments whatever, which give the tint of the ground desired.

As metals never require to be under-coated with varnish, they may be treated in the same manner as wood or leather.

Method of painting Japan work.—Japan work ought properly to be painted with colours in varnish; though, for the greater dispatch, and in some very nice work in small, and where the colours are sometimes tempered in oil; which should previously have a fourth part of its weight of gum animi dissolved in it; or in default of that, a gum sandrachus, or gum mastich. The colour employed in this way, for painting, are best prepared by means of thinning size, corrected by honey or sugar-candy. The body, of the which the embossed work is raised, need not, however, be tinged with the exterior colour, but may be best formed of very strong gum-water, thickened to a proper consistence by bole armeniun and whiting in equal part; which being laid on the proper figure, and repaired when dry, may be then painted with the proper colours, tempered with the size above, or, in the usual manner, with shell-lac varnish.

Manner of varnishing Japan work.—The finishing of Japan-work depends on the laying on, and polishing, the outer coats of varnish which are necessary, as well in the pieces that have only one simple ground of colour, as with those that are painted. This is done best with common seed-lac varnish, except in the instances, and on those occasions, where particular methods are deemed to be more expedient; and the same reasons which decide as to the fitness or impropriety of the varnishes, with respect to the colours of the ground, hold equally with regard to those of the painting. For where brightness is the most material point, and a tinge of yellow will injure it, seed-lac must give way to the whiter gums; but where hardness and a greater tenacity are most essential, it must be adhered to; and where both are necessary, it may be proper one should give way to the other in a certain degree reciprocally, a mixed varnish must be adopted.

This mixed varnish, as we have already observed, should be made of the picked seed-lac. The common seed-lac varnish,
which is the most useful preparation of the kind hitherto invented, may be thus made.

Take of seed-lac three ounces, and put it into water, to free it from the sticks and filth that are frequently intermixed with it; and it should be done by stirring it about, and then pouring off the water, and adding fresh quantities, in order to repeat the operation, till it is freed from all impurities, as is very effectually done by this means. Dry it then, and powder it grizzly, and put it, with a pint of rectified spirit of wine, into a bottle, of which it will not fill above two-thirds. Shake the mixture well together, and place the bottle in a gentle heat, till the seed-lac appears to be done, as is done by rubbing it with a rag dipped in tripoli, or rottenstone, finely powdered; but, towards the end of the rubbing, a little oil of any kind should be used along with the powder; and when the work appears sufficiently bright and glossy, it should be well rubbed with oil alone, to clean it from the powder, and give it a still brighter lustre.

JARJON. See Zircon.

JASIONE, a genus of the monogynia order, in the syngnesia class of plants, and in the natural method ranking under the 44th order, campanaceae. The common calyx is ten-veined; and the corolla has five regular petals; the capsule beneath, two-celled. There are four species, shrubs of the Western ladies.

JASMINUM, JASMINE, or JESSAMINE, a genus of the monogynia order, in the diandra class of plants, and in the natural method ranking under the 44th order, separiae. The corolla is salver-shaped, the berry dicococcus; the seeds arillated, the anther within the tube. There are 17 species. The most remarkable are: 1. The officinalis, or common jasmine, which has long slender stalks and branches, rising upon supports 15 or 20 feet high, with numerous white flowers from the joints and ends, of a very fragrant colour. There is a variety with 2. striped jasmine, another with yellow-striped leaves. 2. The fractus, or shrubby yellow jasmine, has shrubby, angular, trailing stalks and branches, rising upon support eight or ten feet high; trifoliate and simple alternate leaves; with yellow flowers from the sides and ends of the branches, appearing in June; frequently producing berries of a black colour. This species is remarkable for sending up many suckers from its roots, often so plentifully as to form the ground, if not taken up annually. 3. The humilis, or dwarf yellow jasmine, has shrubby firm stalks, and angular branches, of low, somewhat robust and bushy growth; broad, trifoliate, and pin-nated leaves; and large yellow flowers in July, sometimes succeeded by berries. 4. The glandulorum, or greater-flowered Catalonian jasmine, has a shrubby, firm upright stem, branching out into a spreading head from the ground, rising about three to six or eight feet high, with large flowers of a blue-cored colour without, and white, appearing from July to November. Of this there is a variety with semidouble flowers, having two series of petals. 5. The azorium, or azorian white jasmine, has shrubby, long, slender stalks and branches, rising upon supports 15 or 20 feet high, with pretty large flowers of a pure white colour, coming out in loose bunches from the ends of the branches, and appearing in February. The odoratissimum, or most sweet-scented yellow Indian jasmine, has a shrubby upright stalk branching erect, without support, six or eight feet high, with bright yellow flowers in bunches, from the ends of the branches, flowering from July till October, and emitting a most fragrant odour.

The first three species are sufficiently hardy to thrive in this climate without any shelter. The other three species, which are tender, may be increased by layers or suckers, or by grafting and budding them upon the common white and shrubby yellow jasmine. They require shelter in a greenhouse in winter, and the more must always be kept in pots to move them out and in occasionally.

JASPER. This stone is an ingredient in the composition of many mountains. It occurs usually in large amorphous masses, sometimes in rounded or angular pieces. Its fracture is conchoidal, and its colours vary from yellow to 2.3 to 2.7. Its colours are various. When heated, it does not decrepitate. It is usually divided into 4 sub-species.

1. Egyptian jasper. A variety is found chiefly in Egypt. It usually has a spherical or flat-rounded figure, and is enveloped in a coarse rough crust. Specific gravity 2.784 to 2.7. It is chiefly distinguished by the variety of colours which always exist in the same specimen, in concentric stripes or layers. These colours are different browns and yellows, greens, &c.

2. Striped jasper. This variety is also distinguished by concentric stripes or layers, of different colours; these colours are yellow, brownish-red, and green. It is distinguished from the last variety by its occurring in large amorphous masses, and by the disposition of its stripes.

3. Porcelain jasper. So called because its fracture presents the appearance of porcelain. Its colours are various shades of grey, yellow, red, brown, green, mixed together. Found in mass, and in rounded pieces. Greasy. Fracture imperfectly conchoidal; opaque. According to Rose it is composed of: 60.75 silica, 27.25 alumina, 3.60 magnesia, 2.50 oxide of iron, 3.60 potash.

97.10

Found in the neighbourhood of pseudo volcanoes, supposed to have been altered by the action of fire.

4. Common jasper. Specific gravity from 2.53 to 2.7. Its colours are different shades of white, yellow, red, brown, and green; often variegated, spotted, or veined, with several colours.

JATROPIA, the cassava plant, a genus of the monadophila order, in the monoea class of plants, and in the natural method ranking under the 35th order, tricoeae. There is a rare variety of the corolla is hypetalous, and funnel-shaped; there are ten stamens, one alternately longer than the other. There is no male calyx; the corolla is pentatemenous and patent; there are three bud
extremities; the capsule is trilocular, with one seed in each cell. There are nine species, of which the most remarkable are: 1. The curar, or English physic nut, with leaves shaped like those of the cardoon, is a hairy shrub growing about 10 or 12 feet high. The extremities of the branches are covered with leaves; and the flowers, which are of a green herbaceous kind, are set in an umbel fashion round the extremities of the branches, but especially the main stalks. These are succeeded by many fruits, whose outward tegument is green and husky, which being peeled off discloses the nut, whose shell is black, and easily cracked; this contains an almond-like kernel, divided into two parts, between which separation lie two milk-white thin membranaceous leaves, easily separable from each other. These have not only a bare resemblance of perfect leaves, but have in particular every part, the stalk, the middle rib, and transverse ones, as visible as any leaf whatsoever. 2. The gossypifolia, cotton-leaved jatropha, or belly-ache bush; the leaves of which are quinquangular, the flowers in terminal, irregular, bracteate bobs. The stem, which is covered with a light-greyish bark, grows to about three or four feet high, soon dividing into several wide-extended branches. From amongst these sprout a few carill small daisy-purple petals, the pistil of each being thick-set at the top with yellow carinaceous dust, which blows off when ripe. These flowers are succeeded by hexagonal husky bladders, which are opened by the heat of the sun, emitting a great many small dark-coloured seeds, which serve as food for ground doves. 3. The multiform, or French physic-nut, with leaves many-parted and polished. The flowers of this grow in bunches, umbel fashion, upon the extremities of each large stalk, very much resembling, at their first appearance, a bunch of red coral; these afterwards open into small five-leaved purple flowers, and are succeeded by nuts, which resemble those of the first species. 4. The manibot, or bitter cassada, has palmated leaves; the lobes lanceolate, very entire, and polished. 5. The janipha, or jatropha, has palmated leaves; the lobes very entire; the intermediate leaves lobed with a sinus on both sides. 6. The elata, with ternate leaves, elliptic, very entire, hoary underneath, and long-petioled. See figures of the last in plate 22, which renders a more particular description unnecessary.

The root of bitter cassada has no fibrous or woody filaments in the heart, and neither boils nor roasts soft. The sweet cassada has all the opposite qualities (which reside in the juice) by heat. Cassada bread, therefore, is made of both the bitter and sweet; thus: the roots are washed and scraped clean, then grated into a tub or trough; after this they are put into a hair bag, and strongly pressed with a view to squeeze out the juice, and the meal or farina is dried in a hot stone laveron over the fire; it is then sifted. It also forms excellent puddings, well to millet. The scrapping—of fresh bitter cassada are successfully applied to ill-disposed ulcers. Cassada roots yield a great quantity of starch, which the Persians, after they have been cooked, give the name of tapioca. According to father La}

the bodies of other living insects, and generally in those of caterpillars. These eggs in a few days hatch, and the young larva, which resemble minute white maggots, nourish themselves with the juices of the unfortunate animal, which however continues to move about and feed till near the time of its change to a chrysalis, when the young brood of ichneumon-larvae creep out by perforating the skin in various places, and each spinning itself up in a small oval silken case, changes into a chrysalis, the whole number forming a globe on the shrivelled body of the caterpillar which had supplied them nourishment; and after a certain period emerge in the state of complete ichneumons.

It was the want of an exact knowledge of the genus ichneumon that proved so considerable an embarrassment to the older entomologists, who having seen a brood of ichneumons proceed from the chrysalis of a butterfly, could not but conclude that the production of insects was either a variable and uncertain operation of nature or a regular continuation of the same species. The observations however of Swammerdam, Malpighi, Roesel, and others, have long since removed the difficulties which formerly obscured the history of the insect tribe. See Plate Nat. Hist. figs. 235, 236, &c. There are no less than 415 species of this insect.

The 8th species is the hoven guaniacum of Aublet, or tree which yields the elastic resin called guaiacum, a valuable article of commerce; for a particular account of which see CAOUTCHOUC. The figure we have given is copied from Aublet's tab. 335, and not from the erroneous plate given in the Acta Parisiana.

The 9th species is JAUNDICE. \textit{See Medicine.}

The 10th species is JAW. \textit{See Anatomy.}

The 11th species is IBERIS, \textit{secalice cresces}, or \textit{candy-tuft}, a genus of the silicous order, in the tribe malvaceae, and is the subject of our figure. It is the most remarkable species of the group. The umbellata, or common candy-tuft, a well-known annual. The amara, or bitter candy-tuft. The spermervires, commonly called tree candy-tuft. The scepter-flowers, with white flowers in umbels at the ends of the branches, appearing at all times of the year.

The 12th species is IBEX, \textit{in zoology. See Capra.}

The 13th species is IBIS. \textit{See Tantalus.}

The 14th species is ICE. \textit{See Water, and Cold.}

The 15th species is ICE-HOUSE, a building contrived to preserve ice for the use of a family in the summer season. It is generally sunk some feet in the ground in a very shady situation, and covered with thatch.

The 16th species is ICELAND-AGATE, a precious stone met with in the islands of Iceland and Ascension, employed by the jewellers as an agate, though too soft for the purpose. It is supposed to be a volcanic product; being solid, black, and of a glossy texture. When held between the eye and the light, it is transparent, and greenish, like the glass bottles which contain much iron. In the islands which produce it, such large pieces are met with that they cannot be equally divided in glasshouses.

The 17th species is ICHNEUMON \textit{fj}, the name of a genus of flies of the hymenoptera order. The generic character is, mouth with jaws, without tongue; antenna with more than thirty joints; abdomen in most species forked; piercing erected, with a cylindrical beak. The animals of this genus provide for the caterpillar a manner highly extraordinary, depositing their eggs in
whose vertices meet in the centre of a sphere, supposed to circumscribe it, and therefore have their height and bases equal; wherefore the solidity of one of those pyramids multiplied by $\frac{\text{the number of bases}}{2}$, taking the linear edge of the isosceles triangle, is equal to $\frac{1}{3} \text{ the base} \times \text{height}$. See Fig. 128.

To form an isosceles triangle, describe upon card paper 20 equilateral triangles; cut it out by the extreme edges, and cut all the other lines half through; then fold up by these edges, and the solid will be formed. The linear edge of the isosceles triangle being $\frac{1}{3}$, the surface will be $5A \sqrt{3} = 8.650 A^2$, and the solidity $\frac{A}{2} \sqrt{\frac{2}{3} - 1} = 2.187 A^3$.

ICOSAN DRI, from genus "twenty," and epithet, "a man or husband," is the name of the 15th class in Linnaeus's sexual method, consisting of plants with hermaphrodite flowers, which are furnished with 20 or more stamens, that are insered. When the inner side of the calyx or petals. See BOTANY.

IDES, iudaeus, in the ancient Roman calendar, were eight days in each month, the first of which fell on the 15th of March, May, July, and October, and on the 13th day of other months. They were reckoned backwards: thus they called the 14th day of March, May, July, and October, and the 15th of the other months, the ides iudaei, or the day before; the next preceding day, they called the tertio iudaeus, and so on, reckoning always backwards, till they came to the nones. This method of reckoning time is still retained in the church of Rome, and in the calendar of the breviary.

IDIOT, is a fool or madman from his nature. By the old common law there is a writ de idote inquirendo, directed to the sheriff, to inquire by a jury whether the party is an idiot or not, and if he be, for the maintenance of the fact, the profits of his lands and the custody of his person belong to the king, according to the stat. 17 Ed. II. c. 9, by which it is enacted, that the king shall have the custody of the legal tools, and the profits of the without waste or destruction, and shall find them necessary of whose fees the said lands shall be hoven. And after the death of such idiot, he shall render it to the right heir, so that such idiots shall not alien, nor their heirs be disbarred. But it seldom happens that a jury finds a man an idiot from his nature, but only on cogitant from some particular time, which has an operation very injurious in point of law; for in this case he comes under the denomination of a lunatic, in which respect the king shall not have the profits of his lands, but is accountable for the same to the lunatic when he comes to his right mind, or otherwise to his executors or administrators. 1 Black. 303.

JEER, or JEER-Rope, in a ship, is a large rope reeved through double or triple block, lashed at the mast-head, and on the yard, in order to hoist. See JEAUM.

JEERUM. See Anatomy.

JELLY, in chemistry. If we press out the juice of ripe blackberries, currants, and many other fruits, and allow it to remain for some time in a state of rest, it partly coagulates into a trensulose soft sub stance, well known by the name of jelly. If we pour off the uncoagulated parts, and wash the coagulum with a small quantity of water, we obtain jelly approaching to a state of purity.

In this state it is nearly colourless, unless tinged by the peculiar colouring matter of the fruit; it has a pleasant taste, and a tre-nous consistency. It is scarcely soluble in cold water, but very soluble in hot water; and when the solution cools, it again coagulates into the form of a jelly. When long boiled, it loses the property of gelatinizing by cooling, and becomes analogous to mucilage. This is the reason that in making currant-jellies, or any other jelly, when the quantity of sugar added is not sufficient to absorb all the watery parts of the fruit, and consequently it is necessary to concentrate the liquid by long boiling, the mixture often loses the property of coagulating, and the jelly, of course, is spoiled.

Jelly combines readily with alkalis. Nitric acid converts it into oxalic acid, without removing the jelly. If it is boiled with water, it is esteemed transparent. When distilled it affords a great deal of pyromonous acid, a small quantity of oil, and scarcely any ammonia.

Jelly exists in all acid fruits, as oranges, lemons, and gooseberries, etc. The juice of these fruits is allowed to gelatinize, and then poured upon a scarce, the acid gradually filters through, and leaves the other; which may be washed with a little cold water, and allowed to dry. Its bestorded, and it coagulates into a hard transparent brittle mass, which possesses most of the properties of gum. Perhaps, then, jelly is merely gum combined with vegetable acid.

JELLY, animal. See Gelatin.

JESUITS, or the society of Jesus, a most famous religious order in the Roman church, founded by Ignatius Loyola, a native of Guipuscoa in Spain, who in the year 1528 assembled ten of his companions at Rome, principally chosen out of the university of Paris, and made a proposal to the pope to form a new order; when, after many deliberations, it was agreed to add to the three ordinary vows of chastity, poverty, and obedience, a fourth, which was to go into all countries whither he should judge convenient; on which, Ignatius was created general of the order; which in a short time spread over all the countries of the world, to which Ignatius sent his companions, while he staid at Rome, whence he governed the whole society. The order was abolished by pope Clement XIV. (Gangandii) in 1773. See Gregory's Church History, vol. ii.

JESUITS'ARK. See CINCHONA, and PHARMACY.

JET. See Coal.

JET D'Eau. See HYDRAULICS.

JETSON, JETSEN, or JETSAM, in law, is used for any thing thrown out of a ship or vessel that is in danger of being a wreck, and which is driven by the waves on shore.

Jews. In England in former times, the Jews and all their goods belonged to the chief lord where they lived. By stat. Ed. I. the Jews, to the number of 15,000, were banished out of England, and never returned till Oliver Cromwell restored them.

Whenever any Jew shall present himself to take the oath of abjuration, in pursuance of the 10 Geo. III. c. 10, the words, upon the true faith of a Christian, shall be omitted out of the said oath in administering it to such person; and the taking the said oath by persons professing the Jewish religion, without the said words, in like manner as Jews are admitted to give evidence in courts of justice, shall be deemed a sufficient taking of it.

IGNATIUS, a genus of the monogeneity order, in the pentandria class of plants. The calyx is five-toothed; the corolla is long; the fruit an unilocular plump, with many seeds. There are two species, the principal of which is the amara, a native of India. The fruit of this tree contains the seeds called St. Ignatius's beans. According to some, it is from this plant that the colon brook root is obtained.

IGNIS FATUUS, a common meteor, chiefly seen in dark nights about meadows, marshes, and other moist place, on bare grounds, and near dung-hills. It is known among the people by the appellations, Will with a wisp, and Jack with a lantern. See Meteors.

IGNORAMUS. See Calorie, and Chemistry.

IGNORAMUS, was formerly indorsed by the grand jury on the back of a bill, for which they did not find sufficient evidence; but now, since the proceedings were in English, they indorse "no bill," or "not a true bill," or which is the better way, "not found." 4 Stob. 305.

IGUANA. See Lacerta.

JIB, the foremost sail of a ship, being a large stay-still extended from the outer end of the bowsprit prolonged by the jib boom, towards the fore-top-mast head. See Sail.

JIB-BOOM, a boom run out from the extremity of the bowsprit, parallel to its length, and serving to extend the bottom of the jib, and the stay of the fore-top-gallant-mast.

JUNIPER, the holm of the British, or the genus of the tetragnata order, in the tetrandria class of plants, and in the natural method ranking under the 430 order, chamois. The calyx is quadriradiated; the corolla rotaceous; there is no style; the berry is monoeious. There are 16 species of this genus; but the most remarkable is the aquifolium, or common holly. Of this there are a great number of varieties with virigated leaves, which are propagated by the nursery gardeners for sale. The best of these varieties are the painted-holly holly, British holly, Bradley's best holly, phyllis or cream holly, milkmaid holly, Fratich's best holly, golden-edged hedgehog holly, Chitty's holly, glory-plated holly, broderick's holly, Partridge's holly, Herefordshire white holly, Blinda's cream holly, Longstaff's holly, Eales's holly, silver-edged hedgehog holly. All these varieties are propagated by budding or grafting them upon stocks of the common green holly.

Sheep in the winter are fed with droppings of holly. Birds eat the berries. The bark is fermented, and afterwards washed to make the common birdlime. The plant makes an impermeable fence, and bears cropping; however, it is not found in.
all respects to answer for this purpose equally well with the hawthorn. The wood is used in fineering, and is sometimes stained black to imitate ebony. Handles for knives, and covers for mill-bellows, are made of it. Miller says, he has seen the floor of a room laid with compartments of holy and mahogany, which had a very pretty effect.

ILLEGIBLE, a genus of the monogy- num order, in the pentadactyla class of plants, and in the natural method ranking under the 12th order, holocarce. The calyx is pentaphyllous, and cartilaginous; there is no corolla; the stamens is simple; the capsule quinqueseptal, and monospermous. There are 21 species, of which the most remarkable are the paronycha and the capitum. Both these have trailing stalks near two feet long, which spread on the ground, furnished with small leaves like those of knott grass. The heads of the flowers come out from the joints of the stalks, having neat silvery bracts surrounding them, which make a pretty appearance. Their flowers appear in June, and there is some succession of them for at least two months; and when the autumn proves warm, they will ripen their seeds in October.

ILICUM, a genus of the pentagynia order, in the escorcia class of plants, and in the natural method ranking with those of which the order is doubtful. The calyx is tetraphyllous, and deciduous; there are eight petals, and eight petaloid subulated nectaritla. There are 16 stamina with bulb anther; the capsules are ovate, compressed, and monospermous. There are two species, viz. 1. The floridum, with red flowers, and very odorous fruit. It is a native of China. 2. The amanum, a native of the woods of China and Japan. The first is a very ornamental plant, and now common in our greenhouses.

ILLUMINATING, a kind of miniature-painting, antiently much practised for illustrating and adornning books. Besides the sweeter books, there were artists whose profession was that of illuminating and paint manuscript, who were called illuminators: the writers of books first finished their part, and the illuminators embellished them with ornamental letters and paintings. We frequently find in manuscripts for the illuminators, which were never filled up. Some of the antique manuscripts are gilt and burnished in a style superior to later times. Their colours were elegant, and their skill in preparing them must have been very great.

IMAM, a name applied by the Mahomet- ans to him who is head of the congregation in their mosques; and by way of eminence to him who has the supreme authority both in respect to spirituals and temporals.

IMBUE, signifies to steel, piller, or par- loin, and also to waste or diminish goods, &c. entrusted to a person's charge and care. Im- belers of wood forfeit double damages, and may be committed to the house of correction till paid; and servants imbibing their mas- ters' goods to the value of 40s. are deemed guilty of felony without benefit of clergy.

IMBRICATED, among botanists, an appellation given to such leaves of plants, as are placed over one another like the tiles of a house. The term is likewise applied to some of the heart-shells, from their being ridged transversely in the same manner.

IMMEMORAL: in a legal sense, a thing is said to be of time immemorial, or time out of mind, that was before the reign of king Edward II.

IMMERSION, in astronomy, is when a star or planet is so near the sun with regard to our observations, that we cannot see it; being enveloped and hid in the rays of that luminary. It also denotes the beginning of an eclipse of the moon, or that moment when the moon begins to be darkened, and to enter into the shadow of the earth; and the same term is also used with regard to an eclipse of the sun, when the disk of the moon begins to cover it. In this sense immersion stands op- posed to immersion, and signifies the moment wherein the moon begins to come out of the shadow of the earth, or the sun begins to show the parts of his disk which were hid be- fore. Immersion is frequently applied to the satellitics of Jupiter, and especially to the first satellite; the observation of which is of so much use for discovering the longitude. The immersion is the instant wherein it appears to enter within the disk of Jupiter, and its duration the moment when it appears to come out. The im- mersions are observed from the time of the conjunction of the moon with the sun, to the time of his opposition; and the eclipses from the time of his opposition to his conjunction.

IMPALED, in heraldry: when the coats of a man and his wife are not on an heiress are borne in the same escutcheon, they must be marshalled in pale; the husband's on the right side, and the wife's on the left: and this the heralds call baron and feue, two coats impalid. See HERALDY.

IMPAIRANCE, in law, a petition in court for a day to consider or advise what answer the defendant shall make to the plain- tiff's action, and is the continuance of the cause till another day, or a longer time given by the court, and the right, after the impairments removed, in case of fines levied, &c.

IMPERATIVE, one of the moods of a verb, used when we would command, entreat, or request.

IMPERATORIA, mastersort, a genus of the dignaia order, in the pentadactyla class of plants, and in the natural method ranking under the 4th order, umbellata. The fruit is roundish, compressed in the middle, gibus, and surrounded with a border; the petals are inexo-emarginated. There is but one species, viz. the ostrichum, a native of the Austrian and Stylijan Alps, and other mountainous parts of Italy. The plant is cultivated in gardens for the sake of its roots, which are used in medicine. The root has a flavour similar to that of angelica, and is esteemed a good sedative. There are in- stances of its having cured theague when the bark had failed. It should be dug up in winter, and a strong infusion made in wine.

IMPERFECT, something that is defec- tive, or that wants some of the properties for which the members of the same kind: thus mosses are called imperfect plants, because almost all the plants of this kind are wanting in them; and for the like reason the appellation imperfect given to the fungi and the marine plants. See Moss, Fungi, and Submarine.
IMPETUS, IMPRESSION, IMPOSTHUME.

At this period, and for a long time after, foreigners were the principal importers of goods in this country; and as it was thought that many of them were desirous of their merchandise here, returned with the value in money to their own country, which was deemed a serious injury, many laws were made against carrying out of the realm any gold or silver, either in coin, plate, or bullion; and merchant strangers were compelled to give security that they would lay out all the money they received for the wares they imported, in English merchandise to be exported. These indulgent restrictions have been the subject of much debate and of many discussions about the prohibition of some foreign manufactures, the import trade of this country is probably as free as the regulations necessary to secure the payment of heavy duties on almost every article of trade will admit.

Total official value of the imports of Great Britain in the year 1800.

Port of London £18,843,172 2 10
The exports 9,514,642 11 10

England - 28,357,814 14 8
Scotland 2,215,790 11 8

East Indies and China. All other parts.
In 1801 £5,424,441 £27,371,115
1802 5,704,606 25,047,412
1803 6,348,387 21,693,777
1804 5,214,621 23,080,869
1805 24,273,431

The official value of the imports of Ireland in the year 1805, was 5,983,194. 15s. 9d.

IMPOSSIBLE roots, in algebra. To discover how many impossible roots are contained in any proposed equation, Sir I. Newton gave this rule, in his Algebra, viz.: Constitute a series of fractions, whose denominators are the series of natural numbers 1, 2, 3, 4, 5, &c. continued to the number showing the index exponent of the highest term of the equations, and then the numerators the same series of numbers in the contrary order; and divide each of these fractions by the next preceding, and place the resulting quotients in the intermediate terms of the equation; then under each of the intermediate terms, if its square multiplied by the fraction over it, be greater than the product of the terms on each side of it, place the sign +; but if not, the sign — , and under the first and last term place the sign +. Then will the equation have as many imaginary roots as there are changes of the underwritten signs from + to — , and from — to +. So for the equation $x^2 - 4x + 4 = 0$, the series of fractions is $\frac{2}{1}$, $\frac{1}{2}$, then the second divided by the first gives $\frac{2}{3}$ or $\frac{1}{3}$, and the third divided by the second gives $\frac{1}{3}$; hence these quotients placed over the intermediate terms, the whole will stand thus:

$$x^2 - ax + a^2 = 0,$$

Now because the square of the second term multiplied by its superscribed fraction, is $\frac{x^2}{a^2} + \frac{a}{x} + \frac{1}{x^2}$, which is greater than $\frac{a}{x}$, the product of the two adjacent terms, therefore the sign + is set below the second term; and because the square of the first term multiplied by its over written fraction, is $\frac{x^2}{a^2} + \frac{a}{x} + \frac{1}{x^2}$, which is less than $24x^2$, the product of the terms on each side of it, therefore the sign — is placed under that term; and the sign — is set under the first and last terms. Hence the two changes of the underwritten signs ++ — , the one from + to — , and the other from — to +, shew that the given equation has two impossible roots.

When two or more terms are wanting together, under the place of the first of the deficient terms write the sign — , under the second the sign +, under the third — , and so on, always varying the signs, except that under the last of the deficient terms must always be set the sign +, when the adjacent terms on both sides of the deficient terms have contrary signs. As in the equation,

$$x + 3x^2 + 5x^3 + 7x^4 = 0,$$

which has four imaginary roots.

The author remarks, that this rule will sometimes fail of discovering all the impossible roots of an equation, for some equations may have more of such roots than can be found by this rule, though this seldom happens.

Mr. Macaulay has given a demonstration of this rule of Newton's, together with one of his own, that will never fail. And the same has also been done by Mr. Campbell.

See Phil. Trans. vols. 24, 25.

The real and imaginary roots of equations may be found from the method of fluxions, applied to the doctrine of maxima and minima; that is, to find such a value of x in an equation, expressing the nature of a curve, made equal to y, as it would correspond to the greatest and least ordinate. But when the equation is above three dimensions, the computation is very laborious. See Stirling's Treatise on the Lines of the Third Order.

IMPOSTHUME, the same with abscess.

See Surgery.

IMPRESSING men. The power of impressing seamen for the sea service, by the king's commission, has been a matter of some dispute, and submitted to with great reluctance, though it has very earnestly been argued by sir Michael Foster, that the practice of impressing, and granting power to the admiral for that purpose, is of very ancient date, and has been continued by a regular series of precedents to the present time, whence it concludes it to be part of the common law. The difficulty arises hence, that no statute has expressly declared this power to be in the crown, though many of them very strongly imply it. The stat. 2 R. II. c. 4. speaks of mariners being arrested and retained for the king's service, as of a thing well known and practised without dispute, and provides a remedy against the running away.

By stat. 2 and 3 P. and M. c. 16, if any waterman who uses the river Thames, shall hide himself during the execution of any commission for pressing for his majesty's service, he is liable to heavy penalties. By the stat. 5 Eliz. c. 6. no fisherman shall be taken by the queen's commission to serve as a mariner; but the commission shall be first brought to two justices of the peace, inhabiting near the sea-coast where the mariners are to be taken, to the intent that the justices may
INCAPACITY, in the canon law, is of two kinds: 1. The want of a dispensation for age in a minor, for legitimation in a bastard, and the like; this renders the provision of a benefice valid in its original. 2. Crimes and heinous offences, which annul provisions at first valid.

INCCH, a well-known measure of length, being the twelfth part of a foot, and equal to three inches in length.

INCIDENCE, in mechanics, denotes the direction in which one body strikes on another. See Mechanics, and Optics.

INCLINATION, is a word frequently used by mathematicians, and signifies the mutual approach, tendency, or leaning, of two lines or two planes towards each other, so as to make an angle.

Inclination of a right line to a plane, is the acute angle which that line makes with another right line drawn in the plane through the point where the inclined line intersects it, and through the point where it is also cut by a perpendicular drawn from any point of the inclined plane.

Inclination of the axis of the earth, is the angle which it makes with the plane of the ecliptic; or the angle contained between the planes of the equator and ecliptic.

Inclination of a planet, is an arc of the circle of inclination comprehended between the ecliptic and the plane of a planet in its orbit. See Astronomy.

The greatest inclination of Saturn, according to the chart of the Charta, is 22°; of Jupiter, 19° 28'; of Mars, 13° 30'; of Venus, 27° 29'; of Mercury, 6° 54'. According to de la Hire, the greatest inclination of Saturn is 23° 30'; of Jupiter, 19° 20'; of Mars, 11° 51'; of Venus, 29° 53'; of Mercury, 6° 53'.

Inclination of a plane, in dialling, is an arch of a vertical circle, perpendicular both to the plane and the horizon, and intercepted between them. To find this, let AB (see Plate Nine, fig. 133) be a plane inclined to the horizontal HR; apply to the plane AB a quadrant DCF, so that the plummet CME may cut off any number of degrees on the limb, as EF: then the arch DE is the measure of the angle of inclination ABH; for draw $BG$ perpendicular to $EF$, then the angle $CBG$ is parallel to $BG$, the angle $EBC$ is equal to $CIG$; but $DCF$ is equal to $GBH$, being both right angles, therefore the angle $DCF = EBC$, is equal to the angle $GBH = CIG$; that is, $DCF = EBC$.

INCLINED PLANE, in mechanics, one that makes an oblique angle with the horizon. See Mechanics.

INCOMMISSURABLE, a term in geometry, used where two lines, when compared to each other, have no common measure, how small soever, that will exactly measure them both. And in general, two quantities are said to be incommissurable, when no third quantity can be found that is an aliquot part of both.

Such are the diagonal and side of a square; for though each of those lines has infinite aliquot parts, as the half, the third, &c. yet not any part of the one, be it ever so little, can possibly measure the other, as is demonstrated by Euclid.

INCOMMISSURABLE NUMBERS, are such as have no common divisor that will divide them both exactly.

INCORRUPTIBLES, or INCORRUPTIBLES, in church history, heretics which had their original at Alexandria, in the time of the emperor Justinian. Their distinguishing tenet was, that the body of Jesus Christ was incorruptible from its conception, by which they meant that after and from the time he was born in the womb of his holy mother, he was not susceptible of any change or alteration even of the smallest kind, and innocent passions, as hunger, thirst, &c. so that he ate without any occasion before his death, as well as after his resurrection.

INCUS, or Night-Shade. See Medicines.

INCUMBENT, a clerk or minister who is resident on his benefice: he is called incumbent, because he does, or at least ought, to bend his whole study to discharge the cure of his church.

INCURVATION, the bending out of a rectilinear or straight course, occasioned by refraction.

INDEMNITY, in law, the saving harmless; or, a retiring to secure one from all damage and danger that may ensue from any act. An indemnity in regard to estates is called a warranty.

INDETERMINED, in heraldry, is when the outline of an ordinary is notched like the teeth of a saw.

INDETERMINED LINE, in fortification, the same with what the French engineers call redent, being a trench and parapet running out and in, like the teeth of a saw, and much used in irregular fortifications.

INDETERMINATION, is a writing containing a conveyance between two or more, indented or cut unevenly, or in and out, on the top or side, answerable to another writing that, in length, comprises the same words. Formerly when deeds were more concise than at present, it was usual to write both parts on the same piece of parchment, with some words or letters written between them, through which the parchment was cut, either in a straight or indented line, in such a manner as to leave half the word on one part, and half on the other: and this custom is still preserved in making out the indentures of a fine. But at last, indented only has come into use without cutting through any letters at all; and it seems at present to serve for little other purpose than to give name to the species of the deed. 3 Black. 294.

INDEPENDENCE of the protestants in England and Holland, so called from their independency on other churches, and their maintaining that each church or congregation has sufficient power to act and perform every thing relating to the church-government within itself, and is no way subject or accountable to other churches or their deputies.

The present independents differ from the presbyterians only in their church government, in being generally more attached to the doctrines distinguished by the term orthodox, such as original sin, election, reprobation, &c. and in administering the Lord's supper at the close of the afternoons service. The several sects of baptists are all independent with respect to church-government; and, like them, administer the Lord's supper in the evening, whereas the presbyterians administer it after the forenoon's service.

INDETERMINATE PROBLEM, in algebra, one which is capable of an indefinite number of solutions.

INDEX, in arithmetic and algebra, shews to what power any quantity is involved, and is otherwise called an index.

Index of a logarithm, that which shews of how many places the absolute number be-
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There are 35 species, the most remarkable of which is the \textit{tectoria}, a native of the warm parts of Africa, Asia, and America. This plant requires a rich soil, well filled, and not too dry. The seed of it, which, as to figure and colour, resembles gumpowder, is sown in little furrows that are about the breadth of the hoe, two or three inches deep, at a foot distance from each other, and in as straight a line as possible. Continued attention is required to pluck up the weeds, which would soon choke the plant. Though it may be sown in all seasons, the spring is commonly preferred. Moisture causes this plant to shoot above the surface in three or four days. It is ripe at the end of two months. When it begins to flower, it is cut with pruning-knives; and cut again at the end of every six weeks, if the weather is a little rainy. It lasts about two years, after which term it degenerates: it is then plucked up, and planted afresh. As this plant soon exhausts the soil, but also does not absorb a sufficient quantity of air and dew to moisten the earth, it is of advantage to the planter to have a vast space which may remain covered with trees, till it becomes necessary to fell them in order to procure the indigo.

The valuable dye-stuff called indigo bears some resemblance to starch; but its properties are sufficiently peculiar to distinguish it from all other substances, and its importance entitles it to a distinguished place among vegetable principles. It is commonly procured by the following process:

When the plant has been cut down, it is placed in strata in a large wooden vessel, and covered with sure. In this situation it cannot remain long in these warm climates without undergoing some change. Putrefaction, accordingly, very soon commences, or rather a kind of fermentation, which goes on best at the temperature of 80°. The water soon becomes opaque, and assumes a green colour; a smell resembling that of volatile alkali is exhaled, and bubbles of carbonic acid are emitted. When the fermentation has continued long enough, which is judged of by the paleness of the leaves, and which requires from six to twenty-four hours according to the temperature of the air and the state of the plant, the liquid is decanted from the plant, and the water is then carried away to an evaporation place, where it is constantly agitated till blue floculi begin to make their appearance; water is now poured in, which causes the blue flakes to precipitate. The yellow liquid is decanted off, and the blue sediment poured into linen bags. When the water has drained from it sufficiently, it is formed into small lumps, and dried in the shade. In that state it is imported into Europe, and sold under the name of indigo.

The leaves of the indigofera yield a green infusion to hot water, and a green powder may be precipitated from it; but unless a fermentation has taken place, neither the colour nor properties of it have any resemblance to indigo.

Indigo may be obtained from the mercuric tincturium, and the \textit{indigofera} or \textit{wool}; a plant commonly enough cultivated in Britain, and even found wild in England. When this plant is cut down, and arrives at maturity, this plant is cut down, weighed, dried hastily in the sun, ground in a mill, placed in heaps, and allowed to ferment for a fortnight. It is then well mixed, and made up into balls, which are piled upon each other, and exposed to the wind and sun. In this state they become hot, and exhale a putrid ammonical smell. The fermentation is promoted, if necessary, by sprinkling the balls with water. When it has continued for some time, a sufficient thick smut of powder is allowed to form on a coarse powder, in which state it is sold as a dye-stuff. By treating wood nearly in the same manner with the indigofera, indigo has been obtained from it by different chemists.

Indigo is a fine light friable substance, of a deep-blue colour. Its texture is very compact, and the shade of its surface varies according to the manner in which it has been prepared. The principal tints are copper, violet, and blue; the lightest indigo is the best: but it is always more or less mixed with foreign substances, partly owing, doubtless, to the carefulness of the preparation, and partly to the bodies which the plant containing indigo yields to water. From the analyses of Bergman, to whom we are indebted for one of the most complete treatises on the properties of indigo which has yet appeared, the purest indigo, in which he could procure, was composed of the following constituents:

\begin{itemize}
  \item 47 pure indigo
  \item 12 gun
  \item 6 resin
  \item 22 earth
  \item 13 oxide of iron
\end{itemize}

The earth consisted of:

\begin{itemize}
  \item 10.2 barites
  \item 10.0 lime
  \item 1.8 silica
\end{itemize}

The indigo is almost the same as that of the \textit{ilicis}.

But in all probability the earth differs in different specimens; for Proust found magnesia in considerable quantity in the specimens which he examined. The forty-seven parts of bluish pigments are alone entitled to be called indigo; and to them therefore we shall confine our attention.

Indigo is a soft powder, of a deep blue, without either taste or smell. It undergoes no change, though kept exposed to the air. Water does not dissolve any part of it, nor produce any change upon it. Bergman, however, found that indigo, when kept long under water, underwent a kind of putrefaction, or at least exhibited a fetic colour. When a heat is applied to indigo, it emits a bluish red smoke, and at last burns away with a very faint white flame, leaving behind it the earthy parts in the state of ashes.

Neither oxides, or the simple combustibles, have any effect upon indigo, except it is in a state of solution; and the same emblem applies to the metallic bodies.

The fixed alkaline solutions have no action on indigo, except it is newly precipitated from a state of solution. In that case they dissolve it with facility. The solution has at first a green colour, which gradually disappears, and the natural colour of the indigo comes again upon it, so that we see with reason to doubt that the alkalies when concentrated decompose indigo. Pure liquid ammonia acts in the same way. Even carbonates of ammonia dissolves precipitated indigo, and destroys its colour; but the fixed alkaline carbonates have no such effect.

Lime-water has scarcely any effect upon indigo in its usual state; but it readily dissolves precipitated indigo. The solution is at first green, but becomes yellow.

When the solution is exposed to the air, a slight green colour returns, as happens to the solution of indigo in ammonia; but it soon disappears. The effect of the other alkaline earths upon indigo has not hitherto been tried; but it cannot be doubted that they would act nearly as lime-water, but with more energy. The other earths seem to have but little action on indigo in any state.

The action of some on indigo has been examined with most attention, and it certainly exhibits the most important phenomena.

When diluted sulphuric acid is digested over indigo, it produces no effect, except that of dissolving the impurities; but concentrated sulphuric acid dissolves it readily.

One part of indigo, when mixed with eight parts of sulphuric acid, evolves heat, and is dissolved in about 24 hours. According to Hauy, some sulphuric acid and hydrogen gas are evolved during the solution.

If so, we are to ascribe to the mucilage and resin, which are doubtless destroyed by the action of the concentrated acid. The solution of indigo is well known in this country by the name of liquid blue. Bancroft calls it sulphat of indigo. When concentrated it is opaque and black; but when diluted it assumes a fine deep blue colour; and its intensity is such, that a single drop of the concentrated sulphat is sufficient to give a blue colour to many pounds of water. Bergman ascertained the effect of different reagents on this solution in great precision. His experiments threw light, not only on the properties of indigo, but upon the phenomena that take place when it is used as a dye-stuff. The following is the sum of these experiments:

Drop into sulphuric acid. Colour at first blue, then green, and very speedily destroyed. — In weak tartaric acid. Becomes gradually green, and in 144 hours had assumed a very pale blue, not restored by the alkalis. — Colour becomes green, and in four weeks the colour disappeared. — In weak potash. Becomes green, and then colourless. — In weak carbonat of potash. These actions, however, are not very slow. If the solution is very weak, the colour of the indigo is not destroyed. — In ammonia and its carbonat. Colour becomes green, and then disappears. — In a weak solution of sulphat of soda. Colour after some weeks becomes green. — In tartrat of potass. Becomes green, and then colourless. — In a solution of sugar. Became green, and at last yellowish. — In sulphat of iron. Colour became green, and in three weeks disappeared. — In the sulphates. Colour destroyed in a few hours. — Realgar, white oxide of arsenic, and orpiment, produced no change. — Black oxide of manganese destroyed the colour completely. — In the infusion of madder. Indigo became green, and at last yellow. — In the infusion of woad, the same changes, but more speedily.

From these experiments it is obvious that all those substances which have a very strong affinity for oxygen give a green colour to indigo, and at last destroy it. It is hence extremely probable that indigo becomes green...
by giving out oxygen. Of course it owes its blue colour to that principle. This theory was first suggested by Mr. Haussman, and still further confirmed by Berthollet. Now it is only when green that it is in a state capable of being held in solution by lime, alkalis, &c. in which state it is applied as a dye to cloth. The cloth when dip-dyed into the vat containing it, thus dissolved, combines with it, and the blue colour is restored by exposure to the atmosphere. It may be restored equally by plunging the cloth into ozo-muriatic acid. Hence the restoration cannot but be ascribed to oxygen. Hence, then, the reason that sulphurous acid, the vegetable acids, sulphat of iron, give sulphat of indigo a green colour.

From these experiments we see also that the colour of indigo is destroyed by the addition of those oxides which part with oxygen very readily, as the black oxide of manganese. In that case the indigo is destroyed, for its colour cannot be again restored. Nitric acid attacks indigo with great violence, the evolution of much heat, and nitric gas. When of the specific gravity 1.32, it even sets fire to indigo. When the acid is diluted the indigo becomes brown, and crystals make their appearance, doubtless consisting of oxalic acid. What remains behind is a brown viscous substance of a very bitter taste, probably analogous to the yellow bitter principle of Welter.

Muriatic acid does not act upon indigo in its constant state, but it readily dissolves indigo precipitated from the sulphat, and forms a blue coloured solution. The same phenomena are exhibited by the phosphoric, acetic, tartaric acids, and practically by all, except the oxalic acid supporters.

Oxy-muriatic acid destroys the colour of indigo as readily as nitric acid, and obviously for the same reason.

Indigo is not attacked upon by alcohol, ether, nor oils. The two first solvents, indeed, acquire a yellow colour when digested on common indigo by dissolving its resin.

When indigo is mixed up with bran, wood, and other similar substances, and subjected to undergo fermentation, it assumes a green colour during the fermentation, and is then easily dissolved by lime or potash. It is by this process that it is usually rendered proper for dyeing purposes.

When indigo is distilled, it yields products different from any other vegetable substance, if the accuracy of Bergman, who alone has made the experiment, is to be trusted. He distilled 576 grains in a small retort under a pressure of a pneumatic apparatus. He obtained the following products:

- 19 grains carbonic acid gas 173 - of a yellow acid liquid, containing ammonia
- 53 - oil
- 331 - charcoal
- 476.

INDIVISIBLES, in geometry, the elements or principles into which any body or figure may be ultimately resolved; which elements are supposed infinitely small: thus a line may be divided to consist of points, a surface of parallel lines, and a solid of parallel and similar surfaces; and then, because each of these elements is supposed indivisible, if in any figure a line be drawn through the elements perpendicularly, the number of points in that line will be the same as the number of the elements; so that a parallelogram, prism, or cylinder, is resolvable into elements or indivisibles, all equal to each other, parallel and like to the base; a triangle into lines parallel to the base, but descending on the lines proportional for and so are the circles which constitute the parabolic conoid, and those which constitute the plane of a circle, or surface of an isosceles cone.

A cylinder may be resolved into cylindrical curved surfaces, having all the same height, and continually decreasing inwards, as the circles of the base do on which they insist.

The method of indivisibles is only the ancient method of exhaustion, a little disguised and contracted. It is founded of great use in shortening mathematical demonstrations, of which take the following instance in the famous proposition of Archimedes, viz. that a sphere is two-thirds of a cylinder circumscribing it.

Suppose a cylinder, a hemisphere, and an inverted cone (Plate Miscel. fig. 133) to have the same base and altitude, and to be cut by infinite planes all parallel to the base, of which dy is one. It is plain the square of dy will be equal to the area of the base (the radius of the sphere); and consequently, since circles are to one another as the squares of the radii, all the circles of the hemisphere will be equal to all those of the cylinder, deducting the space of those of the cone; before the cylinder, deducting the cone, is equal to the hemisphere; but it is known that the cone is one-third of the cylinder, and consequently the sphere must be two-thirds of it.

INDORSEMENT, in law, any thing written on the back of a deed, as a receipt for money received. See BILLS OF EXCHANGE.

INDORSEMENT, in law, what is alleged as a motive or incitement to a thing, and is used specially in many cases; as, there is an inducement in actions, to a traverse in pleading, a fact or a declaration committed, &c.

Inducements to actions need not have so much certainty as in other cases: a general inducement or burden is not sufficient where it is the ground of the action; but where it is the inducement to the action, in consideration of forbearing a debt till such a day (for that the parties are agreed upon the debt), this being but a collateral promise, is good without shewing how due. 2 Haw. 143.

In any inducement to a satisfaction when what is alleged against it is not the substance of the plea. 4 Bla. 18.

INDUCTION, in law, is the giving a clerk instituted to a benefice the actual possession of the temporalities thereof, in the nature of livery of a pension. It is performed by a mandate from the bishop to the archdeacon, who commonly issues out a precept to some other clergyman to perform it for them; which, being done, the clergyman who induces him indorses a certificate of his induction on the archdeacon's mandate, and they who were present testify the same under their hands, and by this the person induced is in full and complete possession of all the temporalities of his church.

the formation of the nipples. Behold the economy of the infant himself; see him instinctively taught to search for the breast, and to suck the breast; to draw his nourishment from a new source, yet still from your body, and to learn, by degrees, to form a connection sufficiently, you would neither give him over to the sucking of another woman, nor would you feed him with any other substance than your own milk." Dr. Herdan on Feeding.

Dr. Buchan gives it as his opinion, that not one in a hundred of those children survives who are abandoned by their mothers, and committed to the charge of foster-parents in the earliest stages of life; and although we may deem this statement in some measure exaggerated, the reflection of its approach to truth ought to be a sufficient incentive for the appointed and professed guardians of the health and we-being of society to enter a severe and unrestrained protest against the custom to which we now refer.

For the first two or three months the nourishment of the infant ought to be received entirely from the breast of its mother. During the whole of this time its wants are almost confined to nourishment and sleep. It is, however, generally confessed that there are some, although comparatively few, instances of imbecility on the part of the parent to furnish milk in due quantity or suitable quality to the necessities of her offspring. "To the puffy progency of a pumy consumptively disposed mother I would forbid (says Dr. Beddoes) the mother's breast." Now, although we are inclined to suppose that the author just quoted has admitted too much in favour of what is termed rearing by hand (for capacity of bearing is commonly connected with a capacity of nursing children), yet, where circumstances necessarily deprive the child of its regular and more salutary nourishment, it becomes a question of moment, what is to be substituted in its place? Not by any means what the generality of hired attendants direct. As soon as an infant by its cries denotes hunger, the nurse has, for the most part, instant resort to a mixture of bread and water (pap), which is perhaps spiced, or qualified with a little brandy. To attempt the union of oil and water would be scarcely less incongruous; it is not hazarding any thing to assert, that the major part of infanticile ailments are to be attributed to the heterogeneous compounds that are early given to children; and the spicy or spirituous ingredients which are added, in order to force an artificial digestion, the necessity of the latter bears decided evidence against the propriety of the former. In no period of life, during health, ought food to be of such a quality as to require the assistance of condiments or spices, which are especially injurious to the assimilating organ of a newly-born infant.

About half a tea-cupful of cow's milk, gently warmed, is the only food that ought to be given to a child at its birth, after which it will frequently stand alone, and indeed often alarming to the intrusive agitation of nurses, is to be regarded as a demonstration of the proper nature of the food that has been given, and an indication of future health. To this plan it is sometimes necessary to have recourse, even when it is the intention of the mother to suckle her child, as women who have had many children frequently have no proper secretion of milk until after the second or third day from delivery.

Before quitting this part of the subject it is proper to observe, that immediately after the purgatives, as if to prove to the little stranger that it has arrived in a world of physic and of evils, is, although very generally adopted, highly injurious. The bowels do not, in general, require to be thus artificially assisted.

With respect to the quantity and times of administering food, mothers and nurses are accustomed to err. Nothing can be more improper than to suck or feed an infant two or three times in the course of an hour. A child judiciously regulated does not demand nourishment, even during the first months, more than once in three or four hours; as it advances it requires feeding even less frequently, and less deep during the day.

It has already been stated, that, with the exception of suckling, the mother's breast, at least during the first two or three months, is to be the sole repository and entire source of infantile nourishment. If the child is brought up by hand, cow's milk generally warms in the food that will be necessary for the first four or five months. After these times milk may be alternated, not by most bread, biscuit, cakes, sugar, bananas, and gui, but by ground rice or flour well baked; the gravy of spiced meat, which last will generally be taken with avidity; small quantities of beet-root, or veal-jelly, and other substances of the like nature; still avoiding, unless during the actual existence of disease, and under professional direction, every article in the long list of fermented, fermenting, spiced, and spirituous materials; the withholding of which, however it may offend and alarm the nurse, will be of incalculable benefit to the child.

The time of weaning must be regulated entirely by circumstances. The process should not be abrupt, but gradual. It is very seldom that the breast is rejected before the ninth or tenth month.

We have particularly insisted on the necessity of excluding those substances from the diet of infants which are disposed to ferment or turn sour. A general acquaintance with the laws which regulate the existance and decomposition of such substances may be acquired with less labour than would be requisite to retain in the memory, without the aid of some connecting principle, all the individual facts which are prescribed or admitted as part of the diet in childhood and youth; and in consequence of such pleasing and easy acquisition, we should gain knowledge and humanity joining true in the joyous task of averting that ignorance and error have made to attack the extremely susceptible, though not naturally unhealthy, state of the primary periods of existence. Whence does the perversity of nurses and of children arise? Solely from ignorance. Were they convinced that the plans which are adopted prove ultimately subservient of their intended object, they would readily adopt a system of treatment of children: Obedience will always be more cheerful and steady after a reasonable explanation. "I have heard a variety of mothers (says Dr. Beddoes) complain that sugar, biscuit, and cakes, disagreed in the most evident manner; and yet that it was impossible, by any injunctions, to prevent the child from being given the food, and the other (sugar) from being given to stem the hiccups, or to produce a sensation that should suspend crying for a moment. Now it is well known that punctually recurring constrictions in the stomach and bowels arise from those sources; and the parties, by whose mistake, the effect of which is so pernicious, are perfectly informed of it. It remains only to carry their knowledge a step farther. Respecting the juice of the sugar-cane, it is a very striking particular, that the poorest sort will scarcely keep a quarter of an hour in the receiver without turning sour. This can only be told. The acceint nature of bread, of sugar, and of the various compositions into which bread and sugar enter, may be shewn. For this purpose it is only necessary that a solution of sugar and water should be made into vinegar. Viz., that the sugar and water solution can be placed in a bottle nearly equal to that of the human body, and the servant be put to taste the infusion when it becomes acid. By an address suited to the object in view, there will only be small difficulty in giving these simple experiments all the effect that can be desired."

"I shall very contentedly allow the childless and wretched to laugh at me for the whimsical idea of introducing sugar into this country. I have a baulk at hand for any wound the shafts of ridicule may inflict. Considerate parents will avail themselves of so practicable an expedient, and many little sufferers will escape the consequence of an improper regimen. And these are probably (the author might have said certainly) far more serious, even in respect to the future than the present. For it clearly results from a contemplation of the manner in which human feelings and interests gain their connection, that frequent discomposure of the stomach in the morning of life may be instrumental in overcaressing its meridian and its close with a cloud of misery, such as the smallest skin trouble can dispense." Dr. Beddoes' Hygiene. For further information on the subject of diet, consult the article Materia Medica, section Dietetics.

Sect. II. Of temperature, including remarks on the clothing, and likewise on the washing or bathing of infants.

The remarkable success with which the subject of animal temperature has been recently investigated, and the application of facts, deduced from a development of its laws, to the living system, both in its healthy and diseased state, constitute perhaps the most material improvements in modern physiology and medical practice.

Respecting the generation and adjustment of animal heat, it is not the business of this article to enquire (see PHYSIOLOGY, and MEDICINE); our present plan extends no farther than the statement of a few practical rules on the subject of heat and cold, absolutely necessary to be attended to by all who undertake the guardianship of infancy and childhood: «"the management of temperature is of high importance in the treatment of the infant. It runs through, and is connected with, every part of his general treatment.»
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To be considered in his dress, in his covering while asleep, in his bathing or washing, in his treatment in the house as well as out of it, in his air and exercises. With a considerable knowledge of the management of temper-ature, a nurse can scarcely go wrong in any part of the general treatment of an infant. Herdman.

It must be obvious to every one that the infant at birth necessarily undergoes a sudden and material alteration in the temperature of the medium by which, without clothing, it is surrounded. The effects which would result otherwise from this remarkable change, with respect to external warmth, are in some measure obviated by the immediate commencement of respiration. This, however, is not sufficient of itself to supply the defect of external heat. The change thus must be artificially rendered as gradual and imperceptible as possible; and the infant, during the first month, ought scarcely to be exposed to any sensible degree of cold, even for the shortest period. It has been with much difficulty that I have been able to practice to direct that the new-born child be immediately washed with cold water, and other irritating substances, in order to cleanse the surface of the body previously to its being covered with the garments. This custom, however, by our forefathers, or even proper, is the use of warm water and sponge, without any further friction, after washing, than what is necessary completely to dry the skin; indeed the propriety of washing, as many moderns direct, that of an infant at birth, has lately been denied by an author whom we have already quoted; but we think that the use of tepid water, applied with gentleness, and without any subsequent violence of friction, can in no case be objectionable, but ought always to be had recourse to.

As soon as this process is completed, the infant is to be immediately clad; and at this period let the habits of the common routine of nurses and of friends be as sedulously watched, and as earnestly opposed, as in relation to its diet. If the customary mode of feeding infants has induced a long train of pernicious and pernicious habits in drinking, and (which, till very late years, has been persisted in with all the cruel pertinacity of continuance (ignorance), there has been also productive of fatal results, this manner of feeding, that is, the raising the temper of the air, occasioned by an unsuspected breach in the window, directed on the body of a sleeping infant, has often been productive of serious injury. Dr. Bodloe directs that the door of the nursery be never opened to fall below fifty degrees; and it is always to be carefully retained in the memory, that the deficiencies occasioned by ill-constructed buildings can never be compensated by heating the air of the fire; "if the nursery is not only the air rendered impure, but the temperature of the room is made still more irregular, and the danger of colds consequently increased."

There is one caution which is especially necessary with regard to the temperature and economy of nurseries. All occasions and sources of damp must most assiduously be guarded against. This caution is the more necessary, because the danger from this source appears to be the least understood or suspected. It is not uncommon to observe that parents and nurses who would dread the opening of a sash-window, at the same time unwarily expose themselves and the children to a much greater degree of cold by permitting the suspension of wet clothes, in order to dry, about different parts of the apartment, and even by careless respect of the window-frame. The process of drying is the process of producing cold, and that too of the most noxious kind; for cold, when combined with moisture, has been proved, in an excessive degree, injurious to the animal economy. Damp is equally insidious. We are thus inclined to believe that from this cause originate many scorbutic and other infantile ailments so peculiarly prevalent in the British isles; and that where the diseases have been favourably attributed to debilities and premises in the water we drink, and various other sources. By every individual, but more especially by the parents and guardians of infancy and youth, freedom from damp should be the first and great requisite in the choice of apartments and houses.

But to return to the infant’s dress. The covering which we have recommended ought to be continued for the first six or seven weeks of infancy; during this period, as we have already observed, nourishment, warmth, and repose, are almost its only requisites. After this time, however, or towards the close of the second month, the infant economy begins to change; vital action commences now to be connected with voluntary muscular motion; the perceptive faculty is gradually developed; and the whole organization appears to undergo a change. The body is now warmed in a greater degree and more easily by actions of its own production, and heat of its own formation. Externally, the nursery is daily less necessary; and that quantity and kind of clothing which before were proper and needful, now become irksome and tormenting. With this progress of growth the summer months are at the same time about to appear, the covering of the child may, in a short time, be reduced even to a shirt and single external garment; the utility of this light clothing will be rendered evident by the feelings and expressions of the infant. It is almost unnecessary to observe, that general precepts are incapable of undeviating and indiscriminate application. The changes of the weather, the season of the year, and the delicacy or robustness of the constitution, will interfere with every rule, and give exercise to the independent judgment of every parent. Providence has, however, by its own law, in that, in this, as in every other respect, the dictates of nature, which are communicated by the desire and aversion of the infant, furnish the most faithful directories with respect to its management; the utility of this light clothing will be perceived with such distinctness and precision as to be generally intelligible. It is only by disobeying nature’s laws that, in the treatment of infancy, we have wandered wide of the path of rectitude, and are under the necessity of retraceing our steps.

We now close the present section by a few additional remarks on the much-contested question of bathing. It has already been observed, that an exposure upon any entrance into the world, should be immediately washed with tepid or warm water. Others recommend immersion rather than ablution. "For a new-born infant (says Dr. Bodloe) I should prefer instant immersion in water at eighty degrees to washing. It is perhaps immaterial to which mode of cleansing we have recourse, unless the latter may be deemed objectionable on account of the unnecessary check it may make upon the respiratory frame. It is likewise to be observed, that conveniences for the former are procured with more facility than the latter; and that it is not every nursery that can, without difficulty, be furnished with a proper vessel for
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If the practice of immersion is guided by a cautious observance of these particulars, it may be said to be attended with success; but a total neglect of bathing would be greatly preferable to the severe and incalculable manner in which infants are frequently exposed to these violent and rapid changes in temperature. It ought to be added, that whether washing or immersion is employed, much care should be taken in drying the skin, particularly in those parts in which it is loosely situated, as about the groin, and in the epitrochlear region. As the extremities are much less susceptible of injury than other parts of the body, with the aliment that is taken into the stomach: regards the grounds of this opinion it would not be in place, in the present article, to institute any enquiry. (See Mr. Wilkins, M.R.C.S., Epist. Section Dietetics.) We have here only to impress the necessity of a constant and unremitting regard to ventilation, in order to ensure a healthful condition in the infantile economy.

Both the truth and importance of this principle would seem too obvious even to require notice by a writer on regimens, had he not daily opportunities of witnessing the mischiefs arising from neglecting its application. The public mind, however, appears to be at length awakening from a long lethargy of prejudice and error. We at length begin to breathe and to live. Even among the poorer and lowest classes of the community, cleanliness and ventilation come to be acknowledged as the surest barriers against the invasion of disease. Although, however, on this subject modern science has much to boast, much is still to be accomplished, and even in the present day examples cannot be too frequently pressed upon public observation of the injurious tendency, especially in the susceptible and delicate period of infancy, of neglected ventilation. There is reason to suppose that, from the imputation of our ancestors to fresh air, multitudes must have perished in the very dawning of existence. In our times grown persons have been dangerously affected by such a deficiency of this necessary of life, as did not even produce immediate uneasiness. Infants have perished in great numbers by a slow suffocation, terminating in convulsions. As soon as the want of ventilation was observed the mortality has ceased. Beddoes. A fact, of which the following relation furnishes irrefragable evidence. In the lying-in hospital at Dublin 2,944 infants, out of 7,530, died in the year 1782, while the total number born was 7,782. The proportion of infants perished at birth: they almost all expired in convulsions; many fainted at the mouth, their thumbs were drawn into the palms of their hands, their jaws were locked, their faces swollen, and they presented, in a greater or inferior degree, every appearance of suffocation. Such was the weight and frequency of this inquiry whether the rooms were not too close, and insufficiently ventilated. The apartments of the hospital were rendered more airy; and the consequence has been, that the proportion of deaths, according to the register of the succeeding years, is diminished from three to one.

Such facts as these cannot be too often made to pass under review. By the parent anxious for the weal of her offspring, they ought constantly to be enforced upon the minds of servants and nurses, whose sensitiveness in respect to proper ventilation is often only to be equalled by their mismanagement in other particulars. This indifference is often by servants carried to such an extent as very materially to injure their own health. In a large family (says Dr. Darwin) many female servants slept in one room, which they had contrived to render inaccessible to every blast of air. I saw four who were thus seized with convulsions. They were removed into more airy apartments, but were some weeks before they all regained their health. It is very unfortunate that the nostril has been too frequently confined in the same tainted atmosphere; convictions in these would have been much more readily induced, and might perhaps have proved fatal! A child then ought never, in any case, to be permitted to sleep with many individuals in the same apartment. It should not be lulled to rest in its nurse’s arms. When put to sleep in the couch or cradle the face must not be covered; the air must be entirely changed; after the first or second month it should be daily taken out in the open air, when the weather is not cold or damp; this is best done in the forenoon, immediately upon being washed and dressed; care being taken that the infant is not carried too much in one position, and that it does not suffer from cold. Every impediment to the purity of the air within doors is to be as speedily as possible removed. If the skin is prematurely hot, or the little patient becomes restless and febrile, the fires of the nursery are to be extinguished, the windows thrown open, or the apartments changed. It is the misfortune of the atmosphere the free use of the limbs must likewise be added. On exercise scarcely anything remains to be said. Freedom from all constraint is implied in the mode of dress above recommended. To those, however, who imagine that nature can be assisted by the contrivances of art, or that symmetry of form is to be secured by unnatural restriction, it may not be improper to observe, that deformities are only known in those countries where mechanical dexterity has been called upon to prevent them. The infants of the Caiffes (says the author of Travels into the interior of Southern Africa), soon after birth, are suffered to crawl about perfectly naked; and at six or seven months they are able to run. A cripple or deformed person is never seen. In Egypt, again, the hammam is the cradle or school of infancy. From when the infant is born there is nothing covered but the head, and it is dressed with a swathe, the source of a thousand diseases. Laid naked on a mat, exposed in a vast chamber to the pure air, he breathes freely, and with his delicate
PART II.

DISEASES OF INFANCY.

Sec. I.—Mesenteric atrophy (Tubes mesentericae, Alportia infantilis).

This is, in a great measure, the origin and root of the major part of infantile diseases. An affection of the mesenteric glands in children is often connected with, is not unusually the occasion of, and is still more frequently mistaken for, worms; it is the nucleus, through which rickets are produced; it is, in general, the more immediate cause of diarrhoea, and other bowel complaints; and in several instances has been the 'fourth, not the cause, of hydrocele, or dropsy in the brain.'

Than this no complaint bears more evident characters. The physician who has been accustomed to the general aspect of infancy, and its organic disorders, will readily recognize these by the expression of the abdomen. It he perceives a fleshy and tenesmus about the navel, and a general prostration and hardness about the belly, an enfeebled appearance with a laxity, indicating glanular tumefaction; and if, combined with this symptom, a tendency to atrophy, or, as it is called, falling away in flesh and strength, is observed; a greater or lesser degree of mesenteric consumption is present. Such then are the never-failing attendants of the disorder now under notice; they are its distinct and prominent features. A variety, however, of other accessory symptoms, for the most part, display themselves, and constitute part of the malady. Sometimes an universal languor and listlessness will be connected with aecipe to food; at others an insomniac appetite is present. The child is often very precocious; sometimes others the contrary; the evacuations are discoloured, and unhealthy in their appearance; they are, for the most part, slimy, or viscid in their consistence, but are discharged, both in quantity and quality, without the utmost irregularity: the countenance is pale, "except when the hectic flush prints its deceitful and ill-omened animation on the cheek;" the features are, for the most part, full, and languid; the eye is dull; the breathing is oppressed, and spasmodic: the pulse is invariably feebly, but is sometimes slow, and at others inordinately accelerated. In the advanced stages swellings of the feet and ankles are sometimes observed. The little sufferer generally means piteously; and this, if the disorder has arrived to any considerable extent, is almost the only sign which is given of consciousness or feeling.

Causes.—Mesenteric atrophy is most prevalent among the children of the poor, especially in large cities, and in dirty confined situations. "The noxious powers producing it, in the language of Dr. Baunoya, are "notorious."—(Newat's Leechbook, i. p. 274.)" They are the same with those of every other asthma. They are want of food, or diet of watery matter and bread; cold and moisture, the latter increasing the effects of the former; too little nursing (gestations just minus); bad treatment in the times of sleep, meals, and every other part of infantile management; thirst; impure air; an intimation to the instincts of nature in the treatment of children." Elements of Medicine.

To these causes Dr. Brown ought to have added the practice of giving children fermented or spirituous liquors, and those other artificial stimulants, to which we have referred in the former part of the present essay. This custom is extremely prevalent in the inferior classes of society; and hence, in part, the frequency of mesenteric atrophy among the offspring of the poor.

Immediate cause of, and constitutions most obnoxious to, mesentericconsumptions.—The unusual bulk of the abdomen, which is so characteristic of this disease, obviously depends upon a deranged state of the mesenteric glands. The tumefaction, however, does not arise from the source in which it is usually referred to, but is "caused by the presence of tough, rosy tumours, causing an obstruction in the tumefied parts." The theory of mechanical obstruction is indeed totally founded in error, consistent with the theory of the animal economy. It is incompatible with living action; and, as we shall immediately have occasion to observe, has been the cause of much and serious mischief, both in the dog and cat even the parturition, of this and other ailments. "The idea of alternating humours, purifying blood, and clearing passages, rests upon a wrong principle." So far indeed from the glands of the mesentery being less prone to disease than when in a state of health, the exact contrary is the fact; and not only is their area enlarged, but new vessels are often at the same time formed; and hence the morbid increase of bulk.

The attendant atrophy is easy of explanation. The deranged action of the glands in question interferes with the due preparation of the chyle, the whole of which has to undergo the same process as blood. The chyle is the fluid from which the blood is formed; on the quantity and quality of the blood depends health, growth, and life; by its deficiency, or want of due proportion in its component principal parts, mortality, disease, and atrophy, are produced.

The attendant symptoms are not difficult to account for; the torpid and irregular state of the bowels is partly owing to the general inactivity in the lymphatics of the liver; hence the thinner portions of the bile remain unabsobered, and this fluid is in consequence too dulled to afford a due excitation to the intestinal fibre. The slimness and viscosity of the feces arise from the altered condition of the glands of the intestines; and the edematous swellings of the feet are evidences of a general inactivity, or deficient excitement, pervading the whole lymphatic system.

The constitutions in which tubes mesenterica most readily makes its appearance, are those which are denominated scrophulous. The marks of scrofula we shall not here enumerate; it may be sufficient to observe, that the habit of this disease, and the lymphatic and glandular systems are especially prone to suffer from the exciting causes of disease. This indeed is more or less the case in every individual during growth, as, at this period of existence, the office which these vessels perform in the animal economy, is more important and complicated than in the succeeding stages of life.

Treatment.—The most effectual remedies are necessarily the converse of those which have occasioned the complaint; we otherwise enumerate from the Elements of Dr. Brown: "nourishing exciting milk; three or four meals in the course of the day, composed chiefly of warm milk, pure animal, and by no means weak, soup, mixed with vacation, four or bread; a due temperature, so that a general warmth may be preserved, without producing irritation, or occasioning too copious sweat; avoiding every species of evacuation; good nursing; a proper regulation of the times of sleep, food, and every other circumstance connected with the management of the susceptible and tender condition of infancy; cleanliness; tepid bathing in moderately cold weather, and cold bathing in warm; pure air; being sent out of doors as much as possible, excepting when the weather is damp; and, finally, a judicious attention to desires and propensities; this ought to be carried to such an extent as to obviate, if possible, the most trivial irritation, as by the scratching of a part that itches."

The above are necessarily adapted to the milder forms of the complaint. When the disorder has arrived to a greater extent, the medical is now required in aid of domestic treatment: for although the mesenteric atrophy, unless it is a consequence of defective structure, may at all times be prevented, and in its earlier stages may be remedied, without the aid of drugs; these, at length, come to be absolutely indispensable. It ought, however, to be impressed upon the public mind, that pharmacy, although it may correct the errors, can in no wise become a substitute for, or supply the deficiencies of, regimen.

The objects of the medical practitioner, in the treatment of the disease in question, will be twofold. First, by means of diet, and forcibly stimulating the lymphatics and mesenteric glands; and, 2dly, the preservation of a due and equable excitement in order to obviate the recurrence of the disorder.

[N. B. For the explanation of any terms that may not be familiar, the reader is referred to the articles Anatomy, Physiology, and Medicine.] The first of the above intentions is most speedily and effectually accomplished by mercurial purgatives; and of these colonel (submaris hydrargyri) is generally to be preferred. The benefit which has often resulted from preparations of mercury, particularly in the form of submuriatic acid, has fortunately been accounted for upon very erroneous principles. It is customary to attribute every complaint of childhood, where the stomach and intestines shew marks of derangement, to worms. With the signs of the actual existence of these animalcules, we have already remarked those of tubes mesentericae are, from their affinity, often confounded. Advertisements of inoffensive cures for worms, as indeed for every other complaint, have too frequently been allowed to carry the current before the public: these, for the most part, contain mercury, as the only agent of consequence in their composition; and from the operation of this medicine upon the diseased glands, provided, by accident, the gusa-
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Sect. II.—Water in the head. (Hydrocephalus.)

The discriminating characters of this disease demand serious attention from the medical practitioner; for it cannot be doubted that a great number of children are constantly destroyed by water in the brain, where the nature of the matter has been entirely misunderstood, and the symptoms referred to other sources. Most commonly would it be, on the other hand, hydrocephalus has been very frequently suspected, and the event has proved that the suspicion was destitute of any proper foundation.

Hydrocephalus is generally divided by authors into the internal, or that in which the fluid is contained in the veins of the brain; and external, where the disease is exterior to the substance of this organ, and the fluid is in the cerebral membranes. The first species has likewise been denominated acute, the second chronic. This division, however, is calculated to mislead; not merely on account of the frequent conception of it as a disease, but also in the sense of acute (external and internal) of hydrocephalus, but because the former, as well as the latter, is oftentimes chronic, and by no means necessarily preceded by an inflammatory affection of the parts concerned in its production.

The chronic internal, chronic external, and the acute, species of hydrocephalus, would constitute a classification of the disease, approaching nearer to accuracy than that which has been hitherto adopted; and we shall proceed to give a brief description of each, requesting the reader to recollect that the different kinds are often mixed, and consequently exhibit characters in an almost endless variety.

Chronic internal. This, although overlooked in the ordinary division, is perhaps the most usual form in which the affection presents itself; it arises from the same disposition of habit, and is combined with the disease treated of in the preceding section. More commonly, however, it is in a manner similar to this last; and the same may, perhaps, from accidental circumstances, occur in a habit which makes mesenterica, which would at another have produced hydrocephalus. Its symptoms are less decided than those of the other species. When, however, in children of a sluggish habit, or scrofulous constitution, an unusual drowsiness or stupor is present, the child gradually loses its vivacity and spirits, is indolent, and at length loses all appetite for food and dissipates the condition of the head, the symptoms are less indolent. The fluid only fills the subdural or external meninges. The symptoms, hence, cannot be mistaken for those of hydrocephalus. In the infantile form of hydrocephalus, the infant is observed to have a drowsy appearance, and the head is large; the symptoms, however, are less apparent than in the adult form. The fluid is the same in both cases; and the symptoms are produced by the same cause. The fluid is the same in both cases; and the symptoms are produced by the same cause.

In the practice of the writer of this article, extremely small, and very gradually augmented, doses of digitalis have appeared to restore, in a remarkable degree, the wasted vigour of the vitals. The free use of this very important and active medicine has long been admitted in dropsy, an affection of the highest degree. In plasma mesenterica, we have seen the employment of digitalis very judiciously and successfully; and in the use of the same medicine in the latter case. The importance of the subject is clearly shown by the following cases.

Under these circumstances, on account of the comparative minuteness of the dose, the digitalis is best given in the form of tartar: a preparation which has not hitherto been received into the London Pharmacy.
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mentioned, characteristic of the acute species. This first kind of hydrocephalus is succinctly described by Dr. Heberden, in the following words: "Capitis dolores, manus ad capitum, crebro adnotatur, clamores subiti, dissiemo nervorum, stupor, meatus perturbatus, motus venarum lentes, potestos crecit." He adds, "Iustam est hanc symptomata etiamis capitis molem non fuerit auris."

Chronic external.—The head of an infant at, or soon after, the period of birth exhibits a preternatural size and form; the regular process of ossification and growth is stopped, but the principal part of the external surface of the cranium continues soft and yielding, while not unusually, in the progress of the complaint, an undulation of a fluid may be perceived by touching the head to the subcutaneous tissues of the skull. As the disease continues to advance, the signs of its existence become shortly obvious to the most superficial observation; not only does the head increase to an enormous growth, but parts of it are in a proportionate ratio defective; the limbs do not often acquire a much greater bulk than at birth; at the ordinary period of teething no teeth present themselves; the piercing facies, especially as in other infants; and, indeed, although vitality is preserved, it appears to be a vitality almost entirely unconnected with feeling. In this state of torpid existence life itself is, in some instances, prolonged; but, in others, even a greater number of years. In the Commentaries of Van Swieten, we have the relation of life being maintained under this malady for thirty years: this, however, is an anomaly; and indeed the hydrocephalic patient seldom survives the second year.

Acute hydrocephalus.—The acute, phrenitic, inflammatory, or, as it has been termed by some writers, apoplectic hydrocephalus, is not, like the other species, entirely confined to any constitution. Although most frequent in children under twelve years, it is sometimes observed in adults. It has been divided by Dr. Whytt, and others who have followed him, into three distinct stages: the first of which is involuntary, characterized by a pulsation of much celerity and comparative strength; in the second the pulsations become slower, and more feeble; in the third and last period their rapidity is increased even beyond that of the primary stage; but this increased action is now connected with extreme debility. These different changes in the circulation are not, however, always to be traced even in the acute species of hydrocephalus, in that order which the observations of Dr. Whytt would lead us to suppose.

Obsolescence of the stomach, a general feeling of lassitude, with sometimes a kind of palsy of the limbs, or an affection of them, in some measure similar to that observed in St. Vitus's Dance, if the child has previously been able to walk, sometimes present themselves as precursors of the first, or the inflammatory stage; at other times the feverish state, intolerance of light, violent pains at the head, and vomiting, are the first signs of disorder that are noticed. These symptoms are in some cases connected, according to the observations of Dr. Rush, with an impetuosity of sound; the pain of the head is often confined to one side.

In proportion to its intensity the nausea and vomiting become less urgent, while with the remission of the headache the affections of the stomach are disposed to recur. Respiration at this time is spasmodic and irregular; the bowels are generally so constipated as to require very drastic purgatives, in order to produce evacuations. This stage of the complaint continues sometimes for several days, but is more usually in a shorter period succeeded by the second, which commences by a sudden reduction of the pulse, and other symptoms of irritation. The head now becomes less urgent, torpor succeeds to watchfulness, the infant lets his hands to his head, and frequently utters piercing screams (clamores subiti); a degree of feverish sensations and a morbid susceptibility of light; the little patient lies in an horizontal posture, with the head low, and shows an indisposition to be taken up; the bowels still continue torpid; the symptoms of irritation are of the above-mentioned species; and after these symptoms have lasted from seven to fourteen days, the complaint sometimes appears suddenly to decline. This semblance of returning health is often succeeded by a second period of irritation, and to the final period of the complaint: it is now that the pulse increases in frequency, and oftentimes so quick as not to be counted. Dr. Whytt informs us that in some children he has been able to observe this abstraction in the space of a minute; this extraordinary rapidity, however, does not last through the whole of the day; it comes on and declines with the accesses and remissions of the hectic flux in the head. The eyes at length become insensible to the strongest light, convulsions come on, and life is terminated. The duration of this last period, of stagnation, is very variable. Sometimes the patient is carried oil in less than a week from its commencement; at other times the child lingers in a hectic state for three, four, or six weeks; and Dr. Monro has instances of patients surviving this stage, which it is to be protracted even to the fourth month.

Cause.—The two first species of the complaint are decidedly of a scrophulous nature. They generally come on without any evident cause; at different times the abdominal affections, in the early periods of life, originate from lymphatic debility, without previous excitement in the vessels of the brain to produce the effusion; the last species is perhaps always preceded by an inflammation in the internal vessels of the brain. The immediate cause of this irritation is not, however, in every instance to be detected; it may arise in subjects predisposed, in common with all other inflammations, from the sudden alterations of cold and heat. It has been observed to supervene upon the contagious eruptive affections, especially when these have been unusually violent; and Dr. Beidhoe, in a letter to Dr. Darwin, inquires whether it may not happen more frequently than has been suspected from external injury? Zoonymia.

Treatment.—Evacuations of every kind, purge, cathartics, sudorifics, emetics, general and local blood-letting, as well as the external application of cold, and of blisters to the scalp, with due attention to the erect position of the head, had all, in conjunction or separately, been tried in the acute species of hydrocephalus, but, according to the general report of physicians, without any success, therefore, of the ill success that had attended the common routine of treatment in hydrocephalus, Dr. Dobson, of Liverpool, was induced to make trial of mercurials, with an intention of removing the absorptive organs of the brain, and in this manner removing the extravasated fluid. The event appeared to justify his theory; and we have several cases recorded by this physician and others, in which mercury, carried to the extent of salivation, accomplished a speedy and effectual cure. The following case is from Dr. Percival: "One of my own children, a girl, aged three years and three months, has lately been a severe sufferer under this alarming malady. As soon as the characteristic symptoms of the disease clearly manifested themselves, I laid aside all other remedies, convinced by repeated observation of their insufficiency, and trusted solely, though with much solicitude, to the internal and external use of mercury. In forty-eight hours, signs of amendment appeared, and her recovery was perfected in six days. During this period of administration, calomel were administered, and seven scrupules of unguentum mercuriale fortissimamente rubbed into the leg." With the same design of exciting the absorptive organs, digitalis has recently been employed. "In one child," says Dr. Darwin, "I tried the foxglove in tincture, but it was given with too timid a hand and too late in the disease to determine its effects." In the work of Dr. Reid, to which we referred in a former part of this article, we meet with the following observations: "The universality of lymphatic absorbers is rather conceived than actually demonstrated. Dissection has hitherto not been able to detect these vessels in the brain; analogy, however, favours the supposition of their existence. If that frequent and too fatal disease of young persons, water in the brain, admits of cure, the remedy opens the way for the removal of those indicative of water in the ventricles of the brain, that it is scarcely possible to decide with absolute certainty on the interesting question of the inevitable fatality or remissible nature of hydrocephalus."

If foxglove should prove by future experience to succeed as a remedy for this alarming malady, its modus operandi must be referred to the extraordinary faculty which it possesses of representing the arterial, while it stimulates the absorptive system. Both in the acute and chronic hydrocephalus, it appears to be deserving of a more extensive trial.

To the earliest stage of the former we should, a priori, be disposed to conceive it more applicable than even mercury.

Sect. III.—Worms. ( Vermes.)

The marks by which the presence of worms is indicated are confessedly at times, both in the infant and adult, obscure and equivocal. In the majority of cases, however, the phenomena which they present require only for their detection a careful and discerning scrutiny.
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In persons affected with worms, the constipation in general has a particularly vivid and distinct appearance, very different from that which characterizes the diarrhoea. Impeded nutrition of the alimentary canal, as in mesenteric, and hydrocele.

The eyes become dull, the pupil dilated, but not averse to light, as in hydrocele, the upper lip swelled, the sides of the nostrils enlarged, and there is always a constant palpable vitching of their internal membrane. The breath is remarkably offensive, saliva is secreted in unusual abundance; during sleep there is most generally a rolling of the teeth, and epileptic affections are by no means uncommon; the pulse is intermittent, the celebrous irritation is not always of the hectic kind, the appetite is often voracious, lancinating pains are complained of in the bowels and head, and tenesmus, attended with a distressing irritation about the anus. This is, especially from some species of worms, exceedingly frequent. Cough is not uncommon. These last, however, are symptoms which may be met with in the adult than in the child. See Medicine.

Caus.—The tumid belly, blunted contour, and swelled upper lip, says Dr. Darwin, are concomitant circumstances attending the reaction of the absurd system, which is therefore to be esteemed the remote cause of the generation of worms. Worms, however, are often produced through the medium of intestinal viscidities, and the action of the alimentary vesels. The immediately exciting causes are some of those already mentioned as productive of mesenteric atrophy, more especially the reception into the stomach of indigestible substances. Dr. Darwin, indeed, supposes, that not merely the nuxis of worms is thus formed from aliment incapable of assimilation, but that these animalcules are actually received from without: for this opinion, however, there does not appear any foundation. Worms are actually engendered in the alimentary passage.

Treatment.—Emetics; mercurial purgatives; chalybeates; vegetable bitters; avoid aliments of the melon kind. For an account of the different kinds of worms, and specific antphilologies, consult the articles Medicine, and Materia Medica.

Sect. IV.—Rickets. (Rachities. Atrophia Infantilis.)

This is likewise an affection of the lymphatic system. Every one knows the characters by which it is marked. An infant with a large head, proterbant forehead, swellings in the smaller joints, depressed flattened ribs, enunciated limbs, and tubm abdomen, is decidedly rickety. These symptoms, in common with the other affections of infants, usually make their appearance before the second year. The first indication of a rickety tendency is a remarkable lassitude of the muscular fibre: disinclination to exertion follows; general inactivity of the limbs, above enumerated, shortly supervene, followed by hectic, cough, confirmed atrophy, death, or permanently distorted limbs.

Causes.—Obligation, most commonly of an hereditary nature, constitutes the predisposing cause to rickets. Bad air, bad nursing, improper diet, uncleasenes, and damp, are its exciting causes. Hoffmann describes the proximate cause to be a deficient supply of nervous influence to the spinal marrow, producing the deficient nutrition of parts. Dr. Cullen supposes, a deficiency of bone matter in the fluids constituting the intestines. A more correct account, however, of the essentials of rickets, would make it to consist in deficient excitement or power in those vessels, by the action of which osseous matter is thrown out, and hence constituting. Treatment.—Indication 1st. To cleanse the first passages from obstructions. Method of medicating: emetics, cathartics, chalybeats.

Indication 2d. To restore due energy to the structures disturbed. M. M. chalybeats, exercise, bathing.

Sect. V.—Disorder in the bowels. (Diarrhoea infants.)

Among the morbid infancies in the yearly catalogue of every medical practitioner, diarrhoea occupies a conspicuous situation. The griping, green, and otherwise discoloured stools, putrid in the abdomen, with drawing up of the knees towards the stomach, severe crying, febrile irritation, and a greater or less degree of actual convulsion, are perhaps the most common among the diseases of infancy.

Contractions, as we have already observed, are almost invariably occasioned by improper diet. Dr. Darwin gives us the following relation: "A child of a week old, which had been taken from the breast of its dying mother, and had by some uncommon error been suffered to take no food but water-gruel, became sick and gripped in 24 hours, was convulsed on the second day, and died on the third." That among the poor children of Derby who are thus fed, few hundred are starved into scrofula, and either perish or live in a state of wretched debility. Zoonomia.

Treatment.—Colonel with rhubarb, and more spicy substances, is to be immediately given, which is to be followed by antichris, such as prepared chalk and magnesia. With these are to be connected, according to the violence of the disorder, emetics, cathartics, such as cinnamomum, isatinum, and opium. Sometimes it is necessary to give an emetic. In all cases indigestible food is to be avoided.

Sect. VI.—Affections occasioned by teething. (Denitis.)

Pains in the form of convulsions, frequent and sudden startings, especially in sleep, crotions on the skin, disorders of the stomach and bowels, cough, and hectic fever, are not unfrequently occasioned by the process of toothing. Dr. Darwin conjectures, that "the pain of toothing often begins much earlier than is suspected," and that the apparent cause of the disease is in reality its cure, as the convulsions, which are often accompanied with violent and then by far the most alarming of the above symptoms, are commonly relieved when the gum swells and becomes inflamed; at other times a diarrhoea supervenes, which is generally esteemed a favourable circumstance.

In difficult dentition, the pains in the head, convulsions, vomiting, and hectic, sometimes give rise to the suspicion of hydroceleps; from this, however, the disease in question may generally be distinguished, with facility by the case with which, in the last case, the bowels are evacuated; by the inflammatory redness of the gum, and by the pupil of the eye being dilated in an obscure, and constatated in a vivid light, the contrary of which takes place in hydroceleps.

Treatment.—Frequent doses of rhubarb, and the fluid convulsating and mitigating the toothing cough. The gums are to be banded in all cases where the redness and swelling are considerable. This practice can indeed never be objectionable, and the gums thus bandaged, are unefficacious while the cause remains.

Sect. VII.—Group. (Cyananche trachealis.)

The characteristics, or pathomathic symptoms of this disease are, violent prostration, loud and stridulous cough, with the emission of a sound of a peculiar nature, which has been compared to the croak of a young cock.

These symptoms sometimes supervene upon the common precursors of violent inflammation: at other times the disease is formed without previous warning, and has been known to prove fatal in a very few hours from its apparent commencement. If the disease is thus early terminated in the man, the disorder frequently runs on for the space of six days, and terminates for the most part by crisis, with the evacuation of much pale urine.

Causes.—The croup is an inflammation of the upper part, as the peripneumy is of the lower part of the same organ, viz. the trachea or windpipe. It originates from the same sources as other inflammation. The circumstances of the most frequent and tendency in infants, appears to be owing to the extremely disproportionate smallness of the glottis at that period of life. The cause of death, when it happens suddenly, is a deposition of concreted mucus (consequent upon the inflammation), which laces the trachea, and fills up the bronchial cavi- ties. Independently, however, of this circumstance, sudden death may be occasioned by the great loss of power in the musculorous fibres of the glottis, induced by the previously high excitement, "infantes enim mirum indicationis viscitutiam, brevissimis temporibus ruptum, expirarunt." Treatment. — The nature of the effectual, must be speedy and decisive. Emetics: copious bleeding by leeches, applied near to the patient affected; blisters; warm bath; antimonials.

Recently, calomel in large doses has been tried, with success; but yet not sufficiently proved useful in consequence of its extraordinary power in rapidly reducing arterial excitement.

N. B. Croup, in some instances, assumes more of the authentic than of the inflamma- tory nature; and in this case the disorder of the glottis is often protracted to a longer period. The treatment in this latter species requires to be stimulating. Calomel: opiates; blisters; volatile embrocations to the throat; nourishing diet.

For those diseases of young persons which often require local, in connection with general treatment. The distortions of the space, affections of the eyes, scrofulous swellings of lymphatic glands, &c. consult the articles Medicine, and Surgery.

For eruptive and contagious diseases, see Medicine, and Surgery.
INF on which they are presumed capable of acting with reason and discretion; in our law, the full age of man or woman is 21 years. 3 Bl. Abr. 118.

The ages of male and female are different for different purposes: a male at 12 years of age may take the oath of allegiance; at 14 is at discretion, and therefore may consent or disagree to marriage, may choose his guardian, and if his discretion is actually proved, may make his testament of his personal estate; at 17 he may be a procurator or an executor; and at 21 he is in his own disposal, and may alien his lands, goods, and chattels. A female at seven years of age may be betrothed or given in marriage; at nine is entitled to dowery; and at 12 is of years of maturity, and therefore may consent or disagree to marriage, and if proved to have sufficient discretion may bequest her personal estate at 14 is at years of legal discretion, at 17 she may choose a guardian; at 17 be executrix; and at 21 may dispose of herself and her lands. 1 Black. 463.

An infant is capable of inheriting, for the law presumes him capable of property; also an infant may purchase, because it is intended for his benefit, and the freedhold is in him till he discharges thereto, because an agreement is proper for his benefit, and he is bound for his benefit, and because the freedhold cannot be in the grantor contrary to his own act, nor can be in abeyance, for then a stranger would not know against whom to demand his right; and if at full age infant agrees to the purchase, he cannot afterwards avoid it; but if he dies during his minority his heirs may avoid it, for they shall not be bound by the contracts of a person who had wanted capacity to contract. Co. Lit. 2.

As to infants being witnesses, there seems to be no fixed time at which children are excluded from giving evidence; but it will depend in a great measure on the sense and understanding of the children, as it shall appear on examination in court. Bull. N. P. 293.

And where they are admitted, concurrent testimony seems particularly desirable. 4 Bla. 279.

An infant is not bound by his contract to deliver a thing; so if one deliver goods to an infant upon a contract, &c., knowing him to be an infant, he shall not be chargeable in trover and conversion, or any other action for them; for the infant is not capable of any contract but for necessaries, therefore such delivery is a gift to the infant; but if an infant, without any contract, willfully takes away the goods of another, trover lies against him; also it is said, that if he takes the goods under pretence that he is of full age, trover lies, because it is a willful and fraudulent trespass. 1 Sid. 129.

Infants are disabled to contract for any thing but necessaries for their person, suitable to their degree and quality; and what is necessary must be left to the jury. Co. Lit. 172.

An infant, knowing of a fraud, shall be as much bound as if of age. 13 Vin. Abr. 536.

But it is held that this rule is confined to such acts only as are voidable; and that a warrant of attorney given by an infant being absolutely void, the court will not confirm it, though the infant appeared to have given it, knowing it was not good, and for the purpose of collusion.

As to acts of infants being void, or only voidable, there is a diversity between an actual delivery of the thing contracted for, and a bare agreement to deliver it; the first is voidable, but the last absolutely void.

An infant, for his own security for necessaries for him, is chargeable for them, unless provided before marriage; in which case he is not answerable, though she wore them afterward. 1 Str. 108.

An infant is also liable for the nursing of his lawful child.

Where goods are furnished to the son, he is himself liable if they are necessaries. If tradesman deal with him, and he undertakes to pay them, they must resort to him for payment; but if they furnished the infant on the credit of his father, the father only is liable. 2 Esp. 471.

With respect to education, &c. Infants may be charged, where the credit was given bona fide to them. But where the infant is under the parent's power, and living in the house with them, he shall not be liable even for necessaries. 2 Black. Rep. 1325.

If a tenant lives with an under age, for clothes to an extravagant degree, he cannot recover; and he is bound to know whether he deals at the same time with any other tenant. 1 Esp. Rep. 212.

A factor, who endeavours to get money from an infant, may settle the contract; one lends money to an infant to pay a debt for necessaries, and he pays it, although he is not bound in law, it is said he is in equity; but if the infant misapplies the money it is at the peril of the lender.

A promissory note given by an infant for goods or lodging, and for teaching him a trade, is valid, and will support an action for the money. 1 T. R. 41.

And debts contracted during infancy are good considerations to support a promise made to them when a person is of full age; but the promise must be express. 2 Esp. Rep. 164.

Legacies to infants cannot be paid either to them or their parents.

An infant cannot be jurors, neither can he be an attorney, bailiff, factor, or receiver. Co. Lit. 172.

By the custom of London an infant unmarried, and above the age of 14, if under 21, may bind himself to apprentice to a freeman of London, by indenture with proper covenants, which covenants, by the custom of London, will be as binding as if of age.

If an infant draws a bill of exchange, yet he shall not be liable on the custom of merchants; but he may plead infancy in the same manner as he may to any other contract.

An infant cannot sue but under the protection and joining of his guardian; but he may sue either by his guardian, or his next friend, who is not his guardian. Co. Lit. 135.

An action on an account stated will not lie against an infant, though it should be for necessaries. Co. Lit. 172.

INFINITELY, of INFINITELY GREAT LINE, in geometry, an indefinite or indeterminate line, to which no certain bounds, or limits, are prescribed.

INFINITESIMALS, among mathematicians, are defined to be infinitely small quantities.

In the method of infinitesimals, the element, by which any quantity increases or decreases, is supposed to be infinitely small, and is generally considered for its finite or assigned terms, some of which are infinitely less than the rest, which being neglected as of no importance, the remaining terms form what is called the difference of the proposed quantity. The terms that are neglected in this manner, as infinitely less than the other terms of the element, are the very same which arise in consequence of the acceleration, or retardation, of the generating motion, during the infinitely small time in which the element is generated; so that the remaining terms express the elements that would have been produced in that time, if the generating motion had continued uniform; therefore those differences are accurately true without actually being even an infinitesimal small error, and agree precisely with those that are deduced by the method by fluxions.

For example (see Plate Miscell. fig. 136), when DG, the increment of the base AD, of the triangle ADE, is supposed to become infinitely little, the trapezium DGH, consisting of the simultaneous increment of the triangle) consists of two parts, the parallelogram EG, and the triangle EIH; the latter of which is infinitely less than the former, and the ratio being that of one-half DG to AD; therefore, according to this method in fluxions, the part EIH is neglected, and the remaining part, viz. the parallelogram EG, is the difference of the triangle ADE; which may be shown, that EG is precisely that part of the increment of the triangle ADE which is generated by the motion with which this triangle flows, and that EIH is the part of the same increment which is generated, and is the consequence of the acceleration of this motion, and is the base, by flowing uniformly, acquires the augment DG, whether DG be supposed finite or infinitely less.

Example 2. The increment of the rectangle BEMHD (fig. 137) of the rectangle AE, consists of the parallelogram EG, EM, and IA; the last of which, IA, becomes infinitely less than EG, or EM, when DG and IA, the increments of the sides, are supposed infinitely small, because IA is supposed to be to EG as EA to AE, and to EM as DG to AD; therefore, being neglected, the sum of the parallelograms EG and EM is the difference of the rectangle AE; and the sum of EG and EM is the space that would have been generated by the motion with which the rectangle AE flows continued uniformly, but that IA, is the part of the increment of the rectangle which is generated in consequence of the acceleration of this motion, in the time that AD and IA, by flowing uniformly, acquire the augment DG and IA. The same may be observed in propositions wherein the fluxions of quantities are determined, viz. the manner of investigating the differences, and the discussion of quantities, in the method of infinitesimals, may be deduced from the principles of the method of fluxions. For instead of neglecting EIH because it is infinitely less than EG, (according to the usual manner of
soning in that method), we may reject it; because we may thence conclude, that it is not produced in consequence of the generating motion DG, but of the subsequent variations of this motion. And it appears why the conclusion in the method of infinitesimals is not to be represented as if they were only near the truth, but are to be held as accurately true.

In order to render the application of this method easy, some analogous principles are admitted, as that the infinitely small elements of a curve are right lines, or that a curve is a polygon of an infinite number of sides, which being produced, give the tangents of the curve; and by their inclination to each other measure the curvature. This is as if we should suppose, when the base flows uniformly, the ordinate flows with a motion which is uniform for every infinitely small part of time, and increases or decreases by infinitely small differences at the end of every such time.

But however convenient this principle may be, it must be applied with caution and art on various occasions. It is usual therefore in many cases, to resolve the element of the curve into two or more infinitely small right lines, if it is necessary, if we would avoid error, to resolve it into an infinite number of such right lines, which are infinitesimals of the second order. In general, it is a postulatum in this method, that we may descend to the infinitesimals of any order whatever, as we find it necessary; by which means any error that might arise in the application of it may be discovered and corrected by a proper use of this method itself. For an example of this, see Macaulay's Fluxions.

INFLAMMABILITY, that property of bodies which disposes them to kindle or catch fire. See CALCULUS, CHEMISTRY, &c.

INFLAMMATION. See Surgery, and Medicine.

INJECTION, or point of injection, in the higher geometry, is the point where a curve begins to bend a contrary way. See ca

To determine the point of injection in curves, whose semi-ordinates CM, CM' (Pl. Misc. fig. 1.54) are drawn from the fixed point C; suppose CM to be infinitely near C, and make \( \alpha = \frac{\pi}{2} \); let \( \tau \) touch the curve in M. Now the angles \( \alpha C T, \alpha C M' \), are equal; and so the angle \( \alpha C \), while the semi-ordinates increase, does decrease, if the curve is concave towards the centre C. and increases if the convexity turns towards it. Whence this angle, or, which is the same, its measure, will be a minimum or maximum, if the curve has a point of injection or retrogression; and so may be found, if the arch \( \alpha H \), or fluxion of it, be made equal to 0, or infinity. And in order to find the arch \( \alpha H \), draw the angle \( \alpha T \), equal to \( \alpha C \).

Again, draw the arch \( \alpha H \) to the radius \( CH \); then the small right lines \( CM \), \( CM' \), are parallel; and so the triangles \( O L H, \) \( mL \), are similar; but because \( H \) is also perpendicular to \( \alpha L \), the triangles \( \alpha L H, \) \( mL \), are also similar, whence \( \frac{\alpha L}{\alpha H} = \frac{\alpha L}{\alpha H} \); that is, the quantities \( \alpha H, \) \( \alpha L \), are equal. But \( \alpha H \) is the fluxion of \( H \), which is the distance of \( C \) to \( H \); and \( \alpha L \) is a negative quantity, because the time \( \alpha T H \) is the duration, \( \alpha H \) decreases; whence \( \alpha H - \alpha L = \frac{\alpha H}{\alpha L} \), which is a general equation for finding the point of injection, or retrogression. See Fluxions.

INFORMATION, in law. An information may be defined an accusation or complaint exhibited against a person for some criminal offence, either immediately against the king, or against a private person, which, from its enormity or dangerous tendency, the public good requires to be restrained and punished. It differs principally from an indictment in this, that an indictment is an accusation found by the oath of 12 men, but in information is only the allegation of the officer who exhibits it. 3 Bac. Abr. 164.

Informations are of two kinds: first, those which are partly at the suit of the king, and partly at the suit of a subject; and, secondly, such as are only in the name of the king: the former are usually brought upon solemn statutes, which inflict a penalty on conviction of the offender, and are, by the use of the king, and another to the use of the informer; and are called qui tam, or popular actions, only carried on by a criminal instead of a civil process.

Informations that are exhibited in the name of the king alone are also of two kinds: first, those which are truly and properly his own suits, and filed ex officio by his own immediate officer, the attorney-general; secondly, those in which, though the king is the nominal plaintiff, it is at the relation of some private person, or common informer; and they are filed by the master of the crown office, under the express direction of the court. The objects of the king's own prosecutions, filed ex officio by the attorney-general, are properly such enormous misdemeanours as peculiarly tend to disturb or endanger the government. The objects of the other species of informations, filed by the master of the crown office, under the complaint or relation of a private subject, are any gross and notorious misdemeanours, riots, batteries, libels, or other immoralities, of an atrocious kind, not likely to disturb or endanger the government, but which, on account of their magnitude or pernicious example, deserve the most public animadversion. And when an information is filed either thus, or by the attorney-general ex officio, it must be tried by a petty jury of the county where the offence arises; after which, if the defendant is found guilty, he must resort to the court of king's bench for his punishment. 4 Black. 308.

If a common informer should willingly delay his suit, or discontinuance, or be negligent, or shall have a verdict or judgment against him, he shall pay costs to the defendant. 18 Eliz. c. 5.

And in the court of king's bench, particularly if the defendant shall appear and plead to the issue, and the prosecutor shall not at his own costs, within a year after issue joined, procure the same to be tried; or if a verdict pass for the defendant, then the informer profiting thereby, shall not be entitled to enter the said court of king's bench may award the defendant his costs, unless the judge shall certify that there was a reasonable cause for exhibiting such information; and if the informer shall not, in three months after such costs taxed, and demand made, pay the same, the defendant shall have the benefit of the recognition, to compel him thereunto. 4 and 5 W. c. 18.

INFRALAPSIANS, in church history, an appellation given to such predestinarians as think the decrees of God, in regard to the salvation or condemnation of mankind, were formed in consequence of Adam's fall.

INFUSION, a method of obtaining the virtues of plants, roots, &c. by steeping them in a hot or cold liquid.

INFUSORIA, in natural history, minute simple animals, seldom visible to the naked eye. When water is examined with the microscope, particularly that which has long been stagnant, and has vegetable matter growing in it, or water in which vegetables have been immersed, thousands of minute animals have been discovered, which have been arranged together in this order. When wheat that is richly infused in water, small eel-shaped worms are discovered, which were the cause of the disease. Wheat thus injured is proper for the mill, whereas, if it is not, it is convenient to the use of the king. The grains are brown, shrivelled, and of irregular form; each contains one or more of these worms, which lie dormant as long as the grain is dry; but as soon as it is moistened by being washed, or otherwise, the worms are revivified, feed on the flour, and lay their eggs. Such grain vegetables, the young, as soon as they are hatched, eat their way up the stem, and bury themselves in the young shoots of wheat.

INGRESS, in astronomy, signifies the sun's entering the first scrobule of one of the four cardinal signs, especially Aries.

INGROSSER. See Forestalling.

INHALER, in medicine, a machine for steaming the lungs with warm water, recommended by Mr. Mudge in the cure of the carbunular cough. The body of the instrument resembles a porter-pot, holds about a pint of water, being fixed to the side of it, is hollow. In the lower part of the vessel, where it is soldered to the handle, is a hole, by means of which and three others on the upper part of the handle, the water, when it has been heated, will rise to the same level in both. To the middle of the cover a flexible leather tube, about six or seven inches long, is fixed, with a mouth-piece of wood or ivory. In the cover there is a valve fixed, which opens and shuts the communication between the upper and internal part of the inhaler and the external air. This valve is extremely simple: being formed only of a short tube descending forwards from the cover, and having a braciate a small hook upon which a ball of cork plays. When the mouth is applied to the end of the tube in the act of inspiration, the air rushes into the handle, and up through the body of warm water, and the lungs become, consequently, filled with hot vapour. In expiration, the mouth being still fixed to the tube, the breath, together with the steam on the surface of the water in the inhaler, is forced up through the valve in the same manner.
Injunctions issue out of the courts of equity in several instances. The most usual injunction is to stay proceedings at law; as, if one man brings an action at law against another, and a bill is brought to be relieved either against a penalty, or to stay proceedings at law, or some equitable circumstances, of which the party cannot have the benefit at law. In such case the plaintiff in equity may move for an injunction either an attachment, or praying a demurrer, or praying a further time to answer; for it being suggested in the bill that the suit is against conscience, if the defendant is in contempt for not answering, or praying time to answer, it is contrary to conscience to proceed at law in the mean time; and therefore an injunction is granted of course; but this injunction only stays execution touching the matter in question; and there is always a clause giving liberty to call for a plea to proceed to trial, and for want of which to obtain judgment; but execution is stayed till answer, or farther order. 3 Bac. Abr. 173.

When a bill in chancery is filed in the office of the six clerks, if an injunction is prayed therein, it may be had, at various stages of the cause, to the circumstances of the case. If the bill is to stay execution upon an oppressive judgment, and the defendant does not put in his answer within the time allowed by the rules of the court, an injunction will issue; and when the answer comes in, the injunction can only be continued upon a sufficient ground appearing from the answer itself. But if an injunction is wanted to stay waste, or other injuries of the plaintiff, the court may make him file the bill, and a proper answer supported by affidavits, the court will grant an injunction immediately; to continue till the defendant shall make some further order, or hearing it, and when the answer comes in whether it shall then be dissolved, or continued till the hearing of the cause, is determined by the court upon argument, drawn from considering the answer and affidavits together. 3 Bac. 433.

The methods of dissolving injunctions are various; when the answer comes in, and the party has proved his content, by paying the costs of the attachment, if there is one; he obtains an order to dissolve nisi, and serves it on the plaintiff's clerk in court; this order takes notice of the defendant's having fully answered the case of the suing party; and when the whole estate thereof, and being regularly served, the plaintiff must shew cause at the day; or the defendant's counsel, where there is no probability of shewing cause, may move to make the order absolute, unless cause, sitting the court. 3 Bac. Abr. 177.

If the plaintiff who has an injunction die pending the suit, in strictness the whole proceedings are abated, and the injunction with it; but the court may, if they think fit, not take out execution without special leave of the court; he must move the court for the plaintiff to revive his suit within a limited time, or the injunction to stand dissolved; and if the defendant does not do this within the time, then the suit is not revived, the party takes out execution. There are some instances where a plaintiff may move to revive his injunction; but that rarely happens, so it is rarely granted, especially where the injunction has been before dissolved: but where a bill is dismissed, the injunction and every thing else are gone, and execution may be taken out the next day. 3 Bac. Abr. 178.

INJURY, an injury to a man's person or goods. The law will suffer a private injury rather than a public evil; and the act of God or the law does injury to none. 4 Rawle, 129.

INK. There are two principal kinds of ink, writing and printing ink.

Writing-ink. When an infusion of gallnuts some solution of sulphate of iron (green copperas) is added, a very dark blue precipitate takes place.

Printing-ink. A black paint, composed of lamp-black and linseed or saet oil boiled, so as to acquire considerable consistence and tenacity. The art of preparing it is kept a secret; but the obtaining good lamp-black appears to be the chief difficulty in making it. The ink used by copper-plate printers differs from the last only in not being so much boiled, and the black which is used being Frankfort black.

Sympathetic inks are such as do not appear after they are written with, but which may be made to appear at pleasure. When dry, no writing will be visible. When you want to make it appear, wet the paper with a solution of equal parts of gum arabic and water, and the letters will immediately appear of a brown colour. Even exposing the writing to the vapours of these solutions will render it apparent.

2. Write with a solution of gold in aqua regia, and let the paper dry gently in the shade. Nothing will appear; but draw a sponge over it wetted with a solution of this in aqua regia, the writing will immediately appear of a purple colour.

3. Write with an infusion of galls, and when you wish the writing to appear dip it into a solution of green vitriol; the letters will appear black.

4. With diluted sulphuric acid, and...
nothing will be visible. To render it so, hold it to the fire, and the letters will instantly appear black.

5. If on emons, or onions, a solution of sal ammoniac, green vitriol, &c. will answer the same purpose, though not so easily, nor with so little heat.

6. Green sympathetic ink. Dissolve cobalt in nitric acid, and write with the solution. The letters will be invisible till held to the fire, when they will appear green, and will disappear completely again when removed into the cold. In this manner they may be made to appear and disappear at pleasure.

A very pleasant experiment of this kind is to make a drawing representing a winter scene, in which the trees appear void of leaves, and to paint the leaves on with this sympathetic ink; then, upon holding the drawing near to the fire, the leaves will begin to appear in all the verdure of spring, and will very much surprise those who are not in the secret.

Dissolve sympathetic ink. Dissolve cobalt in nitric acid; precipitate the cobalt by potash; dissolve this precipitated oxide of cobalt in acetic acid, and add to the solution one-eighth of common salt. This will form a sympathetic ink, that, when cold, will be invisible, but will appear blue by heat.

Ink, removing stains of. The stains of ink on cloth, paper, or wood, may be removed by almost all acids; but those acids are to be preferred which are least likely to injure the texture of the stained substance. The nitric acid, diluted with five or six times its weight of water, may be applied to the spot, and, after a minute or two, may be washed off, repeating the application as often as may be found necessary. But the vegetable acids are attended with less risk, and are equally effectual. A solution of the oxalic, citric (acid of lemons), or tartaric acids, in water, may be applied to the most delicate fabrics without any injury to the fabric, and the same solutions will discharge writing, but not printing-ink. Hence they may be employed in cleaning books which have been defaced by writing on the margin, without injuring the text. If the juice of an orange is laid upon a Stuart's ink-stain, the stain will be removed, but not so easily as the concrete acid of lemons, or citric acid.

INNS AND INNKEEPERS. Common inns were instituted for passengers; and the duty of innkeepers extends chiefly to the entertaining and harbouring of travellers, finding them victuals and lodging, and securing the goods and effects of their guests; and therefore if one who keeps a common inn refuses to receive a guest as a guest into his house, or to find him victuals or lodging, upon his tendering a reasonable price for the same, he is not only liable to render damages for the injury in an action on the case, but to pay the damages of the party grievous, but also may be indicted and fined at the suit of the king.

Dyer, 158.

In return for such responsibility the law allows him to retain the horse of his guest until paid for his keep; but he cannot retain such horse, unless the owner, though he may retain his goods for such bill, neither can he detain one horse for the food of another. 1 Bulst. 267, 247.

An innkeeper, however, is not bound to receive the horse, unless the master lodge there also. 2 Brow. 218.

Necessities in law bound to furnish provisions unless paid beforehand. 9 Co. 87.

If an innkeeper makes out unreasonable bills, he may be indicted for extortion; and if either he or any of his servants knowingly sell bad wine or bad provisions, they will be responsible in an action of debt.

Any person may set up a new inn, unless it is inconvenient to the public, in respect of its situation, or its increasing the number of inns, not only to the prejudice of the public, but also to the hindrance and prejudice of other ancient and well-governed inns; for the keeping of an inn is no franchise, but a lawful trade, open to every subject, and therefore there is no need of any licence from the king for that purpose. 2 Rolbr. 84.

An innkeeper is distinguished from other trades in that he cannot be a bankrupt; for though he buys provisions to be spent in his house, yet he does not properly sell them, but sells them as fast as he can; therefore his expenses will not, in the same manner, appear as he thinks reasonable; and the attendance of his servants, furniture of his house, &c. are to be considered; and the statutes of bankruptcy only mention merchants that use to buy and sell goods for others; he does not; he lives by buying and selling; but the contracts with innkeepers are not for any commodities in specie, but they are contracts for house-room, trouble, accommodation, and necessaries, and therefore coincide within the design of such words, since there is no trade carried on by buying and bartering commodities. 1 Joes. 437.

But where an innkeeper is a chapman also, and buys and sells, he may, on that account, be a bankrupt, though not barely as an innkeeper, and this has been frequently seen. 7 Vin. 567.

Innkaters are clearly chargeable for the goods of guests stolen or lost out of their inns, and this without any contract or agreement for that purpose; for the law makes them liable in respect of the reward, as also in respect of their being places appointed and allowed by law for the accommodation and security of travellers and traders. Dyer, 205.

But if a person comes to an innkeeper, and desires to be entertained by him, which the innkeeper refuses, because his house is already full; whereupon the party says he will shift among the rest of his guests, and there he is robbed, the host shall not be charged. Dyer, 158.

If a man comes to a common inn to harbour, and desires that his horse may be put to grass, and the host gives him to grass accordingly, and the horse is stolen, the host shall not be charged; because by law the host is not bound to answer for any thing out of his inn, but only for those that are in hospital with him. 8 Co. 31 d.

Innkeepers may detain the person of the guest who eats, or the horse which eats, till payment, and he may do without any agreement for that purpose; for men that get their livelihood by entertainment of others, and who are not charged with the keeping the goods of others, they have a right to detain the property of another, in case of non-payment, nor make such disadvantageous and impedient a supposition, that they shall not be paid; and therefore the law annexed such a condition without the agreement of the parties. Rolbr. 83.

By the custom of London and Exeter, if a man commits a horse to a hostler, and he eats out of the price of his head, the better may take him as his own, upon the reasonable apprehension of four of his neighbours; but the innkeeper has no power to sell the horse, by the general custom of the whole kingdom.

But it has been held, that though an innkeeper in London may, after long keeping, have the horse appraised, and sell him; yet when he has, in such case, had him appraised, he cannot justify the taking him to himself, at the sole expense it was appraised at. 1 Vin. 233.

INNS OF COURT, are so called, because the students therein study the law, to enable them to practise in the courts at Westminster, and also because they use all other gentles of life, and may render them better qualified to serve the king in his court. Fortesc. c. 49.

INNOMINATA OSSA. See Anatomy.

INNUENDO, is a word used in declarations and law proceedings, to ascertain a person's name or name of the named before; as to say he (innuendo the plaintiff) did so and so, when there was mention before of another person.

Innuendo may serve for an explanation where there is plaintiff matter, but never for a new charge; and it may signify what is already expressed, but cannot add or enlarge the importance of it. 2 Salk. 513.

INOCULATION. See Medicine.

INOCULATION, or Barking. See Grafting.

INOLITHUS, in mineralogy, a stone consisting of carbonate of lime, carbonic acid gas, and a little iron; entirely soluble in nitric acid with effervescence; fibrous, parasyte, soft, lightish, breaking into indeterminate fragments. There are several species of the Bollanlitous there are three varieties; the nat'sar, so called from its rich satiny lustre, is found in Russia, Poland, Germany; Satine, and Willow, the fibres straight and a little curved. It is found also about a mile from Abston in Cumberland, washed by the river Tyne, near the level of its bed; colour white, with sometimes a rosy tinge from a diffused oxide of iron, and transmits light from the edges, or in thinner pieces: fracture in the direction of the striæ fibrosum, straight or curved; specific gravity 2.17, contains carbonic acid 47, carbonate of lime 50, water of crystallization 2, and a small portion of iron.

INORDINATE PROPORTION, is where there are three magnitudes in one rank, and three others proportion to them in another, and you compare them in a different order. Thus suppose the numbers in one rank to be 2, 3, 9; and those of the other rank 8, 24, 36; which are compared in a different order, viz. 2; 3: 24: 36; and 3: 9: 8: 24. Then rejecting the mean terms of each rank, you conclude 2: 9: 36: 81; and...
In the church of Rome, a tribunal in several Roman-catholic countries, erected by the popes for the examination and punishment of heretics.

This court was founded in the 12th century by Innocent III. and his followers, who were sent by pope Innocent III. with orders to excite the catholic princes and people to extirpate heretics, to search into their number and quality, and to transmit a faithful account thereof to Rome. Hence they were called inquisitors; and this gave birth to the formidable tribunal of the inquisition, which was received in all Italy, and the dominions of Spain, except the kingdom of Naples, and the Low-countries. See Act of Faith.

INROLLMENT, in law, is the registering, recording, or entering in the rolls of the chancery, king's-bench, common-pleas, or exchequer, or by the clerk of the peace in the records of the quarter-sessions, of any lawful act; a statute or recognizance acknowledges a deed of bargain and sale of land, and the like; but the inrolling a deed does not make it a record, though it thereby becomes a deed recorded; for there is a difference between a matter of record, and a thing recorded to be kept in memory; a record being the entry in parchment of judicial matters connected with court of record, and whereof the court takes notice, whereas an inrolling of a deed is a private act of the parties concerned, of which the court takes no cognizance at the time of doing it, although the court permits it. 2 Litt. Abr. c. 9.

By Stat. 27 H. VIII. c. 16, no lands shall pass, whereby any estate of inheritance or freedom shall take effect, or any use thereof be made, by reason only of any bargain and sale thereof, except the bargain and sale be made by writing indented, sealed, and within six months enrolled in one of the king's courts of record, Westminster, or elsewhere within the county where the lands lie, before the clerk of the peace, and one or more justices. But by 5 Eliz. c. 26, in the counties palatine, they may be enrolled at the respective courts there appointed.

Every deed before it is enrolled is to be acknowledged to be the deed of the party, before a master of chancery, or a judge of the court wherein it is enrolled, which is the officer warranting for inrolling the same; and the inrolling of a deed, if it is acknowledged by the grantor, shall be a good proof of the deed itself when tried. 2 Litt. Abr. 69.
very small circles may be nicely drawn with them, as they are to be conveniently moved and turned about in the hand, by a short steel shaft.

III. Of the drawing pen and pencil. The drawing-pen is only the common steel pen at the end of a brass rod, or shaft, of a convenient length, to be held in the hand for drawing all kinds of straight lines by the edge of a rule. The shaft or handle has a screw in the middle part; and, when unscrewed, there is a fine steel round pin or point, by which you make as nice a mark or drawing as you please for terminating your lines in curious draughts.

The black-lead pencil, if good, is of frequent use for drawing straight lines, and for supplying the place of the drawing-pen, where lines (as in ladies) are necessary; it is also often substituted for the common pen in writing, figuring, &c. Because in all cases, if what be drawn with it be not right, or does not please, it may be very easily rubbed out with a piece of crumb bread, and the whole redrawn.

IV. Of the protractor. The protractor is a semicircle of brass, A B D, divided into 180 degrees, and numbered each way from every other to the semicircle by 10°, 20°, 30°, &c. The central line is the external edge of the protractor’s diameter, or straight side, sloped down to the under side, and is generally called a central edge; in the middle with which to draw a line, or line, or line, in the centre, for the side of the protractor. One or other of the protractors or the other, or both, is used in practice.

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V. Of the parallel ruler. The parallel ruler is so called, because as it consists of two straight rules, connected together by two brass bars, yet so as to admit a very free motion to each: the one rule must always move parallel-wise to the other, that is, one rule will be every where equidistant from the other, and by this means it draws accurately parallel to one or more lines parallel to, or equally distant from, any line proposed. The manner of doing which is thus:

Let it be required to draw a straight line parallel to a given line A B, and at the dis-

tance AC, from it. (fig. 5.) First open the rules to a greater distance than A C, and place the edge of the ruler exactly on the line A B; then, drawing the other rule (fig. 6) firmly on the paper, you move the upper line down from A to the point C, by which (holding it fast) you draw the line C D, which will be parallel to the given line A B.

Many very useful problems in the mathematics are performed by this instrument, of which the following are examples.

1. Let it be required to find a fourth proportional to three right lines given, A B, B C, and A D (fig. 6). To do this, draw the lines A C, A E, marking any angle at pleasure. Upon A C with the compasses set off the lines A B and B C; and upon A E set off the line A D; join D B, and parallel to it draw E C, then will D E be the fourth proportional required. For A B : B C : : A D : D E.

Again, suppose it required to divide any line, say A B, into line A B, and D/E (fig. 7). To do this, join the extremities of each line A B, and parallel to it draw E F, through the given points D E F in the line A C; and by these lines the line A B will be divided exactly similar to the line A C.

The parallel ruler is seldom put into a case of instruments, but those of the larger and better sort; being generally sold by itself, in various sizes, from 6 inches to 2 feet in length.

To the plain scale. The lines generally drawn on the plain scale are these following:

<table>
<thead>
<tr>
<th>Lines of equal parts</th>
<th>Marked</th>
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<tbody>
<tr>
<td>I. Lines of equal parts</td>
<td>E. P.</td>
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<tr>
<td>II. Lines of equal parts</td>
<td>Chords</td>
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<tr>
<td>III. Lines of equal parts</td>
<td>Rbms.</td>
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<tr>
<td>IV. Lines of equal parts</td>
<td>Rms.</td>
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<tr>
<td>V. Lines of equal parts</td>
<td>Tangents</td>
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<td>VI. Lines of equal parts</td>
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<td>VII. Lines of equal parts</td>
<td>Half-Tangents</td>
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<tr>
<td>VIII. Lines of equal parts</td>
<td>Long sine</td>
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<tr>
<td>IX. Lines of equal parts</td>
<td>Latitude</td>
</tr>
<tr>
<td>X. Lines of equal parts</td>
<td>H.</td>
</tr>
<tr>
<td>XI. Lines of equal parts</td>
<td>Inclinations</td>
</tr>
</tbody>
</table>

Of the lines of equal parts. Lines of equal parts are of two sorts, viz. simply divided, and diagonally divided, Plate 3.

1. Simply divided, there are three parallel to one another, at unequal distances (fig. 8), and of any convenient length; divide this length into what number of equal parts is thought necessary, allowing some certain number of these parts so much, as 2, 3, 4, 5, &c., which divisions distinguish by lines drawn across the three parallels. Divide the left-hand division into 10 equal parts, which distinguish by lines drawn across the other parallels but for distinction’s sake, let the fifth division be somewhat longer than the others; and it may not be inconvenient to divide the same left hand division equal parts, which, when laid down on the upper parallel line, having the third, sixth, and ninth divisions distinguished by longer strokes than the rest, whereas that at the sixth division make the longest.

There are, for the most part, several of these simply divided scales put on rulers, one above the other, with numbers on the left hand, shewing in each scale, how many equal parts an inch is divided into; such as 20, 25, 30, 35, 40, 45, &c. and are servedly used, as the plan to be expressed should be larger or smaller.

The use of these lines of equal parts, is to lay down any line expressed by a number of two places or denominations, whether decimally or duodecimally divided; as leagues, miles, chains, poles, yards, feet, inches, &c., to the number of parts, one with each part; thus, if each of the divisions be reckoned 1, as 1 league, mile, chain, &c. then each of the subdivisions will express the part thereof; and if each of the large divisions be called 10, then each small one will be 1; and if the large divisions be 100, then each small one will be 10, &c.

Therefore to lay off a line 8, or 87, or 870 parts, let them be leagues, miles, chains, &c. set one point of the compasses on the ist part of the large divisions, counting from the left hand towards the right, and open the compasses, till the other point falls on the 7th of the small divisions, counting from the right hand towards the left, then are the points of the line of 8, or 87, or 870 leagues, miles, chains, &c. and bears such proportion in the plan, as the line measured does to the thing represented.

But if a length of feet and inches was to be expressed, the same large divisions may represent the feet, and the rest of the inches may be taken from the compasses, as 7 or 87 or 870 leagues, miles, chains, &c. and the like is to be understood of any other dimensions.

2. Diagonally divided. Draw eleven lines parallel to each other, and at equal distances; divide the upper of these lines into such a number of equal parts, as the scale to be expressed is intended to contain; and from each of these divisions draw perpendiculars through the eleven parallels (fig. 9); then the lines from the first of these divisions into 10 equal parts, both in the upper and lower lines; then each of these subdivisions may be also subdivided into ten equal parts, by drawing diagonal lines; viz. from the 10th below, to the ninth above; from the ninth below to the eight above; from the eighth below to the seventh above, &c. till from the first below to the 0th above, so that by these means one of the primary divisions on the scale will be divided into 100 equal parts.

There are generally two diagonal scales laid on the same plane or face of the ruler, one being commonly half the other (fig. 9); the use of the divided scale is much the same with the simple scale; all the difference is, that a plan may be laid down more accurately by it; because in this, a line may be taken of three denominations, whereas from the former, only one could be taken.

Now from this construction it is plain, if each of the primary divisions represent 1, each of the first subdivisions will express $\frac{1}{10}$ of 1; and each of the second subdivisions (which are taken on the diagonal lines, counting from the top downwards) will express $\frac{7}{10}$ of
the former subdivisions or a 100th of the primary divisions; and if each of the primary divisions express 10, then each of the first subdivisions will express 1, and each of the 2d, 1/10; and if each of the primary divisions represent 100, then each of the first subdivisions will be 1, and each of the 2d will be 1, &c., D.

Therefore to lay down a line, whose length is expressed by $347\times 37\frac{a}{7}$ or $3\times 7\frac{a}{7}$ wheaters, miles, chains, &c.

On the diagonal line, joined to the 4th of the first subdivisions, count 7 downwards, reckoning the distance of each parallel 1; there set one point of the compasses, and extend the other, till it falls on the intersection of the third primary division with the same parallel in which the other foot rests, and the compasses will then be opened to express a line of $347\times 37\frac{a}{7}$ or $3\times 7\frac{a}{7}$ &c.

Those who have frequent cause to use scales, perhaps will find, that a ruler with the 20 following scales on it, viz. 10 on each face, will suit more purposes than any set of simply divided scales hitherto made public, on one rule.

One side.—The divisions to an inch. 10, 71, 14, 185/4, 15, 165, 18, 20, 22, 25.

Other side—The divisions to an inch. 23, 32, 36, 40, 45, 50, 56, 60, 70, 85, 100.

The left-hand primary division, to be divided into 10 and 15 parts; for these subdivisions are of great use in drawing the parts of a fortress, and of a piece of cannon.

It will here be convenient to shew, how any plan expressed by right lines and angles, may be delineated by the scales of equal parts, and the protractor. Suppose three adjacent things, in any right-lined triangle being given, to form the plan thereof.

**Example.** Let ABC (fig. 10) be a triangular field, the side $\angle B = 327$ yards; $AC = 208$ yards; and the angle at $A = 44\frac{a}{4}$ degrees.

**Construction.** Draw a line AB at pleasure; then from the diagonal scale take 327 between the points of the compasses, and lay it from A to B; set the centre of the protractor to the point A, lay off 44\frac{b}{4} degrees, and by that mark draw AC; take with the compasses from the same scale 208, lay it from A to C, and join C B; so shall the parts of the triangle ABC, in the plan, bear the same proportion to each other, as the real parts in the field do.

The side C B may be measured on the same scale from which the sides A B, A C, are taken; and the angles at B and C may be measured by applying the protractor to them.

If two angles and the side contained between them were given.

Draw a line to express the side (as before); at the ends of that line, point off the angles; as observed in the field; lines drawn from the ends of the given line through those marks, shall form a triangle similar to that of the field.

Five adjacent things, sides and angles, in a right-lined quadrilateral, being given, to lay down the plan thereof, fig. 11.

**Example.** Given $\angle A = 70^\circ$; $AB = 295$ links; $\angle B = 115^\circ$; $BC = 599$ links; $\angle C = 115^\circ$.

Vol. II.

**INSTRUMENTS.**

**Construction.** Draw A D at pleasure; from A draw A B, so as to make with A D an angle of 120°; make $AB = 215$ (as above the scales); from B, draw BC, to make with $AB$ an angle of 115°; make $BC = 599$; from C, draw CD, to make with $CB$ an angle of 115°; and by the intersection of $CD$ with $AD$, a quadrilateral will be formed similar to the figure in which such measures could be taken as are expressed in the example.

If three of the things were sides, the plan might be formed with equal ease.

Following the same method, a figure of many more sides may be delineated; and in this manner, or some other like to it, surveyors make their plans or surveys.

The remaining lines of the plain scale are thus constructed.

Describe a circumference with any convenient radius, and draw the diameters fig. 12 A B, D E; make $A D$, $B E$, right angles to each other; continue $BA$ at pleasure towards F; through D, draw D G parallel to $BF$; and draw the chords B D, B E, A D, A E. Circumscribe the circle with the chords $BH$, whose sides H M, M N, shall be parallel to A B, B D.

1. **To construct the line of chords.** Divide the arc A D into 90 equal parts: mark the 10th divisions with the figures 10, 20, 30, 40, 50, 60, 70, 80, 90; on D, as a centre, take the divisions of the quadrant arc, to the chord A D, which marked with the figures corresponding, will become a line of chords.

Note. In the construction of this, and the following scales, only the primary divisions are drawn; the intermediate ones are omitted, that the figure may not appear too much crowded.

2. **The line of rhumbs.** Divide the arc B E into 8 equal parts, which mark with the figures 1, 2, 3, 4, 5, 6, 7, 8, and divide each of those parts in right angles to each other; continue $BA$, as a centre, transfer the divisions of the arc to the chord B E, which marked with the corresponding figures, will be a line of rhumbs.

3. **The line of sines.** Through each of the divisions of the arc A D, draw right lines parallel to the radius $AC$; and C D will be divided into a line of sines which are to be numbered from C to D for the right sines, and from D to C for the versed sines. The versed sines may be continued to 180 degrees by laying the divisions of the radius C D, from C to E.

4. **The line of tangents.** A ruler on A, and the several divisions of the arc A D, will intersect the line D G, which will become a line of tangents, and is to be figured from D to G, with 10, 20, 30, 40, &c.

5. **The line of secants.** The distances from the centre C to the divisions on the line of tangents being transferred to the line C F from the centre C, will give the divisions of the line of secants, which must be numbered from A towards F, with 10, 20, 30, 40, &c.

6. **The line of half-tangents (or the tangents of half the arcs).** A ruler on E, and the several divisions of the arc A D, will intersect the radius C A, in the divisions of the semi or half tangents; mark these with the corresponding figures of the arc A D.

The semitangents on the plane scales are generally continued as far as they can be laid out; but the divisions beyond 90° are found by dividing the arc A E like the arc A D, then laying a ruler by E, and these divisions of the arc A E, the divisions of the semitangents above 90 degrees will be obtained on the line C A continued.

7. **The line of longitude.** Divide A H into 60 equal parts; through each of these divisions, parallels to the radius A C, will intersect the arc A E, in as many points; from E as a centre, the divisions of the arc A E, being transferred to the chord A E, will give the divisions of the line of longitude.

The points thus found on the quadrantal arc, taken from A to E, belong to the sides of the equally increasing seamanary parts of the radius; and those arcs reckoned from E, belong to the cosines of those seamanary parts.

8. **The line of latitude.** A ruler on A, and the several divisions of the sines of C D, will intersect the arc A B, in as many points; on B as a centre, transfer the intersections of the arc A B, to the right line B D; number the divisions from B to D, with 10, 20, 30, &c. to 90; and B D will be a line of latitude.

9. **The line of hours.** Bisect the quadrantal arc A B; D, E; in a, b; divide the quadrantal arc a b into 6 equal parts (which gives 15 degrees for each hour); and each of these into 4 others (which will give the quarters). A ruler on C, and the several divisions of the arc a b, will intersect the line M N in the hour, &c. points, which are to be marked as in the figure.

10. **The line of inclinations of meridians.** Bisect the arc A E in c; divide the quadrantal arc a c into 90 equal parts; lay a ruler on C and the several divisions of the arc a c, and the intersections of the line C M will be the divisions of a line of inclinations of meridians.

**Of the sector.** A sector is a figure formed by two radii of a circle, and that part of the circumference comprehended between the two radii.

The instrument called a sector, consists of two flat rulers moveable round on an axis or joint; and from the centre of this joint several scales are drawn on the faces of the rulers.

The two rulers are called legs, and represent the radii of a circle; and the middle of the joint expresses the centre.

The scales generally put on sectors, may be distinguished into single, and double.

The single scales are such as are commonly put on plain scales, and from whence distances or distances are taken, as have been already directed.

The double scales are those which proceed from the centre; each scale is laid twice on the same face of the instrument, viz. once on each leg: from these, distances are to be taken, when the legs of the instrument are in an angular position, as will be shewn hereafter.
The scales of lines, chords, sines, tangents, rhumbs, latitudes, hours, longitude, incl. merid. may be used, whether the instrument is shut or open, each of these scales being contained on one of the legs only.

The scales of inches, decimals, logarithms, sines, tangents, rhumbs, latitudes, hours, longitude, inclin. Merid. are used for similar rules, and are to be used with the sector quite opened, part of each scale lying on both legs.

The double scale of lines, chords, sines, and tangents, or that of which the radius is a degree, are all of the same radius or length; they begin at the centre of the instrument, and are terminated near the other extremity of each leg; viz. the lines at the division 10, the chords at 60, the sines at 90, and the tangents at 45; the remainder of the tangents, or those above 45 degrees, are on other scales beginning at 4 of the length of the former, counted from the centre, where they are marked with 45, and run to about 75°.

Each double scale, one being on each leg and proceeding from the centre, makes an angle; and in an equal angular position are all the double scales, whether of lines, or of chords, or of sines, or of tangents to 45 degrees.

And the angles made by the scales of upper tangents, and of secants, are also equal; and sometimes these angles are made equal to those made by the other double scales.

The scales of polygons are put near the inner edge of the legs: their beginning is not so far removed from the centre, as the 60 on the chords is: where these scales begin, they are marked with 4, and from thence are figured backwards, or towards the centre, to 12.

From this disposition of the double scales, it is plain, that those angles which were equal to each other, while the legs of the sector were close, will still continue to be equal, although the sector be opened to any distance it may admit.

We shall now illustrate the nature of this instrument by examples.

Let CL, CL, (fig. 13) be the two lines of lines upon the sector, opened to an angle LCL; join the divisions 4 and 4, 7 and 7, 10 and 10, by the dotted lines a, b, c, d, E L. L. Then by the nature of similar triangles, it is C L to C B, as L L to a b; and C L to C d, as L L to e d; and therefore a b is the same part of L L as C B is of C d. Consequently, if L L be 10, then a b will be 4, and c d will be 7 of the same parts.

And hence, though the lateral scale C L be fixed, yet a parallel scale L L, is obtainable at pleasure; and therefore though the lateral radius is of a determined length in the lines of chords, sines, tangents, and secants, yet the parallel radius may be had of any size you want, by means of the sector, as far as its length will admit; and all the parallel sines & c. peculiar to it, as will be evident by the following examples in each pair of lines.

Ex. 1. In the lines of equal parts. Having 3 numbers given, 4, 7, 10, to find out a 4th proportional. To do this, take the lateral extent of 16 in the line C L, and apply it parallel-wise, from 4 to 4, by a proper opening of the sector; then take the parallel distance from 7 to 2 in your compasses, and on applying one foot in C, the other will fall on 28 in the line of lines C L, and is the number required; for 4: 7: 16 = 28.

Ex. 2. In the lines of chords. Suppose AB required to lay off an arc of a circle, equal to 33 degrees; then with any convenient opening of the sector, take the extent from 60 to 60, and with it (as radius) on the point C describe the arch A D indefinitely; then in the same opening of the sector take the parallel distance from 33 degrees to 33 degrees, and set it from A to B in the arch A D and draw A B, and it makes the angle at C required.

Ex. 3. In the lines of sines. The lines of sines, tangents, and secants, are used in conjunction with the lines of lines in the solution of all the cases of plain trigonometry; thus let there be given in the triangle A B C, (fig. 14) the side A B = 230°, and the angle A B C = 36° 30'; to find the side A C. Here the angle at C is 53° 30'. Then take the lateral distance 230, from the line of lines, and make it a parallel from 53° 30' to 53° 30' in the line of sines; then the parallel distance between 53° 30' in the same lines, will reach laterally from the centre to 170, 19 in the line of lines for the side A C required.
extent between the first and second terms, you place one foot of the compasses on the third term, then turning the compasses about, the other foot will fall on the fourth term sought.

Thus in example 1, of the three given numbers 4, 7, and 10, if you take the extent from 4 to 7 in the compasses, and place one foot in 10, the other will fall on 28 as the answer, in the line of numbers marked a.

Again, the artificial lines of numbers and sines are used together in plain trigonometry, as in example 3, where the two angles David and the side given; for here, if you take the extent of the two angles 35° 30' and 30° 30' in the line of sines marked a, then placing one foot upon 230 in the line of numbers a, the other will reach to 170 10, the answer.

Also the lines of numbers and tangents are used conjointly, as in the example 4, for take in the line of tangents t, the extent from 45° (radius) to 30° 30', that will reach from 230 17 5 to 176, the answer.

Lastly, the artificial lines of sines and tangents are used together in the analogies of spherical triangles.

This example 6 is solved by taking in the line of numbers, the distance from 60 to 90° (radius) to 30° 15', then that in the line of tangents, will reach from 42° 34' to 28° 30', the answer required.

We shall only further observe that each pair of seventh lines contain the same angle, viz. 6 degrees in the common G-inch sector; therefore to open these lines to any given angle, as 35° for instance, you have only to take 35° literally from the line of chords, and apply it parallelly, from 60 to 60, then will the sides or edges of the sector contain the same angle of 35 degrees.

Of proportional compasses. Though this sort of compasses does not pertain to a common case of instruments, yet a short account of their nature and use may not be unacceptable to those who are not acquainted with them. They are made of two parts, sides of brass, which lie upon each other, so near as to appear one when they are shut.

These sides easily open, and move about a centre, which is itself moveable in a hollow canal cut through the greatest part of their length. To this centre on each side is affixed a sliding piece of a small length, with a fine line drawn on it serving as an index, to be set against other lines or divisions placed upon the compasses. These lines are:
1. A line of lines.
2. A line of superficies, areas, or plans.
3. A line of solids.
4. A line of circles, or rather of polygons to be inscribed in circles.

These lines are all unequally divided, the three first from 1 to 10, the last from 6 to 20; their uses are as follow:

By the line of lines you divide a given line into any number of equal parts; for by placing the index against 1, and screwing it fast, if you open the compasses, then the distance between the points at each end will be equal. If you place the index against 2, and open the compasses, the distance between the points of the longer legs will be twice the distance between the shorter ones; and thus a line is bisected, or divided into an infinite number of equal parts.

If the index be placed against 3, and the compasses opened, the distances between the points will be as 3 to 1, and so a line is divided into three equal parts; and so you proceed for any other number of parts under the compasses.

The numbers of the line of plans answer to the squares of those in the line of lines; for because superficies or plans are to each other, as the squares of their like sides, therefore the square of the plan of 2 is the line of plans; then the distance between the small points will be the side of a plan whose area is 1; but the distance of the larger points will be the like side of a plan whose area is 2, or twice as big. If the index be placed at 3, and the compasses opened, the distances between the points at each end will be the like sides of plans, whose areas are 1 to 3, and so of others.

The numbers of the line of solids answer to the cubes of those in the line of lines; because all solids are to each other as the cubes of their like sides or diameters; therefore, if the index be placed to No. 2, 3, 4, &c. in the line of solids, the lesser and larger points will be the like sides of solids, which are to each other as 1 to 2, 1 to 3, 1 to 4, &c. For example, if the index be placed at 10, and the compasses be opened, the distance will be the diameter of a bullet weighing 1 ounce, then the distance between the larger points will be the diameter of a bullet or globe of 10 ounces, or which is 10 times as big.

Lastly the numbers in the line of circles are the sides of polygons to be inscribed in a given circle, or by which a circle may be divided into those equal parts from 6 to 20.

Thus if the index be placed at 6, the points of the compasses at either end, when opened to the radius of a given circle, will contain the side of a hexagon, or divide the circle into 6 equal parts. If the index be placed against 7, and the compasses opened, so that the index is placed against the radius of the circle; then the shorter points will divide the circle into 7 equal parts for inscribing a heptagon. Again, placing the index to 8, and opening the compasses, the larger points will contain the radius, and the lesser points divide the circle into 8 equal parts, for inscribing an octagon or square. And thus you proceed for others.

Instruments, surgeon's. A case of pocket instruments for surgeons, which they ought always to carry about with them, contains lancets of different sizes; scissors fit for several uses; forceps, plain and furnished with teeth; incision-knives, straight and crooked; a spatula, probes, needles, &c. See Surgery.

Insurance, laws of. Insurance is regarded by the law as a contract between two or more parties; that on one paying a certain premium he shall be indemnified or insured against certain risks set forth in the policy. This is extremely convenient in commerce, but was made use of as a kind of gambling till the statute 14 Geo. III. c. 48, that no insurance shall be made on lives, or on any other event, wherein the parties concerned has no interest; that in all policies the name of such interested party shall be inserted, and nothing more shall be recovered thereon than the amount of the interest of the insured. This, however, does not extend to marine insurances. But as it was a common practice to take in large sums without possessing property on board, and which were called policies or insurances, interest or no interest, and of insuring the same goods several times over, it was enacted, that all insurances, interest or no interest, or without further proof of the interest than the policy, or by way of gaming, or without benefit of salvage to the insurer, should be void, except on privates, or on ships or goods from the Spanish or the enemy; and this was confirmed by the courts; and that no re-assurance shall be legal, unless the former insurer be insolvent or dead; and that in the East India trade the lender of money on bond, or at responderia, shall alone have a right to be indemnified for the money lent; and the borrower shall receive no indemnification or satisfaction from the surplus of his bottomry or responderia bond. No insurance can be made on any illegal voyage.

It is generally calculated in policies that the insurer shall not be answerable for any partial loss on certain articles, but on others less difficult to be preserved at sea, but liable to partial injuries, shall be liable for any partial loss, to the extent of the insured value. Thus, if the ship has been fired at, and all the cargo burned, the insurer shall be liable for those losses above three per cent. But he is liable on all losses, however small, called general average or losses occasioned by the ship's stranding; but this loss must be an immediate, not a remote, consequence of the stranding.

The commencement of the risk on the ship varies in most cases, and usually continues till the ship has been laid under her former anchor. Upon goods it commences when they are on board, and continues till they are removed or landed. The ship insured must be sound, and in every respect fit to bear the sea, and perform the voyage, and if the đevises from the usual course, and stops at places not usually stopped at, without a proper cause, the contract is void.

Insurance upon life is a contract by which the insurer, for a certain time, granted to the age, health, and profession of the person whose life is to be insured, engages that the person shall not die within a certain period, or if he do, the underwriter will pay a sum agreed upon to the person to whom the policy is granted.

Insurance against fire. The insurer undertakes, in consideration of a premium, to indemnify the insured against all losses by fire which he may sustain in his house or goods during the time mentioned in the policy.

Intaglio, precious stones on which are engraved the heads of great men, inscriptions, and the like; such as we frequently see set in rings, seals, &c.

INTEGER, in arithmetic, a whole number, in contradistinction to a fraction.

Intercalary, in chronology. See Dissextile, &c.

Intercommunion, in law, when the consuls of two towns are held together, and the inhabitants of both have, time out of mind, caused their cattle to feed promiscuously on them.

Intercostal. See Anatomy.

Interdict. See Censorship.
by which the church of Rome forbids the performance of divine service in a kingdom, province, town, &c. This measure has been frequently executed in France, Italy, and Germany; and in the year 1770 pope Alexander III. put all England under an interdict, forbidding all ordination or part of divine service, except bishops of dissenting confessions, and giving abolution to dying penitents.

In 1751, a sum of money, paid or allowed in the loan of some other sum, lent for a certain time, according to some fixed rate or proportion. The sum lent, and on which the interest is reckoned, is called the principal; and in any case where the interest is also to be paid on the same, the principal, a proportionately greater interest is usually paid. The current rate of interest is generally considered as the barometer of public credit; and its lowness is a sign almost intangible of the floorine condition of a state; it proves the increase of industry, and the free circulation of wealth, little inferior to a demonstration. In order to prevent individuals from taking unjust advantage, and from the necessities of other states, certain fixed rates have been found necessary in most countries to establish by law a fixed rate of interest for the use of money; this however must, in a great measure, depend on the current rate of interest prevailing; for if it is attempted to reduce by law the common rate of interest below the lowest ordinary market rate, the restriction will be sure to be evaded. This was the case in France, in 1760, when, although the legal rate of interest was reduced from five to four per cent, money continued to be lent at five per cent.

The first act of parliament for regulating the rate of interest in England was 37 Hen. VIII. c. 9, by which interest was fixed at 10 per cent.; before that time interest had usually been taken at higher rates. In 1552 an act was passed against usury, or taking any interest whatever for money lent; the impolicy and oppression of this measure soon became evident; and in 1571 the statute of Henry VIII. which fixed interest at 10 per cent., was revised. As the increase of the sum lent brought within the country, the rate of interest lowered; and in 1695 it was, by 21 James I. c. 17, reduced to eight per cent. The first positive law made in Scotland for fixing the rate of interest was in 1557, when an act was passed, by which the rate of interest was not for the future to exceed 10 per cent. In France, in 1601, Henry IV. issued an edict for reducing the public or national interest of money in that kingdom to six and a quarter per cent. In 1651 the interest of money in several parts beyond sea being lower than the legal interest in England, the Rump-parliament reduced the legal rate from eight to six per cent; and upon the Restoration it was confirmed by 12 Cha. II. c. 13. The last act of parliament for regulating the interest of money was 12 Ann. st. 2, c. 16, by which it was fixed at five per cent. per annum, the present legal rate; but although this is the utmost interest which can be taken for money lent in Great Britain, yet if a contract which carries interest which was made in a foreign country, our courts will direct the payment of interest according to the laws of the country in which the contract was made: thus American, Turkish, and Indian interest have been allowed, to the amount of even 12 per cent.

The rates which have been paid in Great Britain at different periods, for the current interest for money, are as follows:

<table>
<thead>
<tr>
<th>Year</th>
<th>3 per Cent.</th>
<th>5 per Cent.</th>
<th>6 per Cent.</th>
<th>8 per Cent.</th>
<th>10 per Cent.</th>
</tr>
</thead>
<tbody>
<tr>
<td>1735</td>
<td>45</td>
<td>56</td>
<td>68</td>
<td>80</td>
<td>90</td>
</tr>
<tr>
<td>1736</td>
<td>45</td>
<td>56</td>
<td>68</td>
<td>80</td>
<td>90</td>
</tr>
<tr>
<td>1737</td>
<td>45</td>
<td>56</td>
<td>68</td>
<td>80</td>
<td>90</td>
</tr>
<tr>
<td>1738</td>
<td>45</td>
<td>56</td>
<td>68</td>
<td>80</td>
<td>90</td>
</tr>
<tr>
<td>1739</td>
<td>45</td>
<td>56</td>
<td>68</td>
<td>80</td>
<td>90</td>
</tr>
<tr>
<td>1740</td>
<td>45</td>
<td>56</td>
<td>68</td>
<td>80</td>
<td>90</td>
</tr>
<tr>
<td>1741</td>
<td>45</td>
<td>56</td>
<td>68</td>
<td>80</td>
<td>90</td>
</tr>
<tr>
<td>1742</td>
<td>45</td>
<td>56</td>
<td>68</td>
<td>80</td>
<td>90</td>
</tr>
<tr>
<td>1743</td>
<td>45</td>
<td>56</td>
<td>68</td>
<td>80</td>
<td>90</td>
</tr>
</tbody>
</table>

In the United States of America, the lawful interest of money is 6 per cent. in most of the States; in a few it is 7 per cent.; in one it is 5 per cent. In Greece, the mean rate of interest is 10 per cent., and in other parts of Turkey nearly the same; in Persia 25 per cent.; and in the Mogul Empire 30 per cent. In these countries there is no fixed rate of interest, and the usual rate rests chiefly on the necessity of lending. In Sydney and the other English settlements in New South Wales, the rate of interest is fixed by an ordinance, dated 13th June, 1804; at 5 per cent, per annum.

Interest is distinguished into Simple Interest and Compound Interest.

**Interest, Simple,** is that which is reckoned on the principal only, at a certain rate for a year, and at a proportionately greater or less sum for a greater or less time; thus, if 50, is the rate of interest of 100 for a year, the interest for two years, 150, for three years, &c. In most computations, the interest the work is much shortened if the interest of 100 for a given term is known, as the interest of any other sum for the same term will then be found by only multiplying by the given sum. The interest of 100 for a year must be the same proportion as the interest of 100 to its principal; therefore, at 5 per cent., as 100 : 5 : 115 : 0.55; and thus:

The interest of One Pound for One Year,

<table>
<thead>
<tr>
<th>100</th>
<th>5 115</th>
<th>0.55</th>
</tr>
</thead>
<tbody>
<tr>
<td>5</td>
<td>0.50</td>
<td>0.55</td>
</tr>
<tr>
<td>4</td>
<td>0.40</td>
<td>0.45</td>
</tr>
<tr>
<td>3</td>
<td>0.30</td>
<td>0.35</td>
</tr>
<tr>
<td>2</td>
<td>0.20</td>
<td>0.25</td>
</tr>
<tr>
<td>1</td>
<td>0.10</td>
<td>0.15</td>
</tr>
</tbody>
</table>

The interest of One Pound for any number of years.

<table>
<thead>
<tr>
<th>Years</th>
<th>3 per Cent.</th>
<th>5 per Cent.</th>
<th>6 per Cent.</th>
<th>8 per Cent.</th>
<th>10 per Cent.</th>
</tr>
</thead>
<tbody>
<tr>
<td>10</td>
<td>3.25</td>
<td>4.55</td>
<td>5.85</td>
<td>7.15</td>
<td>8.45</td>
</tr>
<tr>
<td>20</td>
<td>6.50</td>
<td>9.10</td>
<td>11.70</td>
<td>14.30</td>
<td>16.90</td>
</tr>
<tr>
<td>30</td>
<td>9.75</td>
<td>14.25</td>
<td>18.75</td>
<td>23.25</td>
<td>27.75</td>
</tr>
<tr>
<td>40</td>
<td>13.00</td>
<td>19.50</td>
<td>26.00</td>
<td>32.50</td>
<td>39.00</td>
</tr>
<tr>
<td>50</td>
<td>16.25</td>
<td>24.75</td>
<td>33.25</td>
<td>41.75</td>
<td>49.25</td>
</tr>
<tr>
<td>60</td>
<td>19.50</td>
<td>29.25</td>
<td>41.75</td>
<td>53.25</td>
<td>64.75</td>
</tr>
<tr>
<td>70</td>
<td>22.75</td>
<td>33.80</td>
<td>47.25</td>
<td>58.75</td>
<td>70.25</td>
</tr>
<tr>
<td>80</td>
<td>26.00</td>
<td>38.30</td>
<td>53.75</td>
<td>65.25</td>
<td>76.75</td>
</tr>
<tr>
<td>90</td>
<td>29.25</td>
<td>42.80</td>
<td>59.25</td>
<td>70.75</td>
<td>83.25</td>
</tr>
<tr>
<td>100</td>
<td>32.50</td>
<td>47.30</td>
<td>64.75</td>
<td>77.25</td>
<td>90.25</td>
</tr>
</tbody>
</table>

As tables of Simple Interest are chiefly referred to, in order to find the interest or discount on bills of exchange, and as by far the greater number of bills which are discounted have been made at 6, the following table will answer most useful purposes; but those who have constant occasion to make such computations, will find much assistance from the extensive tables which have been computed by Smart, Thomson, King, Reid, and others. See also Discount.

**Table:**

Shewing the Simple Interest of One Pound, for any number of days, not exceeding 100, at 5 per Cent.

<table>
<thead>
<tr>
<th>Days</th>
<th>Amount.</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>0.001369</td>
</tr>
<tr>
<td>2</td>
<td>0.002739</td>
</tr>
<tr>
<td>3</td>
<td>0.004109</td>
</tr>
<tr>
<td>4</td>
<td>0.005479</td>
</tr>
<tr>
<td>5</td>
<td>0.006849</td>
</tr>
<tr>
<td>6</td>
<td>0.008219</td>
</tr>
<tr>
<td>7</td>
<td>0.009589</td>
</tr>
<tr>
<td>8</td>
<td>0.010959</td>
</tr>
<tr>
<td>9</td>
<td>0.012329</td>
</tr>
<tr>
<td>10</td>
<td>0.013699</td>
</tr>
<tr>
<td>11</td>
<td>0.015069</td>
</tr>
<tr>
<td>12</td>
<td>0.016439</td>
</tr>
<tr>
<td>13</td>
<td>0.017809</td>
</tr>
<tr>
<td>14</td>
<td>0.019179</td>
</tr>
<tr>
<td>15</td>
<td>0.020549</td>
</tr>
<tr>
<td>16</td>
<td>0.021919</td>
</tr>
<tr>
<td>17</td>
<td>0.023289</td>
</tr>
<tr>
<td>18</td>
<td>0.024659</td>
</tr>
<tr>
<td>19</td>
<td>0.026029</td>
</tr>
<tr>
<td>20</td>
<td>0.027399</td>
</tr>
<tr>
<td>21</td>
<td>0.028769</td>
</tr>
<tr>
<td>22</td>
<td>0.030139</td>
</tr>
<tr>
<td>23</td>
<td>0.031509</td>
</tr>
<tr>
<td>24</td>
<td>0.032879</td>
</tr>
<tr>
<td>25</td>
<td>0.034249</td>
</tr>
<tr>
<td>26</td>
<td>0.035619</td>
</tr>
<tr>
<td>27</td>
<td>0.036989</td>
</tr>
<tr>
<td>28</td>
<td>0.038359</td>
</tr>
<tr>
<td>29</td>
<td>0.039729</td>
</tr>
<tr>
<td>30</td>
<td>0.041099</td>
</tr>
</tbody>
</table>

The interest of any sum for any number of days contained in the table, is found by only multiplying the figures corresponding with the number of days by the sum of money, and if the interest of 120. for 61 days is required, the interest of one pound for 61 days, is, by the table, 0.008361, which multiplied by 120, gives 10, 0.48. If the given sum of money is divided and piece, they must be reduced to the decumal of a pound.
The interest for any greater number of days than are contained in the table, is easily found by means of $\frac{x}{y}$; by which it is required to find the interest of 100, for 135 days, the interest for 100 days by the table is 15838, and for 65 days 39011, which two sums added together, make 59329, or 2005, which multiplied by 30, gives 1484574, or 1483.174 d.

The year number of which in which a given sum will increase to another given sum in consequence of being improved at interest, is found by dividing the latter sum by the former, and in the sum table which is nearest to the quotient will show the term required.

Example. In what time will 1001 increase to 2001, if improved at 5 per cent.?

Divide 2001 by 100, and the number in the table nearest to 5 will the quotient, is 5000 in 8 years, which shows that 50 years is the answer.

### TABLE I.
Shewing the Sum to which $1$. Principal will increase, at 3 per Cent. Compound Interest, in any number of years not exceeding 100.

<table>
<thead>
<tr>
<th>Yrs.</th>
<th>Amount.</th>
<th>Yrs.</th>
<th>Amount.</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1.00</td>
<td>30</td>
<td>1.5533</td>
</tr>
<tr>
<td>2</td>
<td>1.05</td>
<td>31</td>
<td>1.6082</td>
</tr>
<tr>
<td>3</td>
<td>1.10</td>
<td>32</td>
<td>1.6638</td>
</tr>
<tr>
<td>4</td>
<td>1.15</td>
<td>33</td>
<td>1.7200</td>
</tr>
<tr>
<td>5</td>
<td>1.20</td>
<td>34</td>
<td>1.7772</td>
</tr>
<tr>
<td>6</td>
<td>1.25</td>
<td>35</td>
<td>1.8350</td>
</tr>
<tr>
<td>7</td>
<td>1.30</td>
<td>36</td>
<td>1.8936</td>
</tr>
<tr>
<td>8</td>
<td>1.35</td>
<td>37</td>
<td>1.9531</td>
</tr>
<tr>
<td>9</td>
<td>1.40</td>
<td>38</td>
<td>2.0134</td>
</tr>
<tr>
<td>10</td>
<td>1.45</td>
<td>39</td>
<td>2.0745</td>
</tr>
<tr>
<td>11</td>
<td>1.50</td>
<td>40</td>
<td>2.1365</td>
</tr>
<tr>
<td>12</td>
<td>1.55</td>
<td>41</td>
<td>2.1994</td>
</tr>
<tr>
<td>13</td>
<td>1.60</td>
<td>42</td>
<td>2.2632</td>
</tr>
<tr>
<td>14</td>
<td>1.65</td>
<td>43</td>
<td>2.3280</td>
</tr>
<tr>
<td>15</td>
<td>1.70</td>
<td>44</td>
<td>2.3936</td>
</tr>
<tr>
<td>16</td>
<td>1.75</td>
<td>45</td>
<td>2.4601</td>
</tr>
<tr>
<td>17</td>
<td>1.80</td>
<td>46</td>
<td>2.5275</td>
</tr>
<tr>
<td>18</td>
<td>1.85</td>
<td>47</td>
<td>2.5958</td>
</tr>
<tr>
<td>19</td>
<td>1.90</td>
<td>48</td>
<td>2.6649</td>
</tr>
<tr>
<td>20</td>
<td>1.95</td>
<td>49</td>
<td>2.7350</td>
</tr>
<tr>
<td>21</td>
<td>2.00</td>
<td>50</td>
<td>2.8061</td>
</tr>
</tbody>
</table>

In order to find the present worth of any sum which will be received at the end of a certain number of years, multiply the number in the table opposite to the term of years by the sum, and the product will be the answer.

### TABLE II.
Shewing the present Value of $1$, to be received at the end of any number of years, not exceeding 100; discounting at 3 per Cent. Compound Interest.

<table>
<thead>
<tr>
<th>Yrs.</th>
<th>Value.</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>0.9036</td>
</tr>
<tr>
<td>2</td>
<td>0.8163</td>
</tr>
<tr>
<td>3</td>
<td>0.7346</td>
</tr>
<tr>
<td>4</td>
<td>0.6575</td>
</tr>
<tr>
<td>5</td>
<td>0.5869</td>
</tr>
<tr>
<td>6</td>
<td>0.5215</td>
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<td>7</td>
<td>0.4625</td>
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<td>8</td>
<td>0.4101</td>
</tr>
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<td>9</td>
<td>0.3640</td>
</tr>
<tr>
<td>10</td>
<td>0.3224</td>
</tr>
<tr>
<td>11</td>
<td>0.2853</td>
</tr>
<tr>
<td>12</td>
<td>0.2536</td>
</tr>
<tr>
<td>13</td>
<td>0.2267</td>
</tr>
<tr>
<td>14</td>
<td>0.2043</td>
</tr>
<tr>
<td>15</td>
<td>0.1859</td>
</tr>
<tr>
<td>16</td>
<td>0.1699</td>
</tr>
<tr>
<td>17</td>
<td>0.1559</td>
</tr>
<tr>
<td>18</td>
<td>0.1438</td>
</tr>
<tr>
<td>19</td>
<td>0.1335</td>
</tr>
<tr>
<td>20</td>
<td>0.1250</td>
</tr>
</tbody>
</table>

In order to find the present worth of any sum which will be received at the end of a certain number of years, multiply the number in the table opposite to the term of years by the sum, and the product will be the answer.

**In INTEREST.**

The interest for any greater number of days than are contained in the table, is easily found by means of $\frac{x}{y}$; by which it is required to find the interest of 100, for 135 days, the interest for 100 days is 15838, and for 65 days 39011, which two sums added together, make 59329, or 2005, which multiplied by 30, gives 1484574, or 1483.174 d.

The number of years in which a given sum will increase to another given sum in consequence of being improved at interest, is found by dividing the latter sum by the former, and in the sum table which is nearest to the quotient will show the term required.

### TABLE.
Shewing the Sum to which $1$. Principal will increase, at 3 per Cent. Compound Interest, in any number of years not exceeding 100.

<table>
<thead>
<tr>
<th>Yrs.</th>
<th>Amount.</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1.00</td>
</tr>
<tr>
<td>2</td>
<td>1.05</td>
</tr>
<tr>
<td>3</td>
<td>1.10</td>
</tr>
<tr>
<td>4</td>
<td>1.15</td>
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<tr>
<td>5</td>
<td>1.20</td>
</tr>
<tr>
<td>6</td>
<td>1.25</td>
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<td>7</td>
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<td>1.75</td>
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<tr>
<td>18</td>
<td>1.85</td>
</tr>
<tr>
<td>19</td>
<td>1.90</td>
</tr>
<tr>
<td>20</td>
<td>1.95</td>
</tr>
</tbody>
</table>

In order to find the present worth of any sum which will be received at the end of a certain number of years, multiply the number in the table opposite to the term of years by the sum, and the product will be the answer.

### TABLE II.
Shewing the present Value of $1$, to be received at the end of any number of years, not exceeding 100; discounting at 3 per Cent. Compound Interest.

<table>
<thead>
<tr>
<th>Yrs.</th>
<th>Value.</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>0.9036</td>
</tr>
<tr>
<td>2</td>
<td>0.8163</td>
</tr>
<tr>
<td>3</td>
<td>0.7346</td>
</tr>
<tr>
<td>4</td>
<td>0.6575</td>
</tr>
<tr>
<td>5</td>
<td>0.5869</td>
</tr>
<tr>
<td>6</td>
<td>0.5215</td>
</tr>
<tr>
<td>7</td>
<td>0.4625</td>
</tr>
<tr>
<td>8</td>
<td>0.4101</td>
</tr>
<tr>
<td>9</td>
<td>0.3640</td>
</tr>
<tr>
<td>10</td>
<td>0.3224</td>
</tr>
<tr>
<td>11</td>
<td>0.2853</td>
</tr>
<tr>
<td>12</td>
<td>0.2536</td>
</tr>
<tr>
<td>13</td>
<td>0.2267</td>
</tr>
<tr>
<td>14</td>
<td>0.2043</td>
</tr>
<tr>
<td>15</td>
<td>0.1859</td>
</tr>
<tr>
<td>16</td>
<td>0.1699</td>
</tr>
<tr>
<td>17</td>
<td>0.1559</td>
</tr>
<tr>
<td>18</td>
<td>0.1438</td>
</tr>
<tr>
<td>19</td>
<td>0.1335</td>
</tr>
<tr>
<td>20</td>
<td>0.1250</td>
</tr>
</tbody>
</table>
INTERJECTION, in grammar, an indeclinable part of speech, signifying some passion or emotion of the mind.

INTERLOCUTORY ORDER, in law, an order that does not decide the cause, but only some matter incident to it, which happens between the beginning and end of a cause; as when, in chancery or exchequer, the plaintiff obtains an order for an injunction until the hearing of the cause; which order, not being final, is called interlocutory.

INTERMITTENT, or INTERMITTING FEVERS. See Medicine.

INTERNAL, in general, signifies whatever is within a thing.

Euclid proves that the sum of the three internal angles of every triangle is equal to two right angles; whence he deduces several useful corollaries. He likewise adduces, from the same proposition, this theorem, viz., that the sum of the angles of every rectilinear figure, is equal to twice as many right angles, as the figure hath sides, each side subtracting four.

INTERROGATORIES, are questions exhibited in writing to be asked witnesses or contemporaries to be examined. Those interrogatories are in the nature of a charge or accusation; and if any of them is improper, the defendant may refuse to answer it, and move the court to have it struck out. Str. 444.

INTERSECTION, in the mathematics, signifies the cutting of one line or plane by another: thus we say, that the mutual intersection of two planes is a right line.

INTERVAL, in music, the difference in point of gravity or acuteness between any two sounds. Taking the word in its more general sense, we must allow that the possible intervals of sound are infinite, but we only speak of those intervals which exist between the different tones of any established system. These are divisible into simple, compound, or composite, which they call diatonic, and composite intervals, which they call systems. The least of all the intervals in the Greek music was, according to Iamblicus, the difference of one or fourth of a tone; but our scale does not notice so small a division, since all our tones concur in consonances, to which order only one of the three ancient genera, viz., the diatonic, was accommodated. Modern musicians consider the semitone as a simple interval, and only call those compound which consist of two or more semitones; thus from B to C is a semitone, or simple interval, but from C to D is two half-tones, or a compound interval.

TESTATES. There are two kinds of intestates; one that makes no will at all; and another that makes a will, and nominares executors, but they refuse; in which case he dies intestate, and the ordinary commits ad interim a Pet. Inst. 307.

The ordinary by special acts of parliament is required to grant administration of the effects of the deceased to the widow or next of kin, who shall first pay the debts of the deceased, and then distribute the surplus among the kindred, in the manner and according to the proportions directed by 22 and 33 Car. II. c. 10.

INTESTINA, in natural history, an order of worms. The individuals of this order are of a formation the most simple, and live some of them within other animals, some in waters, and a few in the earth. The Gordius perforates clay to give a passage to springs and water, the limerius pierces the earth, that it may be exposed to the action of the air and moisture: in like manner the teredo penetrates wood; and the pilosus and mytilus rocks, and their dissolution.

INTESTINES. See Anatomy, and Physiology.

INTRUSION, in law, is when the ancestor dies seised of any estate of inheritance, expectant upon an estate for life; and then the tenant for life dies, between whose death, and the entry of the heir, a stranger intrudes.

INVESTED, in heraldry, denotes a thing fluted or furrowed. See Heraldry.

INVENTION. See Painting.

INTEREST, in law, is the giving possession of lands by the seisin. The ancient feudal investiture, in which the vassal on descent of land was admitted into the lord's court, and there received his seisin, in the nature of a renewal of his ancestor's grant, in the presence of all the rest of the tenants; but in after-times, entering on any part of the lands, or other notorious possession, was admitted to be equivalent to the formal grant of seisin and investiture: 2 Black. 269.

The manner of grant was by words of pure donation, or given and granted: which are still the operative words in our modern indentations or deeds of feoffment. This was perfected by the ceremony of corporal investiture, or open and notorious delivery of possession in the presence of the other vassals.

But a corporal investiture being sometimes inconvenient, a symbolic delivery of possession was in many cases usually allowed of; by transferring something near at hand, in the presence of credible witnesses, which by agreement should serve to represent the very thing designed to be conveyed; and an occupancy existing, the symbol was permitted as equivalent to the occupancy of the land itself. And to this day, the conveyance of many of our copyhold estates is made from the seller to the lord, or his steward, by delivering a rod or verge, and then from the lord to the purchaser, by a re-delivery of the same, in the presence of a jury of tenants. 2 Black. 313.

INULA, fleabane, a genus of the syngenes polygony-auperillus class of plants, with radiated flowers; the receptacle is naked; the down is simple; and the anther is terminated in five at their bases. There are thirty-four species, of no note.

INVOICE, an account in writing of the particulars of that which is shipped off the goods, to be dispatched by post, or otherwise, to the correspondent. This copy is commonly drawn out upon a sheet of large post-paper, to the end of which is subjoined a letter of advice,

INVOLEMENT. See Botany.

INVOLUTION. See Algebra.

JOINT ACTIONS: in personal actions, several groups may be joined in one suit; but actions found on the same cause of action and a contract cannot be joined, for they may require different pleas and different process. 1 Vent. 333.

JOINT and SEVERAL: an interest cannot be granted jointly and severally; as if a man grants his property to his heir and a servant for life, he cannot make a lease for years, to two jointly and severally; these words (severally) are void, and they are joint tenants. 5 R. 19.

JOINT LIVES: lease for years to husband and wife, if they or any issue of their bodies should so long live as the parties, or the one of them should survive, the other; and not only so long as the husband and wife, &c. should jointly live. Nos. 599.

JOINT TENANTS, are those that come to, and hold and possess the estate by one title pro indiviso, or without partition.

These are distinguished from sole or several tenants, from parceners, and from tenants in common: and they must jointly infeoff, and jointly be implied, and partly and the like of them, and co-parceners; but joint tenants have a sole quality of survivorship, which coparceners have not; for there are two or three joint tenants, and one has issue and dies, then he or those joint tenants that survive, shall have the whole by survivorship. Cowd.

The creation of an estate in joint tenancy depends on the wording of the deed or devise, by which the tenant claims title; for this estate can only arise by purchase or grant, that is, by the act of one person, and never by the mere act of law. Now if any estate is given to a plurality of persons, without adding any restrictive, exclusive, or explanatory words, as if an estate is granted to A and B and their heirs, this makes them immediately joint tenants in fee of the land; for the law interprets the grant, so as to make all parts of it take effect, which can only be done by giving both parties the same estate in them both. Therefore the grantor in the preceding pleased their names, the law gives them a thorough union in all other respects. 2 Black. 150.

If there are two joint tenants, and one releases the other, this passes a fee without the word heirs, because it refers to the whole fee, which they jointly took and are possessed of by force of the first conveyance; but the tenants in common cannot release to each other, for a release supposes the party to have the thing righted, but tenants in common have several distinct estates and interests, which they cannot transfer otherwise than as persons who are sole seized. Co. Litt. 9.

Although joint tenants are seized per me per tout, yet to divers purposes each of them has but a right to a moiety; as to enfeoff, give, or demise, or to forfeit or lose by death in default of a precent; and therefore where there are two or more joint tenants, and they all join in a feoffment, or each of them in joint feoffment gives his appurtenant, Co. Litt. 206.

The right of survivorship, which takes place immediately upon the death of the joint tenant, whether it is a natural or civil death; as if there are two joint tenants, and one of
The estate must be for term of the wife's life, or a greater estate; therefore if an estate is made for life of the X. or many others, this is no good jointure; for if she lives longer than her husband, she may not only to break the provision of life, but also to exclude her from claiming dower, and likewise her settlement, it seems that a provision or settlement on the wife, by way of trust, in other respects it answers the intention of the statute, will be inured in a court of equity.

The estate must be in satisfaction of the whole dower; the reason hereof is, that if it is made in satisfaction of part only, it is uncertain for what part it is in satisfaction of her dower, and therefore void in the whole. Co. Lit. 36.

The estate must be expressed or averred to be in satisfaction of her dower. Lord Coke says, that it must be expressed or averred to be so by a competent provision, and also to this for this does not seem requisite either within the words or intention of the statute. Co. Lit. 36.

It should be made during the coverture; this the very words of the act of parliament require; and therefore if a jointure is made to a woman during her coverture in satisfaction of dower, she may wave it after her husband's death; but if she enters and agrees thereto, she is concluded; for though a woman is not bound by any act when she is not a party to the settlement, yet if she agrees to it when she is at liberty, it is her own act, and she cannot avoid it. Co. Lit. 36. Co. 3.

JOINTURE. A jointure strictly speaking, signifies a joint estate, limited to both husband and wife; but in common acceptation, it extends also to a sole estate, limited to the wife only, and may be thus defined, viz. a competent livelihood of freedom for the wife of lands and tenements, to take effect, in profit or possession, presently after the death of the husband; for the life of the wife at least. 2 Bl. 137.

By the statute of the 97th II. VIII. c. 10, if a jointure is made to the wife, it is a bar of her dower, so that she shall not have both jointure and dower. And to the making of a perfect jointure within that statute six things are observed: 1. Her jointure is to take effect presently after her husband's decease. 2. It must be for the term of her own life, or greater estate. 3. It should be made to herself. 4. It must be in satisfaction of her whole dower, and not of part of her dower. 5. It must either be expressed or averred to be in satisfaction of her dower. 6. It should be made during the coverture. 1 Inst. 32.

The estate must take effect presently after her husband's decease; therefore if an estate is made to the husband for life, remainder to another person for life, remainder to the wife for her jointure, this is no good jointure, for it is not within the words or intent of the statute; for the statute designed nothing as a satisfaction for dower, but that which came in the same place, and is of the same use to the wife; and though the other person dies during the life of the husband, it is not sufficient for every interest not equivalent to dower nor being within the statute, a void limitation to deprive the wife of her dower. 4 Co. 3.
The water disappears. It is then moistened again, and the process repeated till the whole is oxidized. The mass is then pounded, and the powder heated in an iron vessel till it is perfectly dry, stirring it constantly. By making steam pass through a red-hot iron tube, the iron is changed into a brilliant black brittle substance, which, when pounded, assumes the appearance of martial etchings.

This experiment is also made by Lavosier.

3. By burning iron wire in oxygen gas. The wire as it burns is melted, and falls in drops to the bottom of the vessel, which ought to be covered with very fine copper. These metallic drops are brittle, very hard, and blackish, but retain the metallic lustre.

They were examined by Lavosier, and found precisely the same with martial etchings.

The oxide so formed is always composed of 73 parts of iron and 27 of oxygen, as Lavosier and Proust have demonstrated.

It is attracted by the magnet, and is often itself magnetic. It is capable of crystallizing, and is often found native in that state.

The peroxide or red oxide of iron may be formed by keeping iron filings red-hot in an open vessel, for a long time.

One oxide is found native in the iron dam, which is formed by the filings in the vessel, and is called the dam oxide.

Consequently the peroxide, when converted into red oxide, absorbs 0.40 of oxygen; and the same thing, the red oxide is composed of 66.5 parts of black oxide and 33.5 parts of oxygen. One hundred parts of iron, when converted into a peroxide, absorbs 37 parts of oxygen, and the oxides are again converted into peroxide, it absorbs 52 additional parts of oxygen, and the oxide weighs 189.

The peroxide cannot be decomposed by heat; but when heated along with its own weight of iron filings, the whole, as Vaupellin first observed, is converted into black oxide.

The reason of this conversion is evident: The 100 parts of peroxide are composed of 52 parts of iron, combined with two different doses of red quicklime. With 14 parts, which, with the iron, make 66 of protoxide: With 34 parts, which, with the protoxide, make up the 100 parts of peroxide. Now, the first of these doses has a much greater affinity for the iron than the second has. Consequently the 34 parts of oxygen, which constitute the second dose, being retained by a weak affinity, are easily abstracted by the 100 parts of peroxide; and combining with the iron, the whole at once is converted into black oxide: for 100 parts of iron, to be converted into black oxide, require only 37 parts of oxygen.

The peroxide of iron is not magnetic. It is converted into black oxide by sulphurated hydrogen gas and many other substances; which deprive it of the second dose of oxygen, for which they have a stronger affinity, though the wire is capable of decomposing the protoxide. Iron is capable of combining with all the simple combustible bodies.

A small mixture of it constitutes that particular kind of iron, known by the name of cast iron, because it is brittle when cold, though it is malleable when hot.

Birman has shown that the brittleness and bad qualities of cold short iron may be removed by heating it strongly with limestone, and with this the experiments of Lavasavey correspond.

There are a great many varieties of iron, which artists distinguish by particular names; but all of them may be reduced under one or other of the following classes: cast iron; wrought or soft iron; and steel.

Cast iron, or pig iron, is the name of the metal when first extracted from its ores.

The ores from which iron is usually obtained are composed of oxide of iron and clay. The object of the manufacturer is to reduce the oxide to the metallic state, and to separate it from the clay. The two objects are accomplished at once by mixing the ore reduced to small pieces with a certain portion of limestone and of charcoal, and subjecting the whole to a very violent action of heat.

The charcoal absorbs the oxygen of the oxides, and leaves the iron in the metallic state; the limestone combines with the clay, and both together run into fluxes, and form a kind of thin glass; the iron is also melted by the violence of the heat, and being heavier than the glass, falls down, and is collected at the bottom of the furnace. Thus the contents of the furnace are separated into two portions; the glass swells at the surface, and the iron rests at the bottom. A hole at the lower part of the furnace is now opened, and the iron is shown how it can be moulded for all purposes of reception.

The cast iron thus produced is distinguished by the following properties: It is scarcely malleable at any temperature. It is generally so hard as to resist the file. It can neither be hardened to a point, nor formed into a cold curve by any means.

Cast iron is converted into wrought iron, by putting it into a furnace, and kept melted, by means of the flame of the combustibles, which is made to play upon its surface. While melted, it is constantly stirred by a workman, that every part of it may be exposed to the air. In about an hour the hottest part of the mass begins to heave and swell, and to emit a lamen- bent blue flame. This continues nearly an hour; and by that time the conversion is completed. The heaving is evidently produced by the emission of the combustible fluid, As the process advances, the iron gradually acquires more consistency; and at last, notwithstanding the continuance of the heat, it
conceals all together. It is then taken while hot, and hammered violently, by means of a heavy hammer, and it is thereupon not only makes the particles of iron approach nearer each other, but drives away several impurities which would otherwise continue attached to the iron.

In this state it is the substance described under the name of iron. As it has not been demonstrated, it is considered at present, when pure, as a simple body; but it has seldom or never been found without some small mixture of foreign substances. These substances are either some of the other metals, or even on, carbon, phosphorus.

When small pieces of iron are stratified in a close crucible, with a sufficient quantity of charcoal-powder, and kept in a strong red heat for eight or ten hours, they are converted into steel, which is distinguished from iron by the following properties:

It is so hard as to be unannulable while cold; or at least it acquires this property by being immersed while ignited into a cold liquid; for this immersion, though it has no effect upon iron, adds greatly to the hardness of steel.

It is brittle, resists the file, cuts glass, affords spark with flint, and retains the magnetic virtue for any length of time. It loses this hardness by being ignited and cooled very slowly. It melts at above 1300° Westergood.

It is malleable when red-hot, but scarcely so when raised to a white heat. It may be hammered out into much thinner plates than iron. It is more sonorous; and its specific gravity, when hammered, is greater than that of iron.

By being repeatedly heated in an open vessel, and hammered, it becomes wrought iron, which is a simple substance, and if perfectly pure would contain nothing but iron.

Steel is iron combined with a small portion of carbon, and has been for that reason called carburated iron. The proportion of carbon has not been ascertainment with much precision. From the analysis of Vanquelin, it amounts to 0.17%, to 0.40%.

Mr. Clout seems to affirm that it amounts to 0.2% part; but he has not published the experiments which led him to a proportion, which so far exceeds what has been obtained by other chemists.

That steel is composed of iron combined with pure carbon, and not with charcoal, has been demonstrated by Morveau, who formed steel by combining together directly iron and diamond. At the suggestion of Cloutet, he inclosed a diamond in a small crucible of pure iron, and exposed it completely covered up in a common crucible to a sufficient heat.

The diamond disappeared, and the iron was converted into steel. The diamond weighed 907 parts, the iron 57,800, and the steel obtained 56,584; so that 2313 parts of the iron and 15 parts lost in the operation. From this experiment it follows, that steel contains about 0.3% of its weight of carbon.

This experiment was objected to by Mr. Maslett, but the objections were fully refuted by Dr. Gregory and Mr. Cloutet.

Himma, long ago, pointed out a method by which steel may be distinguished from iron. When a little diluted nitric acid is dropped upon a plate of steel, allowed to remain a few minutes, and then washed off, it leaves the spot or a whitish-green. We can easily see the reason of this spot: it is owing to the carbon of the iron which is converted into charcoal by the acid.

This experiment shows us, that carbon is much more readily oxidized when combined with iron than when crystallized in the diamond.

Cast iron, is iron combined with a still greater proportion of carbon than is necessary for forming steel. The quantity has not yet been ascertained with precision: Mr. Clout makes it amount to $\frac{3}{4}$ of the iron. The blackness of the colour, and the fusibility of cast iron, are proportional to the quantity of carbon which it contains. Cast iron is almost always contaminated with foreign ingredients: these are chiefly oxide of iron, phosphur, and silica.

It is easy to see why iron is obtained from its ore in the state of cast iron. The quantity of charcoal, along with which the ore is fused, is so great, that there is an opportunity of saturating itself with it.

The conversion of cast iron into wrought iron is effected by burning away the charcoal, and depriving the iron wholly of oxygen: this is accomplished by heating it violently behind a black spot, whereas the iron has found, that when cast iron is mixed with $\frac{3}{4}$ of its weight of black oxide of iron, and heated violently, it is equally converted into pure iron.

The oxygen of the oxide, and the carbon of the cast iron, combine, and leave the iron in a state of purity.

The conversion of iron into steel is effected by combining it with carbon. This combination is performed in the large way by three different processes, and the products are distinguished by the name of natural steel, steel of cementation, and cast steel.

Natural steel is obtained from the ore by converting it first into cast iron, and then exposing the cast iron to a violent heat in a furnace while its surface is covered with a mass of melted scorie five or six inches deep, Articles of the carbon combines with the oxygen which cast iron always contains, and flies off in the state of carbonic acid gas. The remainder combines with the pure iron, and constitutes it steel. This steel is inferior to the other species; its quality is not the same throughout; it is softer, and not so apt to be k; and as the processes by which it is obtained are less expensive, it is sold at a lower price than the other species.

It is obvious that iron and carbon are capable of combining together in a variety of different proportions. When the carbon exceeds, the compound is carburet of iron, or plumbago. When the iron exceeds, the compound is steel or cast iron in various proportions.

All these compounds may be considered as subcarbonates of iron. The hardness of iron increases with the proportion of charcoal with which it combines, till the carbon amounts to about $\frac{1}{2}$ of the whole mass. The hardness is then a maximum; the metal acquires the colour of silver, loses its granulated appearance, and assumes a crystallized form. If more carbon is added to the compound, the hardness diminishes in proportion to its quantity.

The affinities of iron, and its oxides, are arranged by Herrman as in the following table:

<table>
<thead>
<tr>
<th>Iron</th>
<th>Oxide of Iron</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nickel</td>
<td>Oxalic acid</td>
</tr>
<tr>
<td>Cobalt</td>
<td>Tartaric</td>
</tr>
<tr>
<td>Manganese</td>
<td>Camphoric</td>
</tr>
<tr>
<td>Arsenic</td>
<td>Sulphur</td>
</tr>
<tr>
<td>Copper</td>
<td>Sclatic</td>
</tr>
<tr>
<td>Gold</td>
<td>Metallic</td>
</tr>
<tr>
<td>Silver</td>
<td>Nitric</td>
</tr>
<tr>
<td>Tin</td>
<td>Phosphoric</td>
</tr>
<tr>
<td>Antimony</td>
<td>Arsenic</td>
</tr>
<tr>
<td>Platinum</td>
<td>Floric</td>
</tr>
<tr>
<td>Bismuth</td>
<td>Succinic</td>
</tr>
<tr>
<td>Lead</td>
<td>Citric</td>
</tr>
<tr>
<td>Mercury</td>
<td>Lactic</td>
</tr>
<tr>
<td>Arsenic</td>
<td>Boracic</td>
</tr>
<tr>
<td>Prussic</td>
<td>Phosphoric</td>
</tr>
<tr>
<td>Carbic</td>
<td></td>
</tr>
</tbody>
</table>

IRON-SICK, in the sea-language, is said of a ship or boat, when her bolts or nails are so eaten with rust, and so worn away, that they occasion hollows in the planks, whereby the vessel is rendered leaky.

IRRATIONAL, an appellation given to surd numbers and quantities. See ALGEBRA.

IRREGULAR, in grammar, such inflections of words as vary from the general rules; thus we say, irregular nouns, irregular verbs.

ISATIS, WOAD; a genus of the silique order, in the tetradynamia class of plants; and in the natural method ranking under the 30th order, the siliqueons. The silique is lanceolated, unicellular, monospemous, bivalved, and deciduous; the valves navicular or canoe-shaped. There are four species; but the only one worthy of notice is the tictoria, or common woad, which is cultivated in several parts of Britain for the purposes of dyeing, being used as a foundation for many of the dark colours. See DYES.

ISCHEMUM, a genus of the monocot order, in the polyagamia class of plants; and in the natural method ranking under the 4th order, gramina. The calyx of the herbophyllum is a bilobous glume; the corolla bivalved; there are three Stamina, two styles, and one seed. The calyx and corolla of the male, as in the former, with three stamina. There are eight species.

ISCHURY. See MEDICINE.

ISERTIA, a genus of the hexandria monogamia class and order; the cal is uncoloured, four or six toothed; cor. six-cleft, funnel-form; pome subglobular, six-celled. There is one species, a tree of Cayenne.

ISINGLASS, in the materia medica, &c. See ACIPENSER.

ISSARDIA, a genus of the monogamia order, in the tetradynamia class of plants; and in the natural method ranking under the 17th order, calycanthem. There is no corolla; the calyx is quadrifid; the capsule quadrifidular, and girl with the calyx. There is one species, the aquatic and annual.

ISOCHELÉ TRIANGLE, in geometry, one that has two equal sides.

ISOCRHONAL, ISOCRONE, or IS-
CHRONICUS, is applied to such vibrations of a pendulum, as are performed in the same space of time; as all the vibrations or swings of the same pendulum are, whether the arches it describes are longer or shorter: for when it is describes a shorter arch, it moves so much the slower, and when a long one proportionally faster.

BICHORAL lines, that in which a heavy body is supposed to descend without any acceleration.

ISOETES, a genus of the natural order of filifers, belonging to the cryptogamia class of plants. The anther of the male flower are within the base of the frond or leaf. The capsule of the female flower is baccate, and within the base of the leaf. There are two species.

ISOMETRICAL Figures, in geometry, are such as have equal perimeters, or circumferences.

1. Of isometrical figures, that is the greatest that contains the greatest number of sides, or the most angles, and consequently a circle is the greatest of all figures that have the same compass as it has.

2. Of two isometrical triangles, having the same base, wherein two sides of one are equal, and of the other unequal, that is the greatest whose two sides are equal.

3. Of isometrical figures, whose sides are equal in number, that is the greatest which is equalateral and equangular. From hence follows that common problem of marking the lodging or wailing that will wall in one acre, or even any determinate number of acres, a, fonce or wall in any greater number of acres what ever b. In order to the solution of this problem, let the greater number b be supposed a square. Let a be one side of an oblong, whose area is a; then will \( \frac{a}{b} \) be the other side; and \( 2a + 2b \) will be the ambit of the oblong, which must be equal to four times the square-root of b; that is, \( 2a + 2b = 4 \sqrt{b} \). Whereas the value of \( x \) may be easily had, and you may make infinite numbers of squares and oblongs that have the same ambit, and yet shall have different given areas, thus.

Let \( \sqrt{b} = d \).

Then, \( \frac{a}{b} = \frac{4d}{a} \).

\( a + 2b = 2d \).

\( 2ax - 2bd = -a \).

\( ax = \frac{2}{d} - \frac{a}{b} \).

\( bx = a \frac{2}{d} + \frac{a}{b} + 2d \).

That, if one side of the square be 10; and one side of an oblong be 10, and the other 1; then with the ambit of that square and oblong be equal, viz. each 40, and yet the area of the square will be 100, and of the oblong but 19.

ISOPHYNUM, in botany; a genus of the polygynous order, in the polyandra class of plants; and in the natural method ranking under the third order, multisepulque. There is no calyx, but five petals; the nectaria triad and tubular; the capsules recurved and polyhymnous. There are two species, of no note.

ISSUE, in law, has several significations, it being sometimes taken for the children begotten between man and his wife; sometimes for profits arising from amercements and fines; and sometimes for the profits issuing out of lands or tenements: but this word generally signifies the conclusion, or point of matter, that is, the question from the allegations and pleas of the plaintiff and defendant in a cause to be tried by a jury or court.

There are two kinds of issues in relation to causes, that upon a matter of fact, and that upon a matter of law: that is of fact is where the defendant has done any such thing as the plaintiff has alleged against him; and special, where some special matter, or material point alleged by the defendant in his defence, is to be tried. General issue and special issue, in which the defendant is allowed to give the special matter in evidence, by way of excuse or justification; this is granted by several statutes, in order to prevent a plaintiff pleading, by allowing the defendant to give any thing in evidence, to prove that the plaintiff had no cause for litigation.

ISSUES on SHERIFFS are such unmerited faces and fines to the crown, as are levied out of the issues and profits of the lands of sheriffs, for their faults and neglect; but these issues, or seeking to a good administrator, or such a thing may be taken off before they are estreated into the exchequer.

ISSUES. SEE SURGERY.

ITEA, a genus of the monogynia order, in the pentandria class of plants; and in the natural method is classed under the 4th order, composite. The male calyx is common and triphylous; the florlets of the disc monopetallous and quinquedent; the receptacle divided by small hairs. There is no female calyx nor corolla, but five fruits in the radius; two long styles; and one naked and obtuse. There are two species, natives of North America.

IVA, a genus of the pentandria order, in the monogynia class of plants; and in the natural method is classed under the 49th order, composito. The male calyx is common and triphylous; the florlets of the disc monopetallous and quinquedent; the receptacle divided by small hairs. There is no female calyx nor corolla, but five fruits in the radius; two long styles; and one naked and obtuse. There are two species, natives of America.

JUDGE. The judges are the chief magistrates in the law, to try civil and criminal causes. Of these there are twelve in England, viz. the lords chief justices of the courts of king's-bench and common-pleas; the lord chief baron of the exchequer; the three puisne or inferior judges of the two former courts; and the three puisne barons of the latter.

By stat. 1 Geo. III. c. 23, the judges are to continue in their offices during their good behaviour, notwithstanding any demise of the crown (which was formerly held immediately to vest in their seats), and their full salaries are absolutely secured to them during the continuance of their commissions, by which means the judges are rendered completely in-
plum with a furrowed kernel. There are 8 species, the most remarkable of which is the regia or common walnut. Other two species, called the nigra and alba, or black and white Virginian walnut, are also cultivated in this country, and are equally proper for fruit, having very small kernels.

JUGULAR. See Anatomy.

JUGULARES, in the Linnaean system, is the name of an order or division of fish, possessing characters which is that they have bony fins. See Fish.

JULES. See Materia Medica.

JULIAN PERIOD. See Chronology.

JULUS, a genus of insects, of the order Aptera. The generic character is, antennae moniliform; tarsi two segmented; body sub-cylindric; legs numerous, twice as many on each side as the segments of the body. The julus are very nearly allied to the scehdrepandars or centipedes, but their body, instead of being flattened, is in those insects, is nearly cylindrical or jointed. They are furnished with two pairs of feet, the number on each side doubling that of the segments, whereas in the scehdrepandars the number of joints and of feet is equal on each side. The male is distinguished by numerous hexagonal coxites, as in the major part of the insect tribe., and the mouth is furnished with a pair of decemtate jaws. These animals, when disturbed, roll themselves up in a flat spiral, their general motion is rather slow and unctuatory. The most common species, the julus sabulosus, is often seen in similar situations with the snail and scehdrepandar, and usually measures about an inch and quarter in length; its colour is a polished brownish black, except the legs, which are paler or whitish: it is an oviparous animal, and the young, when first hatched, are very small, of a whitish colour, and are furnished only with three pairs of legs, which are situated on each side the superior part, or near the heart; the remaining pairs not making their appearance till some days after, when about seven on a side become visible: the nails are black, with a white-red spot on each toe: in this state it may sometimes be found in the soft mould of hollow trees.

JULUS INUS, or great Indian julus, bears an extreme resemblance to the former, but is of a smaller size, and measures only seven inches in length: its colour is similar to that of the preceding species. It is found in the warmer parts of Asia and America, inhabiting woods and other retired places: the number of legs, according to Linnaeus, is a hundred and fifteen on each side, but this seems to be a variable circumstance.

JULUS lagurus, or barbed julus, is a very minute and singular species, not exceeding, when at full growth, the eighth of an inch in length. Its colour is pale-brown, and its shape rather broad, and flatish. This insect is by means of two long hairs, which, during the summer months creeping about the banks of trees, walls, &c. is considered by Linnaeus as a species of scehdrepandar, but as the legs are double the number of segments on each side, it is more properly referred to Degener, Scorpol, and others, to the present genus. In fact it may be allowed, like the julus complanatus, another slightly flattened species, to form a kind of connective link between the two groups of insects, the scehdrepandars and the aptera. The julus terrestres has 100 legs on each side: the body is a polished black. It inhabits most parts of Europe, under stones and in the earth. See Plate Nat. Hist. fig. 293.

JUNCUS, the rush, a genus of the monogynous order, in the herbaceous class of plants; and in the natural method ranking under the 5th order, tripetaloids. The calyx is hexaplylious; there is no corolla; the capsule is umbilical. There are 39 species, universally known, being very troublesome weeds, and difficult to eradicate. The pith of two kinds, called the conglomeratus and effusus, or round-headed and soft rushes, is used for wicks to lamps and rushlights. The conglomeratus, and acutus or marine rush, are planted with great care on the banks of the sea in Holland, in order to prevent the water from washing away the earth; which would otherwise be removed every tide, if it was not for the roots of these rushes, which are very deep in the mud, and make them raise near the surface in such a manner as to hold the earth closely together. In the summer-time when the rushes are fully grown, they are cut and tied up in bundles, which are dried, and afterwards carried into the larger towns and cities, where they are wrought into baskets, and several other useful things, which are frequently sent into England. These sorts do not grow so strong in this country as in the Netherlands, where they sometimes arrive at the height of four feet and upwards.

JUNGERMANNIA, a genus of the natural order of algae, in the cryptogamia class of plants. The male flower is pollinicated and naked; the female flower is sessile, naked, with roundish seeds. There are 48 species, all natives of Britain, growing in woods, shady places, by the sides of ditches, &c. Many of them are being used for the purpose of giving a pungent and bitterish taste to the water, especially where they are abundant.

JUNCARIA, a genus of the polypogamia segregata order, in the syngnasia class of plants; the common receptacle is chaffy; the perianthum three-flowered; the stigmas tubular, two-apsed; the exterior lip long; the interior one bipartite. There is one species, a native of America.

JUNIPERUS, the juniper tree; a genus of the monadphylia order, in the monoecea class of plants; and in the natural method ranking under the 31st order, conifer. The conglobulosa is a species of juniper, which has no corolla; three stamina; the female calyx tripartite; there are three petals, and as many styles; the berry is trispermous, and equal, by means of three tubercules of the inflated calyx adhering to it. There are three species of juniper, of which one is: The common, or common juniper, grows naturally in many parts of Britain upon dry barren commons, where it seldom rises above the height of a low shrub, which grows naturally in dry shady roads in the Highlands. Of this species there is a variety called Swedish juniper, which grows ten or twelve feet high, very branchy the whole length, with the branches growing more erect, and leaves, flowers, and fruit, like the former.

2. The oxycedrus, or Spanish juniper, rises from ten to fifteen feet high, closely branched from bottom to top; having short, and-shaped, spreading leaves by threes and fours, succeeded by large red-brown berries. 3. The thuniera, or blue-barked Spanish juniper, grows twenty feet high or more. 4. The Virginiana, or Virginia cedar, grows thirty or forty feet high, branching from bottom to top in a conic manner. 5. The Lycia, Lycian cedar, or oblongum tree, grows twenty feet high. 6. The Phoenician, or Phoenician cedar, grows about twenty feet high. It is a native of Portugal. 7. The Bermudiana, or Bermudian cedar, grows twenty or thirty feet high. 8. The sabina, or savin tree; of which there are three varieties, the spreading, upright, and variegated savin. The propagation of all the junipers is by seed, and of the savins by layers and cuttings.

Juniper-berries have a strong, not disagreeable smell; and a warm, pungent, sweet taste, which, if they are long cherished, or previously well bruised, is followed by a bitterness. The pungency seems to be in the bark; the sweet in the juice; the aromatic flavour in oily vesicles spread through the substance of the pulp, and distinguishable even by the eye; and the bitter in the seeds.

JURY. This strong tower of defence of the British constitution, which is one of the leading features of the Magna Charta, is composed of a certain number of persons sworn to enquire of, and try some fact, and declare the truth upon the evidence brought before them.

In criminal cases juries are divided into grand and petty. The grand jury must be all freeholders, but it does not appear that any specific estate has been determined to be necessary; before them the charge is laid, and such twelve or more of them are of opinion that it is well founded, the accusation is dismissed; which they call not incurring a true bill. If they find a true bill, it must afterwards be confirmed by the unanimous assent of a jury of petty officers. There is no suspicion of partiality can possibly rest.

In civil cases juries are divided into common and special. The latter are generally employed in cases where any difficulties with respect to commercial transactions arise, and are best decided by a special jury of merchants.

To obtain a special jury, a motion is made in court, and rule granted, for the sheriff to attend the master, prothonotary, or other proper officer, with his freeholders' book, in the presence of the attorneys on both sides, and to take indifferently forty-eight freeholders, when each party strikes off twelve, and the remaining twenty-four are returned upon the panel.

A common jury is one returned by the sheriff according to the directions of 3 Geo. 11. c. 22, which appoints that the sheriff shall not return a separate panel for every cause, but the same for every cause to be tried at the same assizes, containing not less than forty-eight, nor more than seventy-two; and that their names being written on tickets, shall be put into a box, and when the cause is called, twelve whose names shall not be drawn shall be sworn, unless absent, chal-
A jury when either party is an alien-born, shall be half dozeners, and the other aliens (if there are so many in the place); but when both parties are aliens, it is presumed there is no more partiality for the one than the other, and therefore it was resolved the jury shall all be drawn from aliens.

If a juror receives a bribe from either party, he shall forfeit ten times as much as he has taken, half to the king, and half to him who sues.

A man who threatens or assaults a juror for giving a verdict against him, is punishable by fine and imprisonment; and if he strikes him in court in the presence of the judge, he shall lose his hand and his goods, and the profits of his land during life, and suffer perpetual imprisonment.

IVORY, chur, in natural history, &c., a hard, solid, and firm substance, of a white color, and capable of a very good polish.

If the task of the elephant, and is followed from the base to a certain height, the cavity being filled up with a compact medullary substance, seeming to have a great number of glands in it. It is observed that the Ceylon ivory, being from the island of Ceylon, do not become yellow in the wearing, as all other ivory does; for this reason the teeth of these places bear a larger price than those of the coast of Guinea.

To soften ivory and other bones, lay them for twelve hours in aqua fortis, and then three days in the juice of beets, and they will become so soft that they may be worked into any form. To harden them again, lay them in strong vinegar. Dioscorides says, that by boiling away the juice of six live men with the root of mandragoras, it will become so soft that it may be managed as one pleases.

Ivory-black is the coal of ivory or bone, forged by great heat, while deprived of all access of air.

JUPITER, in astronomy, one of the superior planets, remarkable for its great brightness. See Astronomy.

JUDICIA, whatever is set up in room of a mast, or on the stern of a ship, by the king's command, to decide any cause at all. This privilege is denied to the king, who must assign a reason for the challenge.

If by reason of challenges, or in default of the usual petty cas, no account be laid on the order of the original panel, attires may be awarded both in civil and criminal cases, that is, a sufficient number of persons present in court to be joined to the other jurors, who are however liable to the same challenges as the principal jurors.

The jury, after the proofs are summed up, unless the case is very clear, retire to consider; and are kept without it, drink, fire, or candle, till they are unanimously agreed.

If the jury eat or drink, or have victuals about them, without the consent of the court, before the verdict, it is finable; and if they do it at the charge of him for whom they find, the verdict will be set aside. Also if they speak with either of the parties, or their agents, after they are gone from the bar, or if they receive any fresh evidence, or cast lots to prevent dispute, the verdict is bad.

When the jury have delivered their verdict, and it is recorded in court, they are dismissed.

JUR, chief justices, there are in each of the above courts three puisne justices; there are also several other justices appointed by the king for the execution of the laws; such as the lords justices in eyre of the forests, who are two justices appointed to determine all offenses committed in those justices of assize, of over and terminal, of good delivery, &c. They are also called justices of nisi prius, and so denominated from the words used in a common form of adjournment of a cause to the court of common pleas. See Nisi Prius, Over and Tender, Common Pleas, and King's Bench.

JUSTICES of the Peace. See Peace. JUSTICIARY, or court of Justiciary, in Scotland, a court of supreme jurisdiction in all criminal cases.

This court came in place of the justiciary or justice-general, which was taken away by parliament in 1672, and was erected into a justice or criminal court consisting of a justice-general alterable at the monarch's pleasure, justice clerk, and five other judges, who are lords of session.

This court commonly sits upon Mondays, and has no more business than its commission from the justice clerk. They have four mace, and a doomsman appointed by the lords of the session.

The form of the process is this; the clerk raises a libel or indictment upon a bill passed by any of the lords of that court, at the instance of the pursuer, against the defendant or criminal, who is immediately committed to prison after citation. When the party, without answer, or by his answer, are cited, the day of compearing being come, fifteen of the great assize are chosen to be the assize upon the panel, or prisoner at the bar. The assize sits with the judges to hear the libel read, witnesses examined, and the debates on both sides, which are written verbatim in the adjournal books. The king's advocate pleads for the pursuer, being the king's cause, and other advocates for the prisoner; and the judges then decide, whether they find the libel or indictment either non-relevant, in which case they desert the diet, and absolve or absolve the party accused; or, if relevant, then the assize of jury of fifteen is returned to the clerk, and their order being preparations taken with them, where they choose their chamber and clerk, and consider the libel, deposition, and debates; and bring in their verdict of the panel sealed, guilty or not guilty; if not guilty, the lords absolve; if guilty, they condemn and declare their sentence of condemnation, and command the sentence to be pronounced against the panel by a mace and the mouth of the doomster. The lords of the justiciary likewise go circuits twice a year into the country. See the article Circuit.

JUSTICIES, a writ directed to a sheriff, by virtue of which he is empowered to hold a plea of debt in his county-court for a sum above 40s., though by his ordinary power he has only cognizance of sums under 40s.

JUSTIFICATION, in law, is an affirming or showing good reason in court, why a thing as he is called to answer as to justify it, or prove a relevancy. See HEDERA.

IX. A genus of the monogynia order, in the triandria class of plants; and in the
natural method ranking under the sixth order, Rosaceae. The corolla is hexaepetalous, patent, and equal; there are three stigmata, a little upright and petalous. There are fifty-four species, consisting of heraeanthous, tuberous, and bulbous-rooted flower perennials, from one to two feet high, terminated by hexaepetalous flowers of different colours. They are propagated by offsets, which should be taken off in summer at the decay of the leaves; but as all the plants of this genus are natives of warm climates, few of them can bear the open air of this country in winter.

IXORA, a genus of the tetrandra monogyne class of plants. The corolla consists of a single petal, the tube is cylindrical, very long and slender; the limb is plane, and divided into four oval segments; the fruit is a berry of a roundish figure, with only one cell; the seeds are four in number, convex on one side, and angular on the other. There are nine species, very ornamental shrubs for the stove.

JUSTICIA, Malabar nut; a genus of the monogyne order, in the diandra class of plants; and in the natural method ranking under the 40th order, Passifloraceae. The corolla is zygomorphic, the sepals and petals four, in two distinct series, sometimes five, in one series. There are three stamens, with or without a style; the ovary is superior, and three-celled; the seeds are numerous, minute, and free from the fruit.

John, the twenty fourth letter of our alphabet; as a numeral, denotes 250; and with a line over it, K, 250000.

KEMPERIA, zygodium, a genus of the monogyne order, in the monogyne class of plants, and in the natural method ranking under the eighth order, Scitamineae. The corolla is zygodiate, with three of the segments larger than the rest, patulous, and hermaphroditic. There are two species, 1. The galangus, common galangal, or long zygodium. 2. The rotunda, or round zygodium. Both are perennials in root; but the leaves rise annually in spring, and decay in winter. They flower in summer, the segments of one petal, tubular below, but plain above, and divided into six parts; they continue three or four weeks in beauty, but are never succeeded by seeds in this country. Both these plants must be potted in light moulds, and always kept in a hot-house.

KALI, a genus of marine plants, which are burnt to procure mineral acid.

KALMIA, a genus of the monogyne order, in the deciduous class of plants, and in the natural method ranking under the 15th order, Scitamineae. The calyx is quinquangular; the corolla salver-shaped, formed of five nectaries and a stem on the under or outer sides; the capsule quinquangular. Of this genus there are four species. Those chiefly in cultivation with us are, 1. The fritillaria, a most beautiful shrub, which rises usually to the height of five or six feet, and sometimes twice that height in its native places. The flowers grow in bunches on the tops of the branches to foot-stocks three inches long; they are white, stained with purplish red, consisting of one petal in form of a cup, divided at the verge into three sections: in the middle area a style and 12 stamens, which, when the flower first opens, appear lying close to the sides of the cup at equal distances, their apices being lodged in 10 little hollow cells, which being prominent on the outside, appear as many little tubercles. This plant is a native of Carolina, Virginia, and other parts of the northern continent of America, yet is not common, but found only in particular places; it grows on rocks hanging over rivulets and running streams, and on the sides of barren hills.

2. The angustifolia, rises to the height of about 16 feet, with evergreen leaves. The flowers grow in clusters, and when bowed, appear white; but on a near view, are of a faint bluish colour, which as the flower deca
ges grows stronger.

KAOLIN, the name of an earth which is used as one of the two ingredients in oriental porcelain. See Porcelain.

KEEL, or KEELING, in the sea-language, is the winding of old ropes about cables, to prevent them from galling.

KEDGING, in the sea-language, is when a ship is brought up or down a narrow river by means of the tide, the wind being contrary.

KEEL, the lowest piece of timber in a ship, running her whole length, from the lower part of her stem to the lower part of her stern-post. Into it are all the lower fast
tocks fastened; and under part of it, a false keel is often used.

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Each of these species is divided into two sub-species.

Keeschlieffen, common: colour blackish grey or greenish: often traversed by veins of quartz: surface smooth: texture compact: fracture splintery, or imperfectly conchoidal: composed according to Wiegleb of 75.00 silica
10.00 lime
4.25 magnesia
5.34 iron
5.07 inflammable matter

98.14

Keelian stone is another species of kesschleffien, but more interspersed by veins of quartz: fracture even: sometimes inclining to conchoidal: specific gravity 2.590: powder black: co.our greyish black.

This, or a stone similar to it, was used by the ancients as a touch-tone. They drew the metal to be examined along the stone, and judged of its purity by the colour of the metallic streak. On this account they called it eisame, "the knave." They called it also

Kalian stone, because, as Linaeraphus ju-
forms us, it was found most abundantly in the river Timoüs in Lydia.

KIEF, in the glass trade, a term used for a sort of potash made use of in many of the glass works, particularly for the green glass. It is the calcined ashes of a plant called by the same name; and in some places of sea-land, or laces, a sort of thick-leaved fucus or seaweed. This plant is thrown on the rocks and shores in great abundance, and in and after the summer months is raked together and dried as hay in the sun and wind, and afterwards burnt to the ashes called kief.

KING, a shell found on the coast of Sumatra; it is sometimes three or four feet in diameter, as white as ivory. See Madden's Hist. of Sumatra.

KENAS, in the sea-language, doubilings in a rope or cable, when handed in and out, so that it does not run easy; or, when any rope makes turns or twists, and does not run free in the block.

SACRALLINE, K. KEMI. See Cocceus.
KERNER MINERAL, a compound of sulphur of antimony and potash.
KEITH, in naval architecture, a vessel with two masts, usually applied to one carrying sails, or one-hour mowers.
KEVLAR, in ship building, a piece of plank faced against the quickwork on the quarter-deck, in the shape of a semicircle; about which the running rigging is belayed.
KEY, in music, a fundamental note or tone to which the whole scale of a movement has a certain relation or bearing, to which the modulations are referred and accommodated, and in which it both begins and ends. There are but two species of keys, one of the major, and one of the minor mode; all the keys in which we employ sharps or flats being deduced from the natural keys of C major, and A minor, of which indeed they are only transpositions.
KEYSTONE. See Architecture.
KEYS. See ORGAN, HARPSICHORD, &c.

KIDNAPPING, is the forcible taking and carrying away a man, woman, or child, from their own country, and sending them to another. This is an offence at common law, and punishable by fine, imprisonment, and pillory.

By stat. 11 and 12 W. III. c. 7, if any captain of a merchant vessel shall during his being abroad force any person on shore, and wilfully leave them behind, or refuse to bring home all such men as he carried out, if able and desirous to return, he shall suffer three months imprisonment. Exclusive of the above punishment for this as a criminal offence, the party may recover upon an action for common law damages for the civil injury.

KIDNEY: See ANATOMY.

RIFFEKIL. This mineral is dug up near Tonkel in Natalia, and is employed in forming the bowls of Turkish tobacco-pipes. Its use in supports a monitory of dervises established near the place where it is dug. It is found in a large fissure, six feet wide, in grey calcareous earth. The workmen assert that it grows again in the fissure, and puffs itself up like froth. This mineral, when fresh dug, is of the consistence of wax; it feels soft and greasy; its colour is white; it specific gravity 1.050; when thrown on the fire it swells, emits a fetid vapour, becomes hard, and perfectly white.

According to the analysis of Klaproth, it is composed of 30.50 silica 17.25 magnesium 9.60 potash 5.00 carbonic acid .50 lime.

KIGGELARIA, a genus of the decapoda order, in the diecia class of plants, and in the natural method ranking under the 5th order, columnifer. The male calyx is quinquepartite; the corolla pentapetalous; there are five trilobate gladioluses, the anthers are perforated at top; the female calyx and corolla as in the male; there are five styles; the capsule unilocular, quinquinalved, and papyraceous. There is but one species, viz. the Africana. As this is a native of warm climates, it must be constantly kept in a stove in this country. It is propagated by seeds, layers, or cuttings, though most readily by seeds.

KILDERKIN, a liquid measure containing four imperial gallons.
KINDRED. See DESCENT.

KING, signifies him who has the highest power and absolute rule over the whole land; and therefore the king is, in intention of law, charles those defects which common persons are subject to; for he is always sup- posed to be of full age, though ever so young. He proclaims wars and embus to offenders against the crown and dignity, except such as he binds by acts not to forgive. The law ascribes to his majesty, in his political capacity, an absolute immortality. The king never dies. For immediately on the decease of the reigning prince in his natural capacity, his imperial dignity, by act of law, without any interregnum or interval, is vested at once in his heir, who is co instanti king to all intents and purposes. And so tender is the law of supposing even a possibility of his death, that his natural dissolution is generally called his death; and it is merely a transfer of property.

By the articles of the union of the two kingdoms of England and Scotland, all persons and persons marrying papists, are forever excluded from the imperial crown of Great Britain; and in such case, the crown shall descend to such person being a protestant, as shall have inherited the same, in case such papist, or person marrying a popist, was naturally dead. 5 Anne, c. 5.

KING'S BENCH. The king's bench is the supreme court of common law in the kingdom, and is so called because the king used to sit there in person; it consists of a chief justice, and four other justices, who are by office the sovereign conservators of the peace, and supreme coroners of the land. This court has a peculiar jurisdiction, not only over all capital offences, but also over all other misdemeanours of a public nature, tending either to a breach of the peace, or to oppression, or faction, or any manner of misgovernment. It has a discretionary power of inflicting exemplary punishment on offenders, either by fine, imprisonment, or such other infamous punishment as the nature of the crime, considered in all its circumstances, shall require.

The jurisdiction of this court is so trans- scendent, that it keeps all inland jurisdictions within the bounds of their authority; and it may either remove their proceedings to be determined here, or prohibit their progress below; it superintends all civil corporations in the kingdom; commands magistrates and others to do what their duty requires, in every case where there is no pecuniary recovery; protects the liberty of the subject, by speedy and summary interposition; takes cognizance both of criminal and civil causes; the former what is called the crown side, or crown of- fice; the latter in the pleas side of the court.

This court has cognizance on the plea side of all actions of trespass, or other injury alleged to be committed vi et armis; of actions for forgery of deeds, maintenance, conspiracy, deceit, and actions on the case which allege any falsity or fraud.

In proceedings in this court, the defendant is arrested for a supposed trespass, which in reality he has never committed; and being thus in the custody of the marshal of this court, the plaintiff is at liberty to proceed against him for any other personal injury, which surmise of being in the custody of the marshal, the defendant is not at liberty to dis- mise.

This court is likewise a court of appeal, into which may be removed, by writ of er- ror, all determinations of the court of common pleas, and of all inferior courts of record in England.

KING'S BENCH PRISON. King's bench new rules. East 30 G. III. it is ordered by the court, that from and after the first day of Trinity term next, the rule made in the sixth day of the reign of king George I. and all other rules for establishments of the king's bench prison, shall be, and the same are hereby, repealed. And it is further or- dered, that from and after the said first day of Trinity term next, the rules of the king's bench prison shall be comprised within the bounds following, exclusive of the public houses hereinafter mentioned; that is to say, from Great Cumbe-court to the parish of St. George the Martyr, in the county of Sur- rant, the north side of Queen's-walk, and Meanchey-walk, to Blackfriars' road, along the western side of the said road to the obe- lok, and thence along the south-west side of the London-road, round the direction post in the north, along the public houses known by the sign of the Elephant and Castle, and thence along the eastern side of Newing- ton caseway to Great Cumbe-court afo- said: and it is also ordered, that the new goal Souther-rk, and the highway, exclusive of the house on each side of it, leading from the king's bench prison to the said new goal, shall be: within and part of the said rules. And it is hereby ordered, that all taverns, victualling houses, ale-houses, and wine-merchants' and houses or places licensed to sell gin, or other spirituous liquors, shall be excluded out of, and deemed no part of the said rules. It is ordered, that from and after the first day of Trinity term next, no prisoner in the king's bench prison, or within the rules afo- said, shall have, or be entitled to have, day rules above three days in each term. And it is further ordered, that every such prisoner shall return within the walls or rules of the house, the house before the o'clock on the evening day on which such rule shall be granted.

KING'S PALACE. The history of the king's
LAB

palace at Westminster extend from Charing-cross to Westminster-hall, and shall have such privileges as the ancient palaces. 38 II. V. H. c. 19. 1219.

KING'S FISHER. See ALCEDO.

KLEINSTEIN: this mineral comprises whole mountains. They are usually insinuated; and like basalt, shew a tendency to assume the form of four-sided prisms. Its colour is usually deep grey, of various shades; but most commonly greenish shades; but shades pulled together, which gives it the appearance of being spotted. Found not only constituting mountains, but also in globular masses, &c. Internal tissue arrest chiefly from so the crystals of rounded and felspar which it contains. Structure sably. Texture compact. Fracture usually splintery; sometimes conchoidal. Brittle. Gives a clear sound when struck with a hammer. Specific gravity 2.573. Pouder light grey. Melts easily into a glass. A species analysed by Klaproth yielded 37.22 silica. 23.50 alumina 2.75 lime 3.35 oxide of iron 0.65 carbonate of manganese 8.10 soda 3.00 water.

98.10

KLEINHOVY, a genus of the class of and order granae decalcified: the calyx is five-leaf; corolla five-petalled; nect. bell-shaped; ap. dilated, five-lobed. There is one species, a tree of Java.

KNAPSACK, a rough leather or canvas bag, which is strapped to an infantry soldier's back when he marches, and which contains his necessaries. Square knapsacks are supposed to be most convenient. They should be made with a division to hold the shoes, blacking-balls, and brushes, separate from the rest. White goat-skins are sometimes used, but we do not conceive them to be equal to the painted canvas ones. Soldiers are put under stoppages for the payment of their knapsacks, which after six years become their property.

KNAPUTIA, a genus of the monogynia order, in the tetrandrae class of plants, and in the natural method ranking under the 48th order, aggregate. The common calyx is oblong, simple, quinquiflorous; the proper one simple, superior; the corollas irregular; the receptacle naked. There are four species, chiefly annuals of the Levant.

KNEE. See Anatomy.

KNEE, in a ship, a crooked piece of timber, bent like a knee, used to bind the beams and futtocks together, by being bolted fast into them both. These are used about all the decks.

KNEES, curving, in a ship, those timbers which extend from the sides to the hatchway, and bear up the deck on both sides.

KNIGHT, properly signifies a person, who, for his virtue and martial prowess, is by the king raised above the rank of gentleman into a higher class of dignity and honour. The ceremonies at the creation of knights have been various; the principal was a kiss on the ear, and a stroke with a sword on the shoulder; they put on him a shoulder-belt, and a gilt sword, spurs, and other military accoutrements; after which, being armed as a knight, he was led to the church in great pomp. Camden describes the manner of making a knight-bachelor among us, which is the least, though the most ancient order of knighthood: to be thus: the person kneeling was gently struck on the shoulder by the prince, and accosted in these words, 'rise,' or 'be a knight in the name of God.' For the several kinds of knights among us, see BARONET, BARONET, BATH, GARTER, &c.

KNIGHTS of the shire, or KNIGHTS of parliament, in the British polity, are two knights or gentlemen of estate, who are elected, on the king's writ, by the freeholders of every county, to represent them in parliament. The qualification of a knight of the shire is to be possessed of 600l. per ann., in a freehold estate. Their expenses during their sittings were by a statute of Henry VIII. to be defrayed by the county; but this is now never required.

K. or L, the eleventh letter of our alphabet, as a numeral, denotes 10; and with over it, thus, L, 5000.

LA, in music, the syllable by which Guidi denoted the last sound of each hexachord: if it begins in C, it answers to our A; if in G to E; and if in F to D.

LABARUM, in Roman antiquity, the standard borne before the Roman emperors; being a rich purple streamer, supported by a spear.

LABDANUM, or Ladanum. This resin is obtained from the eucalyptus, a shrub which grows in Syria and the Grecian islands. The surface of the shrub is covered with a viscid juice, which when concreted forms ladanum. It is collected while moist by drawing over it a kind of rake with thongs fixed to it; from these it is afterwards scraped with a knife. The best is in masses almost black, and very soft, having a fragrant colour and a bitterish taste. When dissolved in alcohol, it leaves behind it a fetid smell. The specific gravity of this resin is about 1.18. See RESINS.

LABEL, in heraldry, a pile usually placed in the middle along the chief of the coat, without touching its extremities.

LABLE, or LAMB, a cereal. A chemical laboratory, though extremely useful, and even essential to all who embark extensively in the practice of chemistry, either as an art, or as a branch of liberal knowledge, is by no means required for the performance of those simple experiments which furnish the evidence of the fundamental truths of the science. A room that is well lighted, easily ventilated; and destitute of any valuable furniture, is all that is absolutely necessary for the purpose. It is even advisable that the construction of a regular laboratory should be deferred till the student has made some progress in the science; for he will then be better qualified to accommodate his plan to his own peculiar views and convenience.
LABORATORY.

It is scarcely possible to offer the plan of a laboratory, which will be suitable to every person, and to all situations; or to suggest anything more than a few rules that should be observed in it. Different apartments are required for the various classes of chemical operations. The principal one may be on the ground floor; twenty-five feet long, fourteen or sixteen feet wide, and open to the roof, in which there should be contrivances for allowing the occasional escape of suffocating vapours. This will be destined chiefly for containing furnaces, both fixed and portable. It should be amply furnished with shelves and drawers, and with a large table in the centre, the best form of which is that of a double cross. Another apartment may be appropriated to the minister operations of chemistry; such as those of precipitation on a small scale, the processes that require merely the heat of a lamp, and experiments on the gases. In a third, of smaller size, may be deposited accurate balances, and other instruments of considerable nicety, which would be injured by the acid fumes that are constantly spread through a laboratory.

The following are the principal instruments that are required in chemical investigations; but it is impossible, without entering very closely into details, to enumerate all that should be in the possession of a practical chemist.

1. Furnaces. These may either be formed of solid brickwork, or of such materials as are on their removal from place to place. See Furnace, and Chemistry.

2. For containing the materials, which are to be submitted to the action of heat in a wind furnace, vessels called crucibles are employed. They are most commonly made of a mixture of fire-clay and sand, occasionally with the addition of plumbago, or black lead. The Hessian crucibles are best adapted for supporting an intense heat without melting; but they are liable to crack when suddenly heated or cooled. The porcelain crucibles made by Messrs. Wedgwood, are of much purer materials, but are still more apt to crack on sudden changes of temperature; and when used, they should therefore be placed in a crucible of fire-clay, the interval being filled with sand. The black-lead crucibles resist very sudden changes of temperature, and may be repeatedly used; but they are destroyed when some saline substances (such as nitre) are melted in them, and are consumed by a current of air. For certain purposes crucibles are formed of pure silver or platinum. Their form varies considerably; but it is necessary, in all cases, to make the edge of the bases of the crucibles of the bars of the grate, by a stand. For the purpose of submitting substances to the continued action of a red heat, and with a considerable surface exposed to the air, a hollow-arched vessel, with a bottom flat, termed a muffle, is commonly used.

3. Evaporating vessels should always be of a flat shape, so as to expose them extensively to the heat. They are formed of glass, of earthenware, and of various metals. Those of glass are with difficulty made sufficiently thin, and are often broken by changes of temperature; but they have a great advantage in the smoothness of their surface, and in resisting the action of most acid and corrosive substances. Evaporating vessels of porcelain, or Wedgwood's ware, are next in utility, are less costly, and less liable to be cracked. They are made both of glazed and unglazed ware. For ordinary purposes, the latter are preferred; but the unglazed should be employed when great accuracy is required, since the glazing is acted on by several chemical substances. Evaporating vessels of glass, or porcelain, are generally lined up to their edge in sand; but those of various metals are placed immediately over the naked flame. When the glass or porcelain vessel is very thin, and of small size, it may be safely placed on the ring of a brass stand, and the flame of an Argand's lamp, cautiously regulated, may be applied beneath it. A lamp thus supported, so as to be raised or lowered at pleasure, on an upright pillar, to which rings of various diameters are attached, will be found extremely useful; and when a strong heat is required, it is advisable to employ a lamp provided with double concentric wicks.

4. In the process of evaporation, the vapour for the most part is allowed to escape; but in certain chemical processes, the collection of the volatile portion is the principal object. This process is termed distillation. See Distillation.

The contents of a lute, however, can only be employed for volatilizing substances that do not act on copper, or other metals, and is, therefore, limited to very few operations, and on that account plumbago and retorts are necessary.

In several instances, the substance raised by distillation, is partly a condensable liquid, and partly a gas, which is not condensed till it is brought into contact with water. To effect this double purpose, a series of receivers termed Woolley's apparatus is employed.

See Chemistry.

When a volatile substance is submitted to distillation, it is necessary to prevent the escape of the vapour through the junctures of the vessels; and this is accomplished by the application of lutes. The most simple method of confining the vapour is obviously useless; it would be to connect the places of juncture accurately together by grinding; and according the neck of the retort is sometimes ground to the mouth of the receiver. This, however, adds too much to the expense of the apparatus to be generally practised.

When the distilled liquid has no corrosive property, (such as water, alcohol, ether, &c.) slips of moistened bladder, or paper or linen spread with flour paste, white of egg, or mucilage of gum Arabic, sufficiently answer the purpose. The substance remains, after expressing the oil from bitter almonds, and which is sold under the name of almond meal or flour, forms a useful lute, when mixed to the consistency of glaziers' putty, or with water or mucilage.

For confining the vapour of acid or highly corrosive substances, the fat lute is well adapted. It is formed by beating perfectly dry and finely-sifted tobacco-pipe clay with painters' drying-oil, to such a consistency that it may be moulded by the hand. The same clay, beaten up with as much sand as it will bear without losing its tenacity, with the addition of cut tow, or of horse-dung, and a proper quantity of water, furnishes a good lute, which has the advantage of resisting a considerable heat, and is applicable in those cases where the fat lute would be melted or destroyed. Various other lutes are recommended by chemical writers; but few that have been enumerated are found to be amply sufficient for every purpose. See Lute.

On some occasions, it is necessary to practice the return of too sudden changes of temperature by a process called cooling. For glass retorts, a mixture of common clay or lamp with sand, and cut shreds of flax, may be employed. If the distillation is performed by a sand heat, the coating needs not to be applied higher than that part of the retort which is heated in sand; but if the process is performed in a wind furnace, the whole body of the retort, and that part of the neck also which is exposed to heat, must be carefully coated. To this kind of distillation, however, earthen retorts are not adapted; and they may be covered with a composition originally recommended by Mr. Willis. Two ounces of borax are to be dissolvd in a pint of boiling water, and a sufficient quantity of slaked lime is added, until the thickness of cream is thus to be applied by a painter's brush, and allowed to dry. Over this a thin paste is afterwards to be applied, formed of slaked lime and common fiescoedile, well mixed and strained through a plastic mill. In a day or two, the coating will be sufficiently dry to allow the use of the retort.

For joining together the parts of iron vessels used in distillation, a mixture of the finest China clay, with solution of borax, is well adapted. In all cases, the different parts of any apparatus made of iron should be accurately fitted by boring and grinding, and the above lute is to be applied to the part which is to receive an aperture. This will generally be sufficient without any exterior luting; otherwise the lute of clay, sand, and flax, already described, may be used.

In every instance, where a lute or coating is applied, it is advisable to allow it to dry before the distillation is begun; and even the fat lute, by exposure to the air during one or two days after its application, is much improved. With lute and sand heat, however, it is perfectly useless, except it is previously quite dry. In applying a lute, the part immediately over the juncture should swell outwards, and its diameter should gradually diminish on each side.

Besides the apparatus already described, a variety of vessels and instruments are necessary, having little resemblance to each other in the purposes to which they are adapted. Glass vessels are very essential for effecting solution, which often requires the application of heat, and sometimes for a considerable duration. In the latter case it is termed digestion, and the vessel called a digestion is the most frequent performing it. When solution is quickly effected, a bottle, with a rounded bottom, may be used, or a common Florence-coil flask serves the same purpose extremely well, and is much preferable, when subjected to changes of temperature.

Glass rods, of any size, strength, and span of the same material, or of par-
retain, are useful for stirring acid and corrosive liquids; and a stock of cylindrical tubes of various sizes, is required for occasional purposes. It is necessary also to be provided with a series of glass measures, graduated to half-cups, ounces, and pints.

Accurate beams, scales, and various redial instruments, with corresponding weights, some of which are capable of weighing several pounds, while the smaller size ascertain a minute fraction of a grain, are essential instruments in the chemical laboratory. So also are mortars of different materials, such as of glass, porcelain, agate, and metal. Wooden stands of various kinds for supporting receivers, should be provided. For purposes of this sort, and for occasionally raising to a proper height any article of apparatus, a series of blocks, made of well-seasoned wood, eight inches (or any other number) square, and respectively four, two, one, and half an inch in thickness, will be found extremely useful; since by combining them in different ways, no less than thirty-one different heights may be attained.

The blowpipe is an instrument of much utility in chemical researches. A small one, invented by Mr. Bunsen, with a flat cylindrical bunsen for condensing the vapour of the breath, and for containing caps, to be occasionally applied with apertures of various sizes, is perhaps the most commodious form. A blowpipe, which is supplied with air from a pair of double bellows, worked by the foot, may be applied to purposes that require both hands to be left at liberty, and will be found useful in blowing glass, and in blowing vessels. The latter purpose, however, may be accomplished by holding them over an Argand's lamp with double wicks.

Laboratory signifies also in military affairs, that place where all sorts of fire-works are prepared both for actual service, and for pleasure, viz. quick matches, fusees, portières, grape-shot, case-shot, carcasses, hand-grenades, cartridges, shells filled and fuses fixed, &c.

Lamb, a genus of fishes of the order thalacerea; the typical character is, teeth strong and subacute: the grinders sometimes, as in the sparrow, convex and crowded: lips thick and doubled: rays of the dorsal fin, in some species, elongated into soft processes. Gill-covers unpaired and scaly.

Laurus nobilis, var. robustus. Labrus, a sort of fish resembling a mackerel, which is a food fish, found in the Mediterranean, sometimes wandering into rivers. There are 41 species belonging to this genus, all of which are but imperfectly understood.

Lavern. See Master and Servant.

Labyrinth, in gardening, a winding maze walk between hedges, through a wood or wilderness. The chief aim is to make the walks so perplexed and intricate, that a person may lose them in them, and to cover them, with as great a number of disappointments as possible. They are rarely to be met with, except in great gardens; as Versailles, Hampton-court, &c.

Lac, an appellation given to several chemical preparations.

Lac. This resin exudes from the tree Vol. II.
This numerous genus may be divided into the following sections, viz.:

1. Crocodiles, furnished with very strong scales.

2. Gunnas, and other lizards, especially with serrated or spiny tails.

3. Cordyles, with dentateurated, and sometimes spiny scales, either on the body or tail, or both.

4. Lizards proper, smooth, and the greater number furnished with broad square scales or plates on the abdomen.

5. Chamaeleons, with granulated skin, large head, long missile tongue, and cylindrical tail.

6. Gekkos, with granulated or tuberculated skin, and lobated feet, with the toes lamellated beneath.

7. Scinks, with smooth, fishy, scales.

8. Salamanders, newts, or eels, with soft skins, and of which some are water-lizards.

9. Snake-lizards, with extremly long bodies, very short legs, and minute feet.

The above divisions neither are, nor can be, perfectly precise; since species may occur which may, with almost equal propriety, be referred to either of the neighboring sections; but, in general, they will be found useful in the investigation of the species.

The following are the most noted:

1. Lacerta crocodilus, or crocodile. The crocodile, so remarkable for its size and powers of destruction, has in all ages been regarded as one of the most formidable animals of the warmer regions. It is a native of Asia and Africa, but seems to be most common in the latter; inhabiting large rivers, as the Nile (see Plate Nat. Hist. t. 237), the Niger, Sce, and preying principally on fish, but occasionally seizing on almost every animal which happens to be exposed to its rapacity. The size to which the crocodile sometimes arrives is prodigious; specimens being frequently seen of 20 feet in length, and instances are commemorated of some which had exceeded the length of 30 feet. The armour with which the upper part of the body is invested is the most elaborate of nature's mechanisms. In the full-grown animal it is so strong and thick as easily to repel a musket-ball; on the longer parts it is much thinner, and of a more pliable nature, and appears as if covered with the most regular and curious carved work: the colour of a full-grown crocodile is blackish-brown above, and yellowish-white beneath; the upper parts of the legs and the sides varied with deep yellow, and in some parts tinged with green. In the young animals the colour on the upper parts is a mixture of brown and pale yellow, the under parts being nearly white: the eyes are protected by a firm membrane, or transparent movable pellicle, as in birds; the mouth is of vast width, the rictus or gape having a somewhat fleshy outline, and both jaws being furnished with very numerous sharp-pointed teeth, of which those about the middle part of each jaw considerably exceed the rest in size, and seem analogous to the canine teeth in the vipers: quadrupeds or mammalia: the number of teeth in each jaw is 40, or 50, and it is very proper to alternate with each other when the mouth is closed; on taking out the teeth and examining the alveoli, it has been found that small teeth were forming beneath, in order to supply the loss of the others when shed.

The auditory foramina are situated on the top of the head, above the eyes, and are moderately large, oval, covered by a membrane, having a longitudinal slit or opening, and thus in some degree resembling a pair of small ears. The legs are short, but strong and muscular, the fore legs are short, curved, and the other legs are long, very long, of a laterally compressed form, and furnished above with an upright process, formed by the gradual approximation of two elevated crests proceeding from the lower part of the back.

The crocodile in a young state is by no means to be dreaded, its small size and weakness preventing it from being able to injure any of the larger animals; it therefore content itself with fish and other small prey; and such as have occasionally been brought to Europe are so far from being formidable or ferocious, that they may be generally trusted with, and domesticated among, birds, insects, or fish, and even among other quadrupeds, or the effect of a cold climate, seem much inclined to torpidity; but in the glowing regions of Africa, where it arrives at its full strength and power, it is justly regarded as the most formidable of all the inhabitants of the rivers. It lies in wait near the banks, and snatches dogs and other animals, swallowing them instantly, and then plunging into the river, and seeking some retired part, where it may be concealed: it then invites it to its prey. In its manner of attack it is exactly imitated by the common lacertas pustularis, or water-newt, which, though not more than four or five inches long, will with the greatest case swallow an insect of more than an inch in length: and that at one single effort, and with a motion so quick, that the eye can scarcely follow it. It poises itself in the water, and having gained a convenient opportunity, it advances in the most rapid and irresistible manner to the insect, and swallows it. If, therefore, a small lizard of four or five inches only in length can thus instantaneously swallow an animal of a fourth part of its own length, we may judge of the force of a crocodile of 18, 20, 22, or 25 feet long, should suddenly ingress a dog or other quadruped.

Crocodiles, like the rest of the lacertas, are oviparous: they deposit their eggs in the sand or mud near or on the banks of the rivers they frequent, and the young when hatched immediately proceed to the water: but the major part are said to be commonly devoured by other animals, as ichneumons, and other carnivorous animals, which are said to form one of their favourite repasts.

In the large rivers of Africa crocodiles are said to be sometimes seen swimming together in vast shoals, and resembling the trunk of so many large trees dancing on the water.
LACERTA.

The negroes will sometimes attack and kill a single crocodile, by stabbing it under the belly, where the skin, at the interstices of the scales, is soft and flexible. It is also, in some countries, the custom to hunt the crocodile by means of strong dogs, properly trained to the purpose, and armed with spiked collars. It is likewise pretended, that in some parts of Africa crocodiles are occasionally tamed; and it is said that they form an article of royal magnificence with the monarchs of those regions, being kept in large ponds or lakes appropriated to their residence. We may add, that the ancient Romans exhibited these animals in their public spectacles and triumphs, Scarsus, during his availsip, treated the people with a sight of five crocodiles, escaped in a temporary lake; and Augustus introduced one into his triumph over Cleopatra, as well as several others, for the entertainment of the people.

2. Lacerta alligator. So very great is the general resemblance of this animal and the crocodile, that many naturalists have been strongly inclined to consider it as a mere variety, rather than a distinct species. The more accurate discrimination, however, of Blumenbach and some others seems to prove that the alligator or American crocodile is specifically distinct from the nilotic, though the difference is not so immediately to strike a general observer. The leading and peculiar characters, which constitute a distinction of species, seems to be, that the head of the alligator is rather smooth on the upper part than marked with those very rugged and hard carinated scales which appear on that of the crocodile; and that the snout is considerably flatter and wider, as well as more rounded at the extremity. The alligator arrives at a size not much inferior to that of the crocodile, specimens having been often seen of 18 or 20 feet in length.

"Though the largest and greatest numbers of alligators," says Catesby, "inhabit the torrid zone, the country abounds in them 10 degrees more north, particularly as far as the river Neus in North Carolina, in the latitude of about 33 degrees, beyond which I have never heard of any, which latitude nearly answers to the southern limits of Africa, where they are likewise found. They frequent not only salt rivers near the sea, but streams of fresh water in the upper parts of the country, and in lakes of salt and fresh water, on the banks of which they lie lurking among reeds, to surprise cattle and other animals. In Jamaica, and many parts of the continent, they are found about 20 feet in length: they cannot be more terrible in their aspect than they are formidable and mischievous in their nature, sparing neither man nor beast they can surprise, pulling them down under water, that being dead, they may with greater facility, and without struggle or resistance, devour them. As quadrupeds do not so often come in their way, they almost subsist on fish; but as Providence, for the preservation, or to prevent the extinction of these harmless creatures, has in many instances re-striped the devouring appetites of voracious animals, by some impediment or other, so this de-troucing monster, by the close connection of his vertex, can neither swim nor run any other way than straight forward, and is consequently disabled from turning with that agility requisite to catch his prey by pursuit therefore they do it by surprise in the water as well as by land; for effecting which nature seems in some measure to have recompensed their want of agility, by giving them a power of deceiving and catching their prey, such or such a manner, as well as by the outerform and colour of their body, which on land resembles an old dirty log or tree, and in the water frequently lies floating on the surface, and there has the like appearance; and has a silent artifice, fish, fowl, turtle, and all other animals, are deceived, suddenly caught, and devoured.

In Carolina they lie torpid from about October to March, in caverns and hollows in the banks of rivers, and at their coming out in the spring make an hideous bellowing noise. The hind part of their belly and tail are eaten by the Indians. The flesh is delicately white, but has so perfumed a taste and smell that I never could relish it with pleasure.

3. Lacerta gaugettus. The gaugettic crocodile is so strikingly distinguished both from the nilotic and the alligator by the peculiar form of the mouth, that it is hardly possible, even on a cursory view, to confound it with the latter. It is of an incredibly long, narrow, and perfectly straight, and the upper mandible terminated above an elevated tubercle. In a very young state the length and narrowness of the snout are still more conspicuous than in the full-grown animal. The teeth are nearly double the number of those of the common crocodile, and are of equal size throughout the whole length of the jaws. This species is a native of India, and is principally seen in the Ganges, where it arrives at a size at least equal to the nilotic crocodile.

4. Lacerta iguana. Though the lizard tribe affords numerous examples of strange and peculiar form, yet few species are perhaps more eminent in this respect than the guana, which grows to a very considerable size, and is often seen of the length of three, four, and even five feet. It is a native of many parts of America and the West Indian islands, and is occasionally to be found in the East Indies. Its general colour is green, but with much variation in the tinge of different individuals: it is generally shaded with brown in some parts of the body, and sometimes this is even the predominant colour. The back of the guana is very strongly serrated; and this, together with the gular pouch, which it has the power of extending or inflating occasionally to a great degree, gives a formidable appearance to an animal otherwise harmless. It inhabits rocky and woody places, and feeds on insects and vegetables. It is itself reared an excellent food, being extremely nourishing and delicate; but it is observed to deserve the common method of catching it by casting a noose over its head, and thus drawing it from its situation; for seldom makes an effort to escape, but stands looking intently at its disposer, in case it is found to be the same time in an extraordinary manner.

The guana may be easily tamed while young, and is both an innocent and beautiful creature in that state.

5. Lacerta basiliscus. The basilisk of the ancients, supposed to be the most malignant of all poisonous animals, and of which the very aspect was said to be fatal, is a fabulous existence, to be found only in the representations of painters and poets.

But the animal known in modern natural history by this name is a species of lizard, of a very singular shape and habit, particularly distinguished by a long and broad wing-like process or expansion continued along the whole length of the back, and to a very considerable distance on the upper part of the tail. There is generally a rare internal radiating array to those in the fins of fishes, and still more so to those in the wings of the draco volans, or flying lizard. This process is of different elevation in different parts, so as to appear strongly simulated and outlined, and is capable of being either dilated or contracted at the pleasure of the animal. The occiput or hind part of the head is elevated into a very conspicuous pointed hood or hollow crest.

It is astonishing its formidable appearance the basilisk is a perfectly harmless animal, and, like many other of the lizard tribe, resides principally among trees, where it feeds on insects, &c. The colour of the basilisk is a pale olive green in some parts of the back, with some darker or lighter lines drawn towards the whole body, which is principally found in South America, and is sometimes considerably exceeds the length before mentioned, measuring three feet, or even more, from the nose to the extremity of the tail. It is said to be an animal of great agility, and is capable of swimming occasionally with perfect ease, as well as of springing from tree to tree by the help of its own power, which it expands in order to support its flight.

6. Lacerta calotes. This species is considerably allied to the common guana in habit or general appearance; but is of much smaller size, rarely exceeding the length of a foot and a half from the tip of the nose to the extremity of the tail. It is also destitute of the very large gular pouch, so conspicuous in that animal; instead of which it has merely a slight inflation or enlargement on that part. In colour it is more varied than that of this tribe; but it is commonly of an elegant bright blue, variegated by several broad, and somewhat irregular white or whish transverse bands on each side of the body and tail. It is a native of the warmer regions of both Asia and Africa, and is found in many of the Indian islands, and particularly in Ceylon, in which it is common. According to the count de Capepe it is also found in Spain, &c. and is said by that author to wander about the tops of bushes in quest of spiders; and he observes, that it is even reported to prey on rats, and to fight with small serpents in the manner of the common green lizard and some others. See Plate Nat. Hist. Fig. 230.

7. Lacerta montana, the monitor, or montitory lizard, is one of the most beautiful of the whole tribe, and is also one of the largest; sometimes measuring not less than four or five feet from the tail up. The form of its body is slender and elegant, the head being small, the snout gradually tapering, the limbs moderately slender, the tail laterally compressed, and inenable decreasing towards the tip, which is very slender and sharp. Though the colour of this lizard are
simple, yet such is their disposition, that it is impossible to survey their general effect without admiration. In this respect, however, the animal varies perhaps more than most others of its tribe. It is commonly black, with the abdomen white, the latter located on the underside of the body. The skin, when distended, is either in the form of several pointed bands, besides which the whole body is generally ornamented by several transverse bands consisting of white annular spots, while the head is marked with various streaks of the same colour, the limbs with very numerous round spots, and the tail with broad, distant, transverse bands. It is a native of South America, where it frequently occurs in woody and watery places; and, if credit may be given to the reports of some authors, is of a disposition as gentle as its appearance is beautiful. It has even gained the title of monitor, salvaguardia, &c. from its pretended attachment to the human race, and it has been said that it warns mankind of the approach of the agitator by a loud and shrill whistle.

Cordylus, with either dentilicate or spiny scales on the body or tail, or both.

8. Lacerta pellona, is one of the middle-sized lizards; the total length being nearly two feet, and the length of the body and tail nearly equal. It is a native of Chili, where it is said to inhabit hollows under ground. It is covered with variously colored spots of yellow, blue, and black; the under parts are of a glossy yellowish-green; the tail long and verticillated by rows of rhomboid scales; and the head of this lizard has been said to be used by the Chilians for the purpose of a burnish.

9. Lacerta stellio, is remarkable for its unusually rough or hirsute appearance of its whole upper surface; both body, limbs, and tail, being covered with pointed scales, projecting here and there to a considerable distance beyond the surface, so that it appears foresticulated with spines; the tail is rather short, and verticillated with rows of rhomboid pointed scales. The general color of the animal is a pale blueish-brown, with a few deeper and lighter transverse variegations; its general length is about eight inches. It is a native of many parts of Africa.

Lizards proper, smooth, and the greater number furnished with broad square plates or scales on the abdomen.

10. Lacerta agilis, green lizard, is found in all the warmer parts of Europe, and seems pretty generally diffused over the ancient continent. It sometimes arrives at a very considerable size, measuring more than two feet to the extremity of the tail; its more general length, however, is from 10 to 15 inches. In its coloration it is the most beautiful of all the European lacerti, exhibiting a rich and varied mixture of darker and lighter green, interpersed with specks and marks of yellow, brown, blackish, and even sometimes red. The green lizard is found in various situations, in gardens, about warm walls, buildings, &c. and is an extremely active animal, often pursuing great crows, turned up grey, and escaping with great readiness from pursuit when disturbed. When taken, however, it is soon observed to become familiar, and may even be tamed to a certain degree; for which reason it is considered as a favourite animal in many of the warmer parts of Europe.

11. Lacerta bullaris, red-throat lizard. This, according to Catesby, is usually six inches long, and of a golden-green colour. It is common in Jamaica, frequenting hedges and trees, but is not seen in houses; when approached it swells its throat into a globular form, the protruded skin on that part appearing of a bright-red colour, which disappears in its withdrawn or contracted state; this action is supposed to be a kind of menace, in order to deter its enemy; but it is incapable of doing any mischief by its bite or otherwise. See Plate Nat. Hist. fig. 235.

Chameleons, with granulated skin, missile tongue, &c.

12. Lacerta chameleon. Few animals have been more admired by natural historians than the chameleon, which has been sometimes said to possess the power of changing its colour at pleasure, and of assimilating it to that of any particular object or situation. It must be received with very great limitations; the change of colour which the animal exhibits varying in degree according to circumstances of health, temperature of the weather, and many other causes; and consisting chiefly in a sort of alteration of shades from the natural greenish or blueish green of the skin into pale yellowish, with irregular spots or patches of dull red.

It is also to be observed, that the natural or usual colour of chameleons varies very considerably: some being much darker than others, and it has even been seen approaching to a blackish tinge. An occasional change of colour is likewise observable, though in a less striking degree, in some other lizards.

The general length of the chameleon, from the tip of the nose to the beginning of the tail, is about ten inches, and the tail is of nearly similar length, but the animal is found entire, and sometimes exceeds the length above mentioned. It is a creature of a harmless nature, and supports itself by feeding on insects; for which purpose the structure of the tongue is finely adapted, consisting of a long, slender body, furnished with a dilated and somewhat circular tip, by means of which the animal seizes insects with great ease, darting out its tongue in the manner of a weeverfish, and retrieving it instaneously with the prey secured on its tip. It can also support a long abstinence, and hence arose the popular idea of the chameleon being nourished by air alone. It is found in many parts of the world, and particularly in India and Africa. It is also sometimes seen in the warmer parts of Spain and Portugal.

The general or usual changes of colour in the chameleon, are from a blueish ash-colour, (its natural tinge) to a green and sometimes yellowish-green, and blackish green, with red. If the animal is exposed to a full sunshine, the unilluminated side generally appears, within the space of some minutes, of a pale yellow, with large roundish patches or spots of red-brown. On reversing the situation of the animal, the same change takes place in the opposite direction; the side which was before in the shade now becoming either brown or ash-colour, while the other side becomes yellow and red; but these changes are subject to much variety both as to intensity of colour and disposition of spots.

Besides the common chameleon, different races appear to exist, which are principally distinguished by their colour, and the more or less elevated state of the angular or crested part of the head. These, which Linnaeus was content to consider as varieties, are now raised to the dignity of species, and are so distinguished in the German edition of the Systema Naturae. Geckos, with granulated or tuberculated skin, lobated feet, and toe ameliated beneath.

13. Lacerta gecko. The gecko, said to be so named from the sound of its voice, which resembles the above word uttered in a shrill tone, is a native of many parts of Asia and Africa, as well as of some of the warmer regions of Europe. The middle-sized lizards, measuring, in general, about a foot in length, or rather more. It is of a thicker and stouter form than most other lizards, having a large and somewhat triangular head, covered with small scales, a wide mouth, large eyes, minute teeth, and a broad flat tongue. The limbs are of moderate length, and the feet are of a broader form than the rest of the genus.

The gecko inhabits obscure recesses, caverns, old walls, trees, &c. and is said to be chiefly on the approach of rain. It is considered as a poisonous nature, highly scurulative kind of fluid exuding from the corners of the feet, which remaining on the surface of fruit or any other edible substance is often productive of troublesome symptoms to those who happen to swallow it. From the peculiar structure of its feet, the gecko can adhere to smoothest or roughest surfaces. The general color of the animal is pale brown, with a few irregular daisy or bluish variegations; but in those insects in the warmer regions of the globe, this colour seems to be blended into a much more brilliant appearance.

14. Lacerta ambra. This remarkable species seems to have been first described by the Count de Cepedelle, who informed us that it appears in some degree to connect the chameleon, the gecko, and the water-newts; that the head, skin, and general form of the body, resembling those of the chameleon, the tail of the water-newts, being of a compressed form, though in a different manner (not vertically but horizontally flattened), while the feet resemble those of the gecko. The largest specimen examined by the author of this work is of about eight inches and six lines in length, of which the tail measured two inches and four lines. The colour of this animal is not constant or permanent, as in most lizards, but variable in the course of time successively different shades of red, yellow, green, and blue. This variation of colour is, however, confined to the upper surface of the animal; the lower always remaining of a bright yellow. These changes, we are
informed, have been observed in the living animal by Mons. Bruyeres, in his native country, and other naturalists. It is very uncommon, and where, though a harmless animal, it is held in great abhorrence by the natives, who consider it as a poisonous nature, and fly from it with precipitation; pretending that it deserts on their branches, and adheres with such force by its fringed membrane, that it cannot be separated from the skin without the assistance of a razor. The principal cause of this popular dread of the animal is, its habit of running down on its hinder part, towards the spectator, instead of attempting to escape; when discovered. Its chief residence is on the branches of trees, where it lives on insects, holding itself secure by coiling its tail, short as it is, half round the trunk of the tree. It is like most other lizards, adapted to rainy weather, when it moves with considerable agility, often springing from branch to branch. On the ground it walks but slowly, the fore legs being shorter than the hinder.

The skin, which raidous-like scales. 15. Lacerta sicarius, or official skin. The scind is one of the middle-sized or smaller lizards, of many of the warmer parts of the world. It abounds in Lybia, Syria, Egypt, and Arabia, frequenting moderately dry and sandy soils, and growing to the length of six or seven inches, or even sometimes more. The head of the scind is rather small than large, the body thick and round, the tail in general considerably shorter than the body. The whole animal is of a pale yellowish-brown colour, with a few brownish dots; and, when undisturbed, the flesh, particularly of the belly, was supposed to be diuretic, alexipharmic, restorative, and useful in leprous and many other cases; but whatever virtues it may possess when used fresh, a great deal of any advantage is lost when it is dried in its natural habitat.
LACTIC acid. If milk be kept for some time it becomes sour. The acid which then appears is this first examined by Scheele, and found by him to have peculiar properties. It is called lactic acid. In the whey of milk this acid is mixed with a little curd, some phosphat of lime, sugar of milk, and mucilage. All these must be separated before the acid can be examined. Scheele accomplished this by the following process:

Evaporate a quantity of sour whey to an eighth part, and then filtrate it: this separates the curdy parts. Saturate the liquid with lime-water, and the phosphat of not precipitates. Filtrate again, and dilute the liquid with three times its own bulk of water; then let fall into it oxalic acid, drop by drop, to precipitate the lime which has dissolved from the whey, and then add a very small quantity of lime-water, to see whether too much oxalic acid has been added. If there has, oxalat of lime immediately precipitates. Evaporate the solution to the consistence of heavy cream; then add a quantity of alcohol, and filtrate again; the acid passes through dissolved in the alcohol, but the sugar of milk and every other substance remain behind. Add to the solution a small quantity of water, and distil with a small heat, the alcohol passes over, and leaves behind the lactic acid dissolved in water.

This acid requires much concentration, when evaporated to dryness, it deliquesces again in the air. When distilled, water comes over first, then a weak acid resembling the tannic, then an empyreumatic oil mixed with more of the same acid, and, lastly, carbonic acid and carbonated hydrogen gas: there remains behind a small quantity of charcoal.

The combinations which this acid forms with alkalies, earths, and metallic oxides, are called lactats, which see.

All that is known concerning these salts are the following facts, ascertained by Scheele. When saturated with fixed alkalies, it gave salts, which were deliquescing and soluble in spirit of wine. It formed deliquescent salts with ammonia, with barytes, with lime, and alumina; but with magnesia it formed small crystals, which how ever at length deliquesced. When submitted to a mixture of hydrogen and tin, and various mixtures of metals and acids, the acid became more crystallized. It dissolved zinc and iron; and it produced with these metals hydrogen gas. Zine was the only metal with which it crystallized.

LACTIC, the lettere, a genus of the subg. of the former order, the eugenie class of plants, and in the natural order ranking under the 49th order, composite. The receptacle is naked; the calyx imbricated, cyllindrical, with a membraneous margin; the petals are simple, stipulated, or stalked. There are 11 species, most of which are plants of no use, and never cultivated but in botanic gardens for variety. That commonly cultivated in the kitchen-gardens is the common or garden lettuce, which includes the following varieties: 1. The common or garden lettuce. 2. Cabbage lettuce. 3. Silesia lettuce. 4. Dutch brown lettuce. 5. Aleppo, or spina lettuce. 6. Imperial lettuce. 7. Green capuchin lettuce. 8. Variegated or striped cos lettuce. 9. Black cos. 10. Red cos. 11. Red capuchin lettuce. 12. Roman lettuce. 13. Prince lettuce. 14. Royal lettuce. 15. Egyptian cos lettuce.

The first of these sorts is very common in all gardens, and is commonly sown for cutting very young, to mix with other salad herbs in spring; and the second, or cabbage lettuce, is only this demanded by culture. The first 40 should be sown in February, in an open situation; the others at three weeks distance; but the latter ones under cover, but not under the drippings of trees. The Silesia, imperial, royal, black, and upright cos lettuces, are first sown in the latter part of February or the beginning of March, on a warm light soil, and in an open situation: when the plants are come up, they must be thinned down to this acid, at any step, they will then require no further care than the keeping them clear of weeds; and the black cos, as it grows large, should have its leaves tied together to whiten the inner part. Succeeding crops of these should be sown in April, May, and June; and towards the latter part of August they may be sown for a winter crop, to be preserved under glasses, or in a bed arched over with hoops and covered with mats. The most valuable of all the English lettuces are the white cos, or the Versailles; and the Egyptian cos. The brown Dutch and the green Dutch are very hardy, and may be sown late under walls, where they will stand the winter, and be valuable when no others are to be had. The red capuchin, Roman, and prince lettuce, are very early kinds, and adorn the ornamental beds; as are also the those for the beauty of the spotted leaves.

The several sorts of garden lettuces are very wholesome, enlolicent, cooling salad herbes, easy of digestion, and since the lettuce has a peculiar property of soothing the belly. Most writers suppose that they have a narcotic quality; and indeed in many cases they contribute to procure rest; this they effect by soothing heat, and relying the appetite. The seeds are in the number of the four lesser cold seeds.

LAGUNAR. See Architecture.

LADDERS, scaling, in the military art, are used in scaling when a place is to be taken by surprise. They are made several ways: here we make them of flat staves, so that they may move about their pins, and shut like a parallel ruler, for conveniently carrying them: the French make them of several pieces, so as to be joined together, and to be made of any necessary length: sometimes they are made of single ropes, knotted at proper distances, with iron hooks at each end, one to fasten them upon the wall above, and another under, to which they are made with two ropes, and staves between them, to keep the ropes at a proper distance, and to tend upon. When they are used in the action of scaling walls, they ought to be rather too long, that they may be in charge only to the stoutest of the detachment. The soldiers should carry these ladders with the left-arm passed through the shoulder, taking care to hold them upright close to their sides, and very short below, to prevent any accident in leaping into the ditch.

The first rank of each division, provided with ladders should shout out with the rest at the signal, making resolution with their firelocks slung, to jump into the ditch: when they are arrived they should apply their ladders against the parapet, observing to place the ladder, rather than the middle of the curtine, because the enemy have less force there. Care must be taken to place the ladders within a foot of each other, and not to give them too much or too little slope, so that they may not be overturned or broken with the weight of the soldiers mounting upon them.

The ladders being applied, those who have carried them, and those who come after, should mount up, and rush upon the enemy sword in hand: if he who goes first happens to be overturned, the next should take care not to be thrown down by his comrade; but, on the contrary, immediately mount himself, so as not to give the enemy time to load his piece.

As the soldiers who mount first may be easily turned over, and their fall may cause the attack to fail, it would perhaps be right to protect their breasts with the fore parts of cutlasses; because if they can penetrate the rest may easily follow.

LADY'S smock. See Cardamine.

LADY'S slipper. See Cypripedium.

LAELIA, a genus of the monogynia or...
LAMINIA, in physiology, the thin plates of which many substances consist.

LAMIA, an order of plants, and in the natural method ranking with those of which the order is doubtful. The corolla is hexapetalous, or none; the calyx is penta- or monopetalous; the flowers are unisexual, and the seeds have a pulpily or casse. There are four species, natives of America. One of them, the apetal, or gum-wood, Dr. Wright informs us, is very common in the woodlands and copses of Jamaica, where it rises to a considerable height and thickness. Pieces of the trunk or branches, suspended in the heat of the sun, discharge a clear tarrentine or balsam, which concretes into a white resin, and which seems to be the same as gum sandarac. Poucke is made of it; and our author is of opinion that it might be useful in medicine like other gums of the same nature.

LAGERSTROEMIA, a genus of the monogynia order, in the polyandria class of plants. The corolla is hexapetalous, and curled; the calyx sepulcral, and campanulated; there are many stamens, and of these the six outer ones thicker than the rest, and longer than the flowers. There are four species, trees of the East Indies.

LAGOEIA, a genus of the monogynia order, in the petandria class of plants. The involucrum is universal and partial; the petals bisulcal; the seeds solitary, inferior. There is one species, wild cumin, an annual, of the Levant.

LAGUNEA, a genus of the class and order monadelpho polyandria. The calyx is simple, five-angled; style simple; stigma peltate; capsule five-celled, five-valved. There are three species, shrubs of the East Indies and Surinam.

LAGURUS, a genus of the digynia order, in the triandria class of plants, and in the natural method ranking under the fourth order, monandria. The calyx is hooded with a villous awn, the exterior petal of the corolla terminated by two awns, with a third on its back retorted. There is one species, a grass of the south of Europe.

LAKES, certain colours made by combining the colouring matter of cochineal, or of certain vegetables, with pure alumina, or with oxides of iron, &c.

LAM, the sovereign pontiff, or rather god, of the Asiatic Tartars, inhabiting the country of Barnabula. The lam is not only adored by the inhabitants of the country, but also by the kings of Tartary, who send rich presents, and go into pilgrimage to pay him adoration, calling him lam-cugiat, q. c. God the everlasting father of heaven. He is never to be seen but in a secret place of his palace, amidst a great number of lamps, sitting cross-legged upon a cushion, and adored all over with gold and precious stones; where, at a distance, they prostrate themselves before him, not being lawful for any to kiss even his feet. He is called the great lam, or lama of lamas, that is, priest of priests. And to persuade the people that he is immortal, the inferior priests, when he dies, substitute another in his stead, and so continue to cheat from generation to generation. These priests persuade the people that the lama was raised from death, in a hundred years ago, that he has lived ever since, and will continue to live for ever.

LAMINE, in physiology, the thin plates of which many substances consist.

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LAMP BLACK, among colouren. See Black.

LAMPREY. See Petromyzon.

LAMPYRIS, glow-worm, a genus of insects of the order Coleoptera: the generic character is: wing-cases longish, flexible; thorax flat, semi-serrulcral, concealing and surrounding the head; abdomen with the sides pleated into papillae; female (in most species) wingless. The lampyris noctuica, or common glow-worm, is a highly curious and interesting animal. It is seen during the summer months as late as the close of Aug., if the season is mild, on dry banks, about woods, pastures, and hedgerows, exhibiting, as soon as the dew is off, the most beautiful and luminous phosphorescent splendour, in form of a round spot of considerable size. The animal itself, which is the female insect, measures about three-quarters of an inch in length, and is of a dull earthy brown colour on the upper parts, and beneath, more or less tinged with rose-colour, with the two or three last joints of the body of a pale or whitish sulphur-colour. It is from these parts that the phosphoric light arises; the exuviae are of a yellowish colour, with a very slight cast of green; the body, exclusive of the thorax, consists of ten joints or divisions. The larva, pupa, and complete female insect, scarcely differ perceptibly from each other in general appearance, but the phosphoric light is strongest in the complete animal. The glow-worm is a slow-moving insect, and in its manner of walking frequently seems to drag itself on by short and slight efforts. The male is smaller than the female, and is provided both with wings and wing sheaths; and it is but rarely seen.

It is certain that in some species of this genus the male, as well as the female, is luminous; as in the lampyris Italica, which seems to be a native of our own island also, though less common here than in the warmer parts of Europe. Abdorvanus describes the wing-cases as having the wings of a dusky colour, and at the end of the body two brilliant fiery spots like the flame of sulphur. See Plate Nat. Hist. figs. 238, 239.

In the Philosophical Transactions for the year 1684, we find a paper by a Mr. Walter, describing the English flying glow-worm as of a dark colour, with the tail part very luminous. He maintains that both male and female of this species are winged, and that the female is larger than the male: the light of this insect was very vivid, so as to be plainly perceived even when a candle was in the room. Mr. Walter observed this species at Northaw, in Hertfordshire. From the figure given by this writer it appears to be about half an inch in length, which is much smaller than the common female glow-worm.

In Italy this flying glow-worm is extremely plentiful; and we are informed by Dr. Smith and other travellers, that it is a very common practice for the ladies to stick them by way of ornament in different parts of their head-dress during the evening hours.

The common or wingless glow-worm may be very successfully kept, if properly supplied with meadow turf, grass, moss, &c. for a considerable length of time; and as soon as the evening commences, will regularly exhibit its beautiful effulgence, illuminating every object within a small space around it, and sometimes the light is so vivid as to be perceived through the glass by which it is kept. This insect deposits its eggs, which are small and yellowish, on the leaves of grass, &c. There are 13 species of the lampyris.

LAND, in the sea language, makes part of several compound terms: thus land-lock'd, or to lay the land, is just to lose sight of it. Land-locked, is when land lies all round the ship, so that no point of the compass is open to the sea; if she is at anchor in such a place, she is said to be land-locked, and is therefore concluded to ride safe from the violence of winds and tides. Land-marks, any mountain, rock, steepel, tree, &c. that may serve to make the land known at sea. Land is that in, a term used to signify that another point of land hinders the sight of that the ship came from. Land to, the ship lies land to, that is, she is so far from shore that it can only be just discerned.

LAND-TAX. See Taxation.

Landscape. See Painting.

LAST branch of the public revenue, the origin of which may be traced to the fines or commutations for military service, levied during the feudal system under the name of scutages. These are supposed to have been the first more arbitrary compositions, as the king and the persons liable could agree; but the practice having been much abused, it was declared by Magna Charta, and afterwards repeatedly confirmed by acts of parliament, that no scutage should be imposed without the consent of the great men and commons, in parliament assembled. This tax was sometimes exacted under the name of hydage, or carrage; but taxes on land came afterwards to be generally denominated subsidies, or assessments. During the Commonwealth, taxes on land were levied by monthly assessments; and commissioners were appointed in each county for rating the land, and assessing the rates according to the exigencies of the times, from 35,000l. to 120,000l. a month; the assessments in Scotland were commonly 6000l. but sometimes 1000l. a month; in Ireland the rate of raising money was so prodigiously high, that the great body of money was found so productive, that, with some little variations, it has under the denomination of land-tax ever since formed an important branch of the revenue.

The land-tax, till lately, differed from all the other branches of the public revenue (except part of the duties on malt), in being imposed annually, whereas other taxes have been granted either for a term of years, or for more commonly of late years, for ever; but though granted for only one year at a time, it has been regularly continued from year to year since the Revolution, having never been wholly taken off; but it has varied with respect to the rate at which it has been imposed, having been usually reduced during peace, and increased again in time of war, to answer, in part, the increased expenditure. In 1683 it was first raised to four shillings in the pound, but twice given in the following year, and according to which it has continued to be raised to the present time, at the following rates:

In 1698 and 1699, at 3s.
1700, at 2s.
1702 to 1712, at 3s.
1713 to 1715, at 2s.
1719, at 4s.
1717 to 1721, at 3s.
1722 to 1726, at 2s.
1727, at 3s.
1728 and 1729, at 3s.
1730 and 1731, at 2s.
1732 and 1733, at 1s.
1734 to 1739, at 2s.
1740, at 3s.
1750 to 1752, at 3s.
1753 to 1755, at 2s.
1756 to 1766, at 4s.
1767 to 1770, at 3s.
1771, at 4s.
1772 to 1775, at 3s.
1776 to 1798, at 4s.

The sums to be raised at 4s. in the pound were stated, in the annual act, at 1,999,657l. 7s. 10d. for England, and 47,954l. 1s. 2d. for Scotland, making together 2,037,607l. 9s. 6d.; and upon credit of this annual sum was annually borrowed of the Bank in anticipation of the tax, for which sum exchequer-bills were given them, which were to be discharged out of the produce of the tax as it came in; but the full amount of the assessment was seldom, if ever, collected, so that the nett payments into the exchequer always fell short of the sum borrowed on the credit thereof, exclusive of interest on the bills; and the deficiency was made good out of the supplies for the next year.

In 1795 the current value of the public funds having been unusually depressed for some time past, and apprehensions being entertained that the further increase of the funded debt would be attended with peculiar inconvenience, unless some mode was discovered of counteracting its effects, a project was adopted of offering the land-tax for redemption or sale. With this view an act was passed, creating a perpetual annual tax, from 25th March, 1759; and being thus converted into a permanent annuity, it was offered for sale to the proprietors of the lands upon which it was charged; or if they declined it, to any other person who chose to become a purchaser. In the first case it was considered as a redemption of the tax, the estate becoming in future wholly free from it; in the latter case the purchaser became entitled to receive the land-tax regularly from the receiver-general, half-yearly, on the 16th of March and 20th of September in every year. The consideration to be given in either case was not to be in money, but stock, either in the three per cent. consols, or three per cent. reduced, to be transferred to the commissioners for the reduction of the national debt. The quantity of stock to be transferred for redemption of the tax by persons interested in the land on which it was charged, was so much capital as yielded an annuity or dividend exceeding the amount of the tax to be redeemed by one-tenth part thereof; and the stock thus transferred for purchase of the tax by persons not interested in the land, was so much capital as yielded an annuity or dividend exceeding the tax to be purchased by one-fifth part thereof. Thus
the amount of three per cent. stock to be transferred for 10s. per annum, was 300l. 13s. 4d. for redemption, or 400l. for purchase.

This scheme was adopted with the view of facilitating the raising of money on loan, by absorbing a large extent of land tax, and thus raising the current price; while at the same time it would be attended with an increase of revenue. This at least was the avowed object of the measure, which was estimated in its consequences of raising or taking out of the market about 80,000,000l. of stock; the advantages offered by it were however, by no means such as to induce a general approval of it, many persons subject to the tax declined redeeming it, and few were inclined to become purchasers. The period first limited was several times extended, but the plan succeeded very imperfectly, and on the 1st of February, 1833, the total amount of 2 per cent. stock, which had been transferred for the redemption of land tax, was only 21,794,307l. 17s. 3d.

LANERIA, a genus of the hexandria monogynia class and order. The corolla is superior, woolly, the caps. three-celled. There is one species, a herb of the Cape.

LANGAYA, a genus of serpents; the generic character is, abdominal scales; caudal rings; terminal scales.

Langaya nasuta, snouted langaya. The genus langaya, consisting of a single species only, differs from all the rest of the serpent tribe in having the upper part or beginning of the tail marked into complete rings or circular divisions resembling those on the body of the amphisbaena, while the extreme or terminal part is covered with small scales, as in the genus anguis.

The langaya nasuta, or long-snouted langaya, is in length about two feet eight inches, and its greatest diameter about seven lines; the head is covered with small scales, but the snout, which is extremely long and sharp, projecting to a considerable distance beyond the lower jaw, is covered with very small scales; the teeth, in shape and disposition resemble those of the snapping-turtles. The natives of Madagascar are said to hold the langaya in great dread, considering it as a highly poisonous serpent.

LANGUED, in heraldry, expresses such animals whose tongue appearing out of the mouth, is borne of a different colour from that of the body.

LANIUS, the shrike, or butcher-bird; a genus belonging to the order of accipitres, the characters of which are these: the beak is somewhat straight, with a tooth on each side towards the apex, and naked at the base; and the tongue is lacertine.

1. The excubitor, great cicerine shrike, or greater butcher-bird, is in length 10 inches. The plumage on the upper parts is of a pale ash-colour; the under parts, white; through the eyes there is a black ring; the scapulars are white; the base of the greater quills is white, the rest black. The method of killing its prey is singular, and its manner of devouring it less extraordinary: small birds it will seize by the throat, and, without an annul tax, probably is the reason the Germans also call this bird wurchen, or the suffocating angel. It feeds on small birds, young nestlings, beetles, and caterpillars. When it has killed the prey, it fixes them on some thorn, and, when thus spirited, pulls them to pieces with its bill. Where they are in a cavity of a cliff, or they will often treat their food in much the same manner, sticking it against the wires before they devour it. This bird inhabits many parts of Europe and North America. The female has its nest with hair and moss, linting it with wool and gossamer, and lays six eggs, about as big as those of a thrush, of a dull olive-green, spotted at the thickest end with black. In spring and summer it imitates the voices of other birds, by way of decoying them within reach, that it may destroy them; but beyond this the natural note is the same throughout all seasons. In countries where they are plentiful, the husbandmen value them, on supposition of their destroying rats, mice, and other vermin. They are supposed to live five or six years; and are often trained up for catching small birds in Russia.

2. The colibrirl, or lesser butcher-bird, is seven inches and a half in length. This bird is much more common than the former species. Mr. Latham suspects its being a bird of passage, never having seen it in winter. It lays six white eggs, marked with a rufous brown circle, within forty-eight hours. The nest is generally in a hedge or low bush, near which it is said, no small bird chooses to build; for it not only feeds on insects, but also on the young of other birds in the nest, taking hold of them by the neck, and strangling them, beginning to eat them first at the brain and eyes. It is fond of grasshoppers and beetles than of other insects, which it eats by morsels, and when satisfied, shakes the remains of the insects into the grass, which does the same against the wires of it, like the former species.

3. The infaustus, or rock shrike, is in length seven inches and three quarters. The bill is about an inch long, and blackish; the head and neck are of a dark ash-colour, marked with small rufous spots; the upper part of the back is a dark brown; the lower much paler, inclining to ash, especially towards the tail; the sides of the body, inclined with white, are covered with pale margins; the breast, and under parts of the body, are orange, marked with small spots, some white and others brown. This species is met with in many parts of Europe, from Sweden on the north, to Portugal on the south; and is found in some parts of Germany, the Alpine mountains, those of Tyrol, and such-like places. The manners of this bird seem disputatious; it has an agreeable note of its own, approaching to that of the hedge sparrow; and will also learn to imitate that of others. It makes the nest among the holes of the rocks, &c., hiding it with great art; and lays three or four eggs, feeding the young with worms and insects, on which it also feeds itself. It may be taken young from the nest, and brought up as the nightingale.

4. The autumnalis, or white-wreathed shrike, is about the size of a common thrush. Its bill is pale; the upper parts of the body are grey; the under rufipennis; from the eyes to the hind head there passes a whitish line, composed of numerous white feathers, rendering it truly characteristic; the wings are rounded; the quills brownish, with grey edges, which are more numerous and slender brown lines; the tail is rounded, brown, and crossed with numerous bars of darker brown; the legs are pale. This elegant species inhabits China, where it is known by the name of whomgo. It may be observed, among others, in the natural watches, where the white line seems to encompass the back part of the head like a wreath.

5. The tyrannus, or tyrant shrike, is about the size of a thrush. Its bill is a blackish brown, beset with bristles at the base; the eyes are brown; the upper parts of the plumage grey brown; the under white; the bron t includes ash-colour; the head is blackish on the upper part; the base of the feathers on that part in the male is orange, but seldom visible except it excites the terrors, when there appears a streak of orange down the middle of the crown. It inhabits Virginia. There is a variety which inhabits St. Domingo and Jamaica. These birds are called darwin, pipit, or spurin, from their cry, which resembles those words. All authors agree in the manners of these birds, which are so curious a great degree while the hen is sitting; no bird whatever dare approach their nest, they will attack the first which comes near, without reserve, and usually come off conquerors.

Many species of this genus are found in Ceylon, and other hot countries, as the linus varius. See Plate Nat. Hist. fig. 243.

LANNIERS, or Laniiacae, in a small, are small groups reared into the dead-plant's head, the eyes of all grounds, either to slacken them or to set them fast; the stays of all masts are also set fast by lanniers.

LANTEA, or Indian sage, a genus of the angiospermia order, in the dianthusea class of plants, and as in the natural method ranking under the 40th order, personatae. The calyx is indistinctly quadridentated; the stigma broken, and turned back like a hoop; the fruit is a plan with a buliberal kernel. There are 9 species, consisting of shrubby exotics from Africa and America for the greenhouse or stove, growing to the height of a yard or two, and adorned with oblong, oval, and roundish simple leaves, with numerous, tubular, four-lobed, whitish, or yellow, with some tinted flowers of different colours. They may be propagated either by seeds or cuttings. 1. The camara, or wild sage, is remarkable for the beauty of its flowers, which are yellow, tinged with red. 2. The involucrata, or white-wreathed ash-coloured leaves and a most agreeable smell. They are both natives of the West Indies, the former growing wild among the bushes, and the latter being found near the sea. Their leaves, particularly those of the seaside sage, are used by the black people in teas for colds and complaints of the stomach.

3. The acteola is a beautiful stove plant, remarkable for its flowers changing from yellow to red. See Plate Nat. Hist. fig. 243.

LANTERN, Magic, an optical machine, whereby little painted images are represented so much magnified, as to be accounted the effect of magic by the ignorant. See Optics.

LANTERN, See Architecture.

LAPIDARY. There are various machines employed in the cutting of precious stones, according to the quality: the diamond, which is extremely hard, is cut on a wheel of soft steel, turned by a mill, with diamond-dust, tempered with olive-oil, which also serves to polish it. The Oriental ruby, sapphire, and topaz, are
cut on a copper wheel with diamond-dust, tempered with olive-oil, and are polished on a third wheel with tripoli, or soapstone. The hyacinth, emerald, ametyst, garnets, agates, and other stones, not of an equal degree of hardness with the other, are cut on a leaden wheel with small and water, and polished on a tin wheel with tripoli, or soapstone. The turquoises of the old and new rock, girasol, and opal, are cut and polished on a wooden wheel with tripoli also.

LAPS, in general, is used to denote a stone of any kind. See Mineralogy.

Lapis calcitrix, a genus of stones consisting of silica, a small quantity of aluminium, with about one-tenth of lime, and a slight trace of oxide of iron: hard, lustrous, shining within, breaking into fragments with sharp edges; compact, not mouldering in the air; of a more or less perfectly conchoidal texture; never opaque, tough, admitting of a high polish, and generally of a common form; not melting before the blowpipe. See Plate Nat. Hist. fig. 241.

LAPLISIA, or sea-hare, a genus of marine inlets belonging to the order of vermec mollusca. See Plate. The body is covered with a shield-like mantle. It has a shield-like membrane on the back, a lateral pore on the right side, the anus on the extremity of the back, with four feelers resembling ears. The figure represents the deplatis minor, which grows to the size of a man and a half in length, and to more than an inch in diameter; its body approaches to an oval figure, and is soft, punctured, of a kind of gelatinous substance, and of a pale lead-colour; from the larger extremity there is a four oblong and thick prominence; these are the tentacles; two of them stand nearly erect, two are thrown backward. It is not uncommon about our shores, especially off Anglesea. It causes, by its poisonous juice, the hair to fall off the hands of those that touch it; and is so extremely fetic as to create sickness at the stomach. The major, or greater sea-hare, grows to the length of eight inches.

LAPPAGO, a genus of the trinaria digerens class and order. There is one species, a grass.

LAPSANA, nipplewort, a genus of the polygonum aquatilis class, in the syngecynia class of plants, and in the natural method polyburnthae: the receptacle is naked; the calyx calculated, with all the inferior scales calcuated or finely channelled. There are five species, which grow commonly as weeds by the sides of ditches. The young leaves of the common kind, called dock-cresses, have the taste of radishes, and are eaten raw at Constantinople as a salad. In some parts of England the common people boil them as greens, but they have a bitter and disagreeable taste.

LAPSE, the omission of a patron to present to a church, within six months after voidable; by which neglect title is given to the ordinary to collate to such church; and in such cases, the patronage devolves from the patron to the bishop, from the bishop to the archbishop, and from the archbishop to the king. A donative does not go in lapse; but the ordinary may compel the patron by ecclesiastical process to fill up the vacancy. But if the donative has been augmented by the governors of queen Anne's bounty, it will lapse in like manner as a representative living.

LAPSED LEGACY, is where the legatee dies before the testator; or where a legacy is given upon a future contingency, and the legatee dies before that contingency happens. As if a legacy is given to a person who attains the age of 21 years, and the legatee dies before that age; in this case the legacy is a lost or lapsed legacy, and shall sink into the residuum of the personal estate. 2 Black. 613.

LABBOARD, among seamen, the left hand side of the ship, when you stand with your face towards the head.

LARCENY, is the felonious and fraudulent taking away the personal goods of another; which goods, if they are above the value of 12d. it is called grand larceny; if of that value or under, it is petit larceny; which two species are distinguished in their punishment, but not otherwise. 4 Black. 229.

The mind only makes the taking of another's goods to be felony, or a bare trespass only; but as the variety of circumstances is so great, and the complications thereof so mingled, it is impossible to prescribe all the different cases in which a felonious intenion is or the contrary; it must therefore be left to the due and attentive consideration of the judge and jury, wherein the best rule is, in doubtful matters, rather to incline to acquittal, than in general it may be observed, that the ordinary discovery of a felonious intent is, if the party do it secretly, or being charged with the goods deny it. 11 H. 399.

As all felony includes trespass, every indictment must have the words feloniously took, as well as carried away; whence it follows, that if the party be guilty of no trespass in taking the goods, he cannot be guilty of felony in carrying them away. 1 Haw. 89.

With respect to what shall be considered a sufficient carrying away, to constitute the offence of larceny; it seems that any the least removing of the thing taken, from the place where it was before, is sufficient for this purpose, though it be not quite carried off. 1 Haw. 93.

As grand larceny is a felonious and fraudulent taking of the more personal goods of another above the value of 12d. so it is petit larceny if the stolen thing is not of the value of 12d. or under. In the several other particulars above-mentioned, petit larceny agrees with grand larceny. 1 Haw. 83.

In petit larceny there can be no accessories either before or after. 1 H. 1. 530.

Larceny from the person. If larceny from the person be done privily without his knowledge, by picking of pockets or otherwise, it is excluded from the benefit of clergy by 5 Eliz. c. 4, provided the thing stolen be above the value of 12d. 2 H. 11. 330.

But if done openly and avowedly before it, it is within the benefit of clergy. 1 Haw. 97.

Larceny from the house. Every person who shall be convicted of the feloniously taking away in the day-time, any money or goods of the value of 5s. in any dwelling-house, or out-house thereto belonging, and used to and with the same, though no person be there in, shall be guilty of the felony, without benefit of clergy. 5 Eliz. c. 15.

Receiving stolen goods. Any person who shall buy or receive any stolen goods, knowing them to be stolen; or shall receive, harbour, or conceal any felon or thieves, knowing them to be so; shall be guilty of felony to the felony; and being convicted on the testimony of one witness, shall suffer death as a felon convict; but he shall be entitled to his clergy. 5 Anne c. 31.

But if any person receiving or buying stolen goods, knowing them to be stolen, may be transported for fourteen years. 4 Geo. 1. c. 11.

Where the principal felon is found guilty to the value of the thing stolen of petit larceny only, the receiver, knowing the goods to have been stolen, cannot be transported for fourteen years, and ought not to be put upon his trial; for the acts which made receivers of stolen goods knowingly, accessories to the felony, must be understood to make them accessories in such cases only, where by law an accessory may be; and there can be no accessory to petit larceny. 33 Geo. c. 74.

Every person who shall apprehend any one guilty of breaking open houses in a felonious manner, or of privately and feloniously stealing goods, wares, or merchandise, of the value of 5s. in any shop, warehouse, storehouse, or stable, though it is not broken open, and if no person is therein to put in fear, and shall prosecute him to conviction, shall have a certificate without fee, under the hand of the judge, certifying such conviction, and within what parish or place the felony was committed, and also that such felon was discovered and taken, or discovered or taken, by the person so discovering or apprehending; and if any dispute arise between several persons so discovering, or apprehending, the judge shall appoint the certificate into so many shares, to be divided among the persons concerned, as to him shall seem just and reasonable. Leishe's Cro. Law, 307. See Jurors.

LARK. See Alauda.

LARKSPUR. See Delphinium.

LARVA, in natural history, a name given by Linneus to insects in that state, called by the ancients erucia, or caterpillars.

LARUS, the name in the order of anseres, the characters of which are: the bill is straight, culverted, a little crooked at the point, and without teeth; the inferior mandible is gibbous below the cusp; the rostra are thin, situated in the middle of the beak. The different species are principally distinguished by their colour. The most remarkable are:

1. The marins, or black-backed gull, in length 29 inches, breadth five feet nine. The bill is very strong and thick, and almost four inches long; the colour a pale yellow; the head, neck, whole under-side, tail, and lower part of the back, are white; the upper part of the back and wings are black; the quills-leathers tip with white; the legs of a pale flesh-colour. It inhabits several parts of England, and breeds on the highest cliffs. The egg is blunt at each end, of a dusky olive-colour, quite black at the greater end, and the rest of it thinly marked with dusky spots. It is also common on most of the northern coasts of Europe. It frequents Greenland, but chiefly inhabits the distant islands of the Arctic sea. We may, placing them on the heads of dicing which the birds leave there from time to time. It is said to attack other birds, and to be particularly an
enemy to the eider duck. It very greedily devours carrion, though its most general food is fish. It is common also in America, as low as South Carolina, where it is called the old-wife.

2. The eustria, or Skua gull, is in length two feet; the extent four feet and a half; the weight three pounds; the feathers on the head, neck, back, scapulars, and coverts of the wings are of a deep brown, marked with a rust-colour (brightest in the male). The breast, belly, and vent are ferruginous, tinged with ash-colour. This bird inhabits Norway, the Ferroo isles, Shetland, and the noted rock Foula a little west of them. It is also a native of the South Sea. It is the most formidable of the gulls; its prey being not only fish, but what is wonderful in a seabird, all the lesser sort of water-fowl, such as teal, &c. Mr. Schrotter, a surgeon in the Ferroo isles, relates that it likewise preys on ducks, poultry, and even young lambs.

The natives of the Orkneys are often very rudely treated by them while they are attending their sheep on the hills, and are obliged to guard their heads by holding up their sticks, or the heads of the birds themselves. In Foula it is a privileged bird, because it defends the flocks from the eagle, which it beats and pursues with great fury; so that even rapacious bird seldom ventures near its quarters.

3. The parasitic, or dun-gunter, is in length 21 inches; the upper parts of the body, wings, and tail, are black; the base of the quills white on the inner webs; and the middle feathers of the tail near four inches longer than the rest. This is a very small species, and very common in the Hebrides, where it breeds on heaths. It comes in May, and retires in August; and if disturbed flies about like the gawpin, but soon alights. It is also found in the Orkneys; and on the coasts of Yorkshire, where it is called the lesser. This bird does not often swim, and flies generally in a slow manner, except in pursuit of other birds, when it will often fly swiftly. It runs along seas in flocks, in order to make them disgorge the fish or other food which this common plunderer greedily catches.

4. The cans, or common gull, is in length 16 or 17 inches; the weight one pound. The bill is yellow; the head, neck, and under parts of the body and tail are white; the back and wings pale-grey. It is a tame species, and may be seen by hundreds on the shores of the Thames and other rivers, in the winter and spring, at low tides, picking up the various worms and small fish left by the tides; and will often follow the plough in the fields contiguous, for the sake of worms and insects which are turned up; particularly the cockle-chatter or dorbet in its larva state, which it joins with the rooks in devouring most greedily.

5. The tridactylus, or tarrock, is in length 14 inches, breadth 30; weight seven ounces. The head, neck, and under parts, are white; near each ear, and under the throat, there is a black spot; and at the hind part of the neck a crescent of black; the back and scapulars are blueish-grey; the wing-covers dusky edged with grey; the quills and tips white. This species breeds in Scotland, and inhabits other parts of northern Europe, quite to Iceland and Spitzbergen. It is observed frequently to attend the whales and seals, for the sake of the fish which the last drive before them into the shallows, when these birds dart into the water suddenly, and make them their prey.

6. The ridibundus, pewit, or black-headed gull, is in length 15 inches, breadth three feet; the quills black, and wing-tips and neck are of an ash-colour; the neck, all the under parts, and tail, are white; the first ten quills are white, margined, and more or less tipped with black; the others of an ash-colour. This species breeds on the shores of some of our rivers; but full as often in the inland fens of Lincolnshire, Cambridgeshire, and other parts of England. They make their nest on the ground, with rushes, dead grass, &c. and lay three eggs of a greenish-brown, marked with red-brown blotches. After the breeding season, they again disperse to the coast.

The young birds in the neighbourhood of the Thames are thought good eating, and are called the red legs. They were formerly more numerous; but numbers were annually taken and fattened for the table. Whitehock, in his annals, mentions a piece of ground near Portsmouth, which produced to the owner 40 particulars a year by the sale of pewits, with the species of the sea. It is remarkable that in old times the gulls that in old times were admitted to the noblemen's tables. The note of these gulls is like a hoarse laugh.

7. The trismis, or laughing gull, is in length 18 inches, breadth three feet; it is found in Russia on the river Don, particularly about Tschercask. The note resembles a coarse laugh, whence the name of the bird. It is met with also in different parts of the coasts of America, and is very numerous in the Bahama islands.

There are 14 or 15 other species of this genus. See Plate Nat. Hist. fig. 242.

LARYNX. See Anatomy.

LASH, or LACE, in the sea language, signifies to bind and make fast.

LASERITIUM, lusor-curtus, a genus of the plant class of plants, and in the natural method ranking under the 45th order, umbellata. The fruit is oblong, with eight membranaceous angles; the petals, reflexed, emarginated, and patent. There are more species which are all remarkable for their beauty, so are only preserved in botanic gardens for the sake of variety.

LATOPISTOMA, a genus of the class and order tetrandria monogynia; the calyx is very short, five-petalled; corolla funnel-form, foxtail-cleft; caps. orbicular, one-celled, two-seed.

There is one species, a shrub of Guiana.

LASKETS, small lines, like loops, sewed to the bonnets of drabbers of a ship, to lash or lace the bonnets, the courses, or the drabbers to the bonnets.

LASKING, at sea, is much the same with going large, or veering, that is, going with a quarterly wind.

LAST, in general, signifies the burden or load of a ship. It signifies also a certain measure of fish, corn, wool, leather, &c. A list of codfish, whiting, herrings, and ashes for soap, is 12 barrels; of corn or rapsessed, 10 barrels, of red-herrings 20 cedes; of hides 12 dozen; of leather 20 dickers; of pitch and tar 14 barrels; of wool 12 sacks; of stock-fish 1000; of flux or feathers 1700 pounds.
screw in E, the conical end F may at any time be made to fit its socket; the punch of G has a cylindrical hole through its top to receive the polished pointed rod d, which is moved by the screw c, and fixed by the screw j; the whole punch is fixed on the triangular piece P, which bears the point of which, a, b, c, are put through holes b, in the bottom of the punch under the bar. The whole is fixed by the screw c pressing against it; by this means the punch can be taken off the bar without first taking off the standard I, as in the common lathes; and the triangular bar is found to be far preferable to the double rectangular one in common use.

The rest J in a similar contrivance; it is in 3 pieces; see figs. 141, 141, 142. Fig. 141 is the piece, the opening (a, b, c) in which is laid upon the bar H, fig. 138.; the four legs d d d d of fig. 142. are then put upon the bar (into the recesses in fig. 141. which are made to receive them), so that the notches in d d are held by the bar. Fig. 143: the punch heads e, f, in fig. 140. are then slid into the notches in the top of d d d d, to keep the whole together; the groove i is to receive a corresponding piece on e, fig. 140., to which it is fixed, and fig. 140. has a cover, to keep the chips out of the grooves. It is plain, that by tightening the screw b in the bottom of figs. 138. and 142., the whole will be fixed and prevented from sliding along the bar H, and fig. 140. from sliding in a direction perpendicular to the bar; the piece l, on which the tool is laid, can be raised or lowered at pleasure, and fixed by the screw m. On the end n of the spindle P, figs. 138. and 139., is mounted a self-adjusting hand-mandril, for holding any kind of work which is to be turned (fig. 144.). As the female screw to receive the screw n, fig. 138.; near the bottom of the screw A is another BB, which is prevented from moving by a bar attached to the mandril, and is used for holding any kind of work which is to be turned (fig. 144.). As the female screw to receive the screw n, fig. 138.; near the bottom of the screw A is another BB, which is prevented from moving by a bar attached to the mandril, and is used for holding any kind of work which is to be turned (fig. 144.). As the female screw to receive the screw n, fig. 138.; near the bottom of the screw A is another BB, which is prevented from moving by a bar attached to the mandril, and is used for holding any kind of work which is to be turned (fig. 144.). 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LAVATERA, a genus of the polygonum order, in the polyneurina class of plants, and in the natural method ranking under the 37th order, commeliniana. The exterior calyx is double and trifid; the anthers and seeds are very many and mosaicous. There are two species, one of the herbaceous flowery animals, or shrubby perennial, growing erect from two or three to eight or ten feet high. They are easily propagated by seed in the open ground in the spring, and thrive best in a warm season where the plants are designed to remain.

LAUDANUM. See Pharmacy.

LAUGERIA, a genus of the monogynia order, in the petunia class of plants, and in the natural method ranking among those of which the order is double. The corolla is quinquefid; the fruit is a plum with a quinquelocular kernel. There are two species, shrubs of the West Indies.

LAUNCH, in the sea-language, signifies to put out: as, launch the ship, that is, put it out of the dock; and forward, speaking of things that are stowed in the hold, is, put them more forward. Launch, ho! is a term used when a yard is hoisted high enough, and signifies hoist no more.

LAUNDER, among miners, a place where they wash their supplies. It is sometimes used by the miners as a washing place.

LAUREATION, in the universities of Scotland, signifies the act of taking the degree of master of arts, which the students are permitted to do after four years study.

LAVRUS, the bay-tree, a genus of the monogynia order, in the petunia class of plants, and in the natural method ranking under the 12th order, holarcania. There is no calyx; the corolla is calycine, or serving in place of the calyx, and sepalata; the stamens are with three glandulae, each terminated by two bristles surrounding the germin. The interior florets furnished with glandulae at the base; the fruit a monogynous plum. There are: 32 species, of which the most 20 are successively grown bay-tree, a native of Italy, and has an upright trunk branching on every side from the bottom upward, with spear-shaped, nervous, stiff, evergreen leaves, three inches long, and six inches broad, large, glossy, quinquelocular, directed flowers, succeeded by red berries in autumn and winter. Of these species there are varieties, with broad, narrow, striped, or waved leaves. 2. The arbutis, or deciduous bay, grows naturally in North America. It rises with an upright stem, covered with a purplish bark, having oblong, oval, acuminate, veined, deciduous leaves, two or three inches long, and half as broad, growing opposite, with the lower leaves succeeded by red berries. 3. The benzoin, or benjamin tree, is also a native of North America; grows 15 or 20 feet high, divided into a very branchy head, with oval, acute, deciduous leaves, two and a half inches broad, and small yellowish flowers, not succeeded by berries in this country. This, it is to be remarked, is not the tree which bears the gum benzoin, that being a species of hexas. 4. The sassafras is a native of the same country. It has a shrub-like straight stem, with both oval and three-lobed, shining, deciduous leaves, of different sizes, from three to six inches long, and nearly as broad, with small yellowish flowers succeeded by blackish berries, but not in this country. 5. The indica, or Indian box-tree, rises with an upright straight trunk, branching regularly 20 or 30 feet high, adorned with very large, spear-shaped, plane, nervously, evergreen leaves, small white-green flowers, succeeded by large oval black berries, which do not ripen in this country. 6. The barbonia, or Carolina red-box-tree, rises with an upright straight stem, branching 15 or 20 feet high, with large, spear-shaped, evergreen leaves, transversely veined; and long bunches of flowers on red footstalks, succeeded by large blue berries sitting in red cups. 7. The canis, or canis-tree, grows naturally in the woods of the western parts of Japan, and in the adjacent islands. See Plate Nat. Hist. fig. 244. The root smells stronger of camphor than any of the other parts, and yields it in greater plenty. The bark of the stalk is outwardly somewhat rough; but in the inner surface smooth and mucous, and therefore easily separated from the wood, which is dry, and of a white colour. The flowers are produced in small bunches in the top of the stalk; the fruit, or the berries, succeed by the armpits of the leaves; but not till the tree has attained considerable age and size. The flower-stalks are slender, branched at the top, and divided into very short pedicels, supporting a single blossom. These flowers are white, and consist of six petals, which are succeeded by a purple and shining berry of the size of a pea, and in figure somewhat top-shaped. It is composed of a white substance, till pulpily torn out, with the taste of cloves and camphor; and of a nucleus or kernel of the size of a pepper, which is covered with a black, shining, oily coricile, of an insipid taste. 8. The cinnamomum, or cinnamon-tree, is a native of Ceylon. It has a large root, and divides into several branches, covered with a bark, which, on the outer side is of a greyish brown, and on the inside has a reddish cast. The wood of the root is hard, white, and has no smell. The body of the tree, which grows to the height of 20 or 30 feet, is covered, as well as its numerous branches, with a bark which at first is green and afterwards red. The leaf is larger and more move tree; and it is threeseweed, the nerves vanishing towards the top. When first unfolded, it is of a flanne-colour; but after it has been for some time exposed to the air, and grows dry, it changes to a deep green on the upper surface, and to a lighter on the lower. The flowers are small and white, and grow in large bunches at the extremity of the branches; they have an agreeable smell, something like that of the bay, and of the myrt. The fruit is shaped like an acorn, but is not so large. 9. The cassia, or base cinnamon, has lancedolated leaves, triple-nerved. 10. The person, avocado-pears, or alligator pear, rises to a considerable height, with a straight trunk, of which the bark and wood are of a greyish colour. The leaves are long, oval, pointed, of a substance like leather, and of a beautiful green colour. The flowers are produced in clusters at the extremities of the branches, and consist each of six petals disposed in the form of a star, and of a dirty-white or yellow colour, with an agreeable odour, which diffuses itself to a considerable distance. It is a native of the West Indies. The petals be-
LAW

Laws of England are divided into
civil, or private, and
common law, or lex
sine scripta.

The law non scripta is not so
called from its being conveyed from
former ages by word of mouth, but because the
original authority of the rules is not found in
writing, and they receive their force by long
usage, and by their universal reception
throughout the kingdom; and it is curious
to observe, that those rules maxims of our
ancestors, of which no person knows clearly
the origin, exceed in clearness, brevity, and
authority, all that the united wisdom of the
most enlightened men have produced in later
times.

The common law is divided into
1st. General custom, which is the
universal rule of the whole kingdom, and is the
law by which proceedings and determinations in
the courts of justice are ordinarily directed.
This for the most part settles the course of
inheritance, the manner and form of acquiring
and transferring property, the solemnities and
obligations of contracts, the rules of
exchanging, wills, deeds, and acts of parliament;
the redress of civil injuries, the different kinds
of remedies with the punishments allotted to
each; the institution of four superior courts
of record; and many other particulars which
differ themselves as extensively as the
distribution of common justice requires, all of
which are not connected by any particular
statutes (though they are acknowledged by all)
but depend entirely upon the common law.

2ndly. Particular customs which concern
the inhabitants of some particular district.

3rdly. The third branch are those laws
which are adopted by certain courts and juris-
dictions, as the civil and canon laws.

The civil law is understood to signify
the civil law of the Roman empire. The
canon law is a body of Roman ecclesiastical
law relating to matters over which the church
exercises a jurisdiction. The civil law is used
in four courts under certain restrictions, viz.
the archbishop's and bishops' courts, usually
styled curia christiana; the courts mar-
tial, the courts of admiralty, and the courts
of the two universities.

The second division of the laws of England
are the statutes made by the king, lords,
and commons, assembled in parliament. The
oldest statute extant is the celebrated Magna
Charta, 9 Hen. 3: though, doubtless, the records
of many antecedents to that have been lost,
and the maxims received as common
law.

Statutes are general or special, public or
private: general or public acts, are those
which concern the whole nation; and these
judges are obliged to take notice, though they
should not be formally pleaded by the
party who claims an advantage under them.
Special or private acts are such as operate on
private persons and concerns, which must be
formally set forth by the party, or the judges
are not obliged to notice them.

Statutes are either declaratory of the
common law, where it is become disreputable, or
fallen into disuse; or remedial, when made
to supply the defects, or abridge the superflui-
ties of the common law. These latter are
subdivided into enabling and restraining
statutes, by enlarging the common law where it
was too circumscribed, and restraining it
where it was too luxuriant.

There are also theounds of the laws
of England, a court of equity to moderate and
explain them. (See Equity.) The courts of
equity are, however, only had recourse to
in matters of property; for our constitution
will not permit the courts of common law to
 treat in cases any
judge should have the power of construing
the law otherwise than according to the
letter. This caution, while it protects the
public liberty, can never oppress the individual.
A man cannot suffer more punishment than
the law directs, but he may suffer less. The
laws cannot be strained to inflict a penalty
beyond what the letter warrants, but in cases
where the letter induces any apparent hard-
ship, the crown has power to pardon.

In treating of the laws, the best mode, and
which has been of the greatest use, is to
follow William Blackstone in his excellent Commentaries,
after the example of Wood in his Institutes, is to
divide them, 1st, into the rights of persons,
or the rights as to personal security, personal
liberty, and property. 2nd. The rights of
things, or the rights which a man may acquire in and to such external things as
are unconnected with his person.
3rd. Private wrongs, or such as are the
infringement of the private rights of individuals; and
4th. public wrongs, or such as are a violation
of the public rights, and affect the whole
community.

It is of course unnecessary, and perhaps a
work of this nature irrelevant, to recommend
the study of the law; it is sufficient to add
the words of the great judge Blackstone on
this subject. "It is incumbent (says he)
upon every man to be acquainted with the
laws, lest he incur the censure as well as the
inconvenience of living in society without
knowing the obligations it lays him under."

LAVENIA, a genus of the class and order
syngenesia polygamia aequalis. The calyx is
nearly regular; style bifid; fruit three
seeds; roots white, two species.

LAWSIONIA, Egyptian privet; a genus of
the monocotyledon order, in the octandria
class of plants, and in the natural method
ranking with those of which the order is
doubtful. The calyx is quadriparted; the petals
four; and the stigma four, in pairs; the capsule is quadri-
particular and polysemous. There are four
species, all natives of India. Some authors
take the mimosa to be the plant termed by the
Greeks henna or alcaena, the pulverised
leaves of which are much used by the
Eastern nations for dying their nails yellow;
but others, Dr. Hassequist in particular,
attribute that effect to the leaves of the other
species of Egyptian privet which bears prickly
branches. It is probable that neither set
of writers are mistaken, and that the shrub in
question is a variety only of the thorny lav-
sonia, rendered mild by culture.

LAY-BROTHERS, among the Roman-
istians, those whom they call persons who
devote themselves, in some convent, to
the service of the religious. They wear a
different habit from that of the religious, but
never enter into the choir, nor are present at
the chapters; nor do they make any other
vows, except of constancy and obedience. In
numeraries there are also lay-sisters.

LAY-MAN, among painters, a small statue
either of wax or wood, whose joints are so
formed, that it may be put into any attitude
or posture. Its principal use is for adjusting
the drapery in cliuring.

LAYERS, in gardening, are tender shoots or
twigs of trees, laid or buried in the ground,
till, having struck root, they are separated
from the parent tree, and become distinct
plants. The propagating trees by layers is
done in the following manner: the branches
of the trees are to be slit a little way, and laid
under the mould for about half a foot; the
ground should be first made very light, and
after they are laid they should be gently wa-
tered. If they will not remain easily in the
position they are put in, they must be pegged
down with wooden hooks: the best season for
doing this is, for evergreens, toward the end
of August; and for other trees in the begin-
ning of June. If a William Blackstone have
a taken root, they are to be cut off from the main
plant the succeeding winter, and planted out.

If the branch is too high from the ground, a
spout of earth is to be raised to a proper height
on the root. 2nd. The branch may be either tied
round with a wire, or cut round for an inch or two at the place, and it
is a good method to pierce several holes through it with an awl above the part tied
with the wire.

LAZAR-HOUSE, or LAZARETTO, a
public building, in the nature of an hospital,
to receive the poor and those afflicted with
contagious distempers: in some places lazare-
rettos are appointed for the performance of
quarantine; in which case, those are obliged
to be confined in them who are suspected
to have come from places infected with the
plague. This is usually a large building, at
some distance from a city, whose apartments
are detached from each other, where ves-
ticles are given, and the crew shut up for
about 40 days, more or less, according to the
time and place of their departure. The laza-
retto of Milan is esteemed one of the finest
hospitals in Italy.

LAZULITE. This stone, which is found
chiefly in the northern parts of Asia, was long
known to mineralogists by the name of lapis
lazuli.

Lazulite is always amorphous. Its texture
is earthy. Its fracture uneven. Lustre 0.43.
Opaque, or nearly so. Hardness 8 to 9. Spec-
tral gravity 2.74. Colour blue; often
dotted white from specks of quartz, and
dot from particles of pyrites.

It retains its colour at 100° Wedgewood;
but it is heated higher it becomes more and more a yellowish-brown mass. With acids it effec-
tes a little, and if previously calcined,
turns with them a jelly.

Marggraf published an analysis of lazulite
in the Berlin Memoirs for 1758. His ana-
lysis was confirmed by Kliprauch, who found a specimen of it to contain

<table>
<thead>
<tr>
<th>Component</th>
<th>Percentage</th>
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<tbody>
<tr>
<td>46.0 silica</td>
<td></td>
</tr>
<tr>
<td>14.5 alumina</td>
<td></td>
</tr>
<tr>
<td>28.0 carbonat of lime</td>
<td></td>
</tr>
<tr>
<td>6.3 sulphat of lime</td>
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LEAD.

The deutoxide of lead may be formed by dissolving the metal in nitric acid, and pouring pon expanding it with a yellow-coloured powder is obtained, which is the deutoxide of lead. This oxide is composed of 91 parts of lead, and 9 of oxygen. When lead is kept melted in an open vessel, its surface is soon covered with a grey-coloured powder. When this powder is removed, another succeeds it; and by continuing the heat, the whole of the lead may soon be converted into this substance. If these powders are heated and agitated for a short time in an open vessel, they assume the form of a greenish-grey powder. Mr. Proust has shown that this powder is a mixture of deutoxide, and a portion of lead in the metallic state. It retains its green colour to the blue and yellow powders which are mixed in it. If we continue to expose this powder to heat for some time longer in an open vessel, it absorbs more oxygen, assumes a yellow colour, and is then known in commerce by the name of massicot. The reason of this change is obvious. The metallic portion of the powder gradually absorbs oxygen, and the whole of course is converted into deutoxide.

When these powders are exposed to the vapour of warm vinegar, they are gradually corroded, and converted into a heavy white powder, used as a paint, and called white lead. This powder used formerly to be considered as a peculiar oxide of lead; but it is now known that it is a compound of the deutoxide and carbonate of lead.

3. If massicot ground to a fine powder is put into a furnace, and constantly stirred while the flame of the burning coals plays against its surface, it is in about 48 hours converted into a beautiful red powder, known by the name of minium, or red lead. This powder, which is likewise used as a paint, and for various other purposes, is the tritoxide or red oxide of lead.

4. If nitric acid, of the specific gravity 1.200, is poured upon the red-coloured oxide of lead, 183 parts of the oxide are dissolved; but 13 parts remain in the state of a black, or red oxide, which is the peroxide, or brown oxide of lead, first discovered by Scheele. The best method of preparing it is the following, which was pointed out by Proust, and afterwards still farther improved by himself. Four pounds of red oxide of lead into a vessel partly filled with water, and make oxymuriatic acid gas pass into it. The oxide becomes deeper and deeper coloured, and is at last dissolved. The solution, and the brown oxide of lead precipitates. By this process 68 parts of brown oxide may be obtained for every 100 of red oxide employed. This oxide is composed of about 79 parts of lead and 21 of oxygen. It is of a brilliant dull brown colour. When heated it emits oxygen gas, becomes yellow, and melts into a kind of glass. When rubbed along with sulphur in a mortar, it sets the sulphur on fire, and causes it to burn with a brilliant flame. When heated on burning coals the lead is reduced. All the oxides of lead are very easily converted into glass; and in that state they oxidize and combine with almost all the other metals except gold and silver. This property renders lead exceedingly useful in separating gold and silver from the baser metals with which they happen to be contaminated. The gold or silver to be purified is melted along with lead, and kept for some time in a cup, made of burnt boxes, or the ashes of wood. The lead is gradually vitrified, and sinks into the cup, carrying along with it all the metals which were mixed with the silver and gold, and leaving the metals on the cup in a state of purity. This process is called cupellation. The lead employed is afterwards extracted from the cup, and is known in commerce by the name of lighthouse. It is a half-fusible yellowish-white powder, of a dull colour, and composed of scales. It is merely an oxide of lead more or less contaminated with the oxides of other metals. But the best lighthouse is made by oxidizing lead directly, and then increasing the heat till the oxide is fused. The more violent the fusing heat, the whiter is the lighthouse.

Lead has not yet been combined with carbon, nor hydrogen; but it combines readily with sulphur and phosphorus.

1. Sulphur of lead may be formed either by straining its two component parts, and melting them in a crucible, or by dropping sulphur on intervals on melted lead. The sulphuret of lead is brittle, brilliant, of a deep blue-grey colour, and almost black on the edges of the lead. These two substances are often found naturally combined; the compound is then called galena, and is usually crystallized in cubes. Sulphuret of lead is composed, according to the experiments of Vonzel, of 86.8 parts of lead and 13.2 of sulphur.

2. Phosphuret of lead may be formed by mixing together equal parts of filings of lead and phosphoric glass, and then fusing them in a crucible. It may be cut with a knife, but separates into plates whenhammered. It is of a silver-white colour with a shade of blue, but it soon tarnishes when exposed to the air. This phosphuret may also be formed by dropping phosphorus into melted lead.

It is composed of about 12 parts of phosphorus, and 88 of lead.

Lead does not combine with azotic gas. Muriatic acid gradually corrodes it, and converts it into a white-coloured oxide.

Lead is capable of combining with most of the metals.

1. Lead may be easily alloyed with gold by fusion. The colour of the gold is injured, and soon changes on exposure to the air. Many experiments have been made with this alloy, in order to possible to purify platinum from other metals by cupellation, as is done successfully with silver and gold, but scarcely any of the experiments have succeeded; because platinum requires a much more violent heat to keep it in fusion than can be easily given.

2. Platinum and lead unite in a strong heat: the alloy is brittle, of a purplish colour, and soon changes on exposure to the air. Many experiments have been made with this alloy, in order to possible to purify platinum from other metals by cupellation, as is done successfully with silver and gold, but scarcely any of the experiments have succeeded; because platinum requires a much more violent heat to keep it in fusion than can be easily given.

3. Silver is often alloyed with lead in order to purify it by cupellation. This alloy is very fusible, much softer than silver, but much less tenacity, elasticity, and toughnessness; its colour is nearly that of lead, and its specific gravity greater than the mean density of the metals alloyed.

4. Mercury assimilates readily with lead in any proportion, either by triturating it with lead filings, or by pouring it upon melted lead.
LEAD. See Botany.
LEA-GOLD. See Aurum, Gold, Gilding, etc.
LEAF. See Architecture.

LEAF, in clocks and watches, an application given to the matches of their pinions. See Clockwork.

LEAGUE, a measure of length, containing more or less geometrical pieces; according to the different usages and customs of countries. A league at sea, where it is chiefly used by us, being a land-measure mostly peculiar to the French and Germans, contains three English leagues or four English miles. The French league sometimes contains the same measure, and in some parts of France it consists of three thousand five hundred paces; the mean or common league consists of two thousand and four hundred paces, and the little league of two thousand. The Spanish leagues are larger than the French, seventeen Spanish leagues making a degree, or twenty French leagues, or sixty English leagues, 200 English statute miles. The Dutch and German leagues contain each four geographical miles. The Persian leagues are pretty near the same extent with the Spanish; that is, they are equal to 17 English, and it is said to be near to what Herodotus calls the length of the Persian parang, which contained thirty stadia, eight of which, according to Strabo, make a mile.

LEAK, a small leak, a hole in the ship through which the water comes in. To spring a leak is said of a ship that begins to leak; to stop a leak, is to fill it with a plug wrapt in oakum and well tarred; or putting in a tarpaulin cloth, to keep the water out; or nailing a piece of sheet-lead upon the place.

LEAKAGE, the state of a vessel that leaks, or lets water, or other liquid, ooze in or out. See the preceding article. Leakage, in commerce, is an allowance of 12 per cent. in the customs, allowed to importers of wines for the waste and damage it is supposed to have received in the passage; an allowance of barrels in twos, which are also made to the brewers of ale and beer, by the excise-office.

LEAK, in music. This word is properly applicable to any disjunct degree, but is generally used to signify a distance consisting of several intermediate intervals.

LEAK-YEAR. See BISEXTILE.

LEASE, a conveyance of lands, generally in consideration of rent or other annual recompense made for life, years, or at will, but always for a shorter term than the lessor has in the premises, otherwise it partakes more of the nature of an assignment.

By the common law, all persons seized of an estate might grant leases for any period less than their interest lasted; but statutes have been since made, some to enlarge and some to restrict it. They are divided into enabling and restricting statutes; by the enabling stat. 32 Henry VIII. c. 28, a tenant in tail may make leases to endure for twenty-one years or three lives to bind his issue in tail, but not those in remainder or reversion. Husband seized in right of their wives may make leases for the same period, provided the wife join in it. All persons seized of an estate of fee-simple in right of their churches, except parsons or vicars, may bind their successors under certain restrictions. 1. The lease must be by indenture; 2. It must be for a term of years of making; 3. All old leases must be surrendered or be within a year of expiring; 4. It must be for three lives or twenty-one years, not both; 5. It may be for a shorter term, but must not exceed seven years; 6. It must be of lands and tenements, or lands only let for twenty years part; 7. The most usual rent for that time must be reserved; 8. Such leases cannot be made without imprisonment of the land.

From the disabling statutes, we find that all colleges, cathedrals, and other ecclesiastical or deanonary corporations, and all parsons and vicars, are restrained from making leases unless under the following regulations. They need 3 lives or 21 years; the accustomed rent must at least be reserved thereon: 3. Houses in corporations or market-towns may be let for 40 years, provided they are not the mansions of the lessors; but not more than 10 acres of ground belonging to them; and provided the lessee agrees to keep them in repair, and they may be aliened in fee-simple for lands of equal value in recompense: 4. If there is an old lease which has been more than 3 years to run, no new lease shall be made: 5. No lease shall be made without imprisonment of waste: 6. All bonds and covenants tending to frustrate the provisions of the statutes of 13 and 18 Eliz. shall be void.

Two observations seem to present themselves concerning these statutes: 1. That they do not enable any persons to make such leases as they are by common law restrained from making; therefore, a parson or vicar, though it is restrained from making longer leases than for 21 years 3 lives, even with the consent of the patron or ordinary, yet is not enabled to make any lease at all, to bind his successor without such consent. 2. If leases granted to these acts are void, yet they are good against the lessor during his life, if he is a sole corporation; and it is an aggregate corporation, as long as the head lives: for the act was intended for the benefit of the successor alone, and it is a maxim of law that no man shall take advantage of his own wrong. With regard to college leases, one-third of the old rent must be reserved in wheat or malt, reserving a quarter of wheat for every 6l. and a quarter of malt for every 5s. or the leases must pay for the same, at the price of the market nearest the respective colleges on the market-day before the rent is due.

There are further restraining statutes which direct that if any beneficed clergyman is absent from his benefice above 80 days in the year, all leases and agreements made by him of the profits of his cure shall be void, except in the case of licensed pluralists; who are allowed to damnum this cure, if he is not absent above 40 days in the year. See 13 Eliz. c. 40. 14 Eliz. c. 11. 18 Eliz. c. 11. and 43 Eliz. c. 9.

All leases except such as do not exceed
3 years from the making, whereupon the reserved rent must be at least two-thirds of the improved value of the estate immediately after it is improved, and it is no particular term of words is necessary to constitute a good lease. They must be made to natural-born subjects of this realm, or issued by a naturalized, or to descendents, for all leases made to aliens shall be void; and there is even a statute in force, 32 Hen. VIII. c. 16, which imposes a penalty of 5l. on the lessor and lessee. It has however been held that an alien merchant may take a lease for his own residence, but it shall not go to his executors; the reasons for these laws are evidently to prevent foreigners getting too firm a footing in the kingdom.

**LEASE and LEASE is a conveyance which since the stat. 27 Hen. VIII. c. 10, commonly called the statute of uses, has taken place of the deed of feu-duty, as it supplies the need of livery and seisin. It is made thus: A lease or bargain and sale for one year, from the tenant to the lessee, is first prepared, whereby the lessee becomes actually possessed of the lands, then by the above-mentioned statute the lessee is enabled to take a grant of the land intended to be conveyed to him and his heirs for ever; accordingly a release is made, reciting the lease and declaring the uses. In the lease, a pepper-corn is a good consideration to make the lessee capable of receiving a release. This mode of conveyance is become so usual, that it merits particular attention. See this matter very ably discussed by the annotator of the latter part of Coke's Commentaries, p. 271.**

### LEASES, value of.

**The purchaser of a lease may be considered as the purchaser of an annuity equal to the rack-rent of the estate; and the same principles, from which are deduced the present value of annuities to continue during any given term, will apply to the value of leases. The sum paid down for the grant of a lease is so much money paid in advance for the annual rents, as they may be due. It may be considered as a sum which puts out to interest, will enable the lessee to repay himself the rack-rent of the estate, or the yearly value of his interest therein, during the given term; therefore no money should be demanded by the lessor, for the grant of the lease, than will enable him to do this at a given rate of interest. In order to find what this sum should be it would be necessary to ascertain separately the present value of each annual rent, or the sum which, put out at interest at the given rate, will enable the landlord to repay himself the several yearly rents as they become due. Thus, if a person has 100l. due to him a twelvemonth hence, and he wishes to have the value of the same advanced immediately, the sum that ought to be given as an equivalent therefor, allowing 5 per cent. interest, is 95l. 4s. 9d.; for this is the sum which, put out at interest at the rate of 5 per cent., will, at the end of the year, amount to 100l. So also, if a person has 100l. due to him at the end of two years, and he wishes to have the value advanced immediately, the sum that ought to be given as an equivalent therefor, is 90l. 14s. 3d. For this is the sum which put out at the same rate of interest, will, at the end of two years amount to 100l. In the same manner, if a**

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In order to find the value of a lease, it is first necessary to ascertain the true rack-rent of the estate, or the annual value that it may be justly estimated to be worth; otherwise it will be impossible to determine, with any degree of accuracy, the real sum which ought to be given for the purchase of the same. On this point difficulties will sometimes arise; for the value of an estate depending very often on some real or supposed advantages, or on some local or personal recommendations, will, in many instances, occasion a difference of opinion; and in most cases, be a matter of some uncertainty. However, when all these circumstances have been taken into consideration, some annual rent equivalent thereto must be assumed, and when this is settled the value of the lease will be easily found; thus, if an estate is worth 100l. per annum rent, the value thereof for sixty-nine years, allowing the purchaser 6 per cent interest for his money, is 16,3670 (the number in the table) multiplied by...
lee, corolla, if glume, is therefore the by required, 5 given payable calculated that is chase chaser rent the the not set duct seven years,。“ 

five, of the given value, that be entered of estate of the number of years, or the unexpired value of the unexpired term of six years, or the number of years purchase in the table ought to be multiplied by the difference only between such annual expense and the whole estimated rent of the estate; thin if a person possesses an unexpired term of sixty years in a lease, for which he pays 100/. per annum rent, but which is now worth 150/. per annum, the gross sum which he ought to receive for the grant of such lease, will be equal to $100/ x (150 - 100)/100 = 50/ per annum, for the given term; or 16,1614 (the number in the table corresponding with 60 years, at 6 per cent.) multiplied by 50, which gives 800.L. is 4d.

In order to find the annual rent corresponding to any given sum paid for a lease, divide the sum paid by the number of years purchase that are found against the given term in the table, and the quotient will be the annual rent required. Example: A person pays £1000 for the lease of an estate for 16 years, what annual rent is equivalent thereto in order to allow the purchaser 7 per cent. interest for his money? In the table against 16 years, and under 7 per cent. column, the number of years purchase to be 9,4466; therefore 1000 divided by 9,4466 gives 105/. 17s. for the annual rent required.

The values in the table are calculated on the supposition that the payments of the sever al rents of the estate are made yearly; hence, if the payments are made half-yearly, or quarterly, and the purchaser can put his money at the same rate, so as to receive his interest half-yearly or quarterly, which may commonly be done; the values will, in such cases, be somewhat more than those given in the table. The difference, however, is not very great, but if the exact value is required, it may in many cases be obtained by attending to the following remarks, viz. in the case of the rent of which is payable half-yearly, is equal to half the value of the same lease payable yearly, calculated at half the given rate of interest, and to continue double the number of years; and that the value of a lease the number of years which is payable quarterly, is equal to one quarter the value of the same lease payable yearly, calculated at a quarter of the given rate of interest, and to continue four times the number of years.

It frequently happens that a long lease is not to be entered on or enjoyed till after the expiration of a short lease, or till the end of a given number of years; in such cases, deduct the value of the short lease, or the value set against the given number of years in the table, from the value of the longer lease, and the difference will give the true present value of the longer lease. Example: What sum ought to be given for the remainder of the lease of an estate for 56 years, after the next seven years, allowing the purchaser 6 per cent. interest for his money, the clear rent being reckoned at 70L. per annum? In the table against 56 years, and under 6 per cent. we find 10.406, and in the same column against 49 years, we find 10.529; the latter value subtracted from the former leaves 10.403, which multiplied by 70 gives 731.255 or 731.5/. 1d. for the sum required.

Leases are frequently granted during a life, or for a specified term of years subject to the payment of a fine. The following are given in a very useful collection of tables for the purchasing and renewing of leases by F. Bally, and may in most cases be found from the tables inserted under the article LIFE ANNUITIES.

LEATHER. See Cuts, and Tanning.
LEAVEN. See Fermentation.
LECHEA, a genus of the triandria tri-gynia class and order. The calyx is three-parted; petals, three-linear; capsules, three-seeded, three-valved, seeds solitary. There are three species, herbaceous plants of America and China.

LEYCITHIS, a genus of the poylanthra monogynia class and order. The calyx is six-parted; petals, six-petalled; nectarium, bifatulate, staminate: pericarp, circinnate, six; seed many-seeded. There are six species, trees or shrubs of Guiana.

LEDGER, the principal book wherein merchants enter their accounts. See Book-keeping.

LEDGES, in a ship, are small pieces of timber lying athwart from the roof-trees to the roof-trees: they serve to bear up the gratings or nettings of the half-deck. See Ship-building.

LEEDUM, marsh eustus, or wild rosemary; a genus of the monogynia order, in the de-candria class of plants; and in the natural method ranking under the 18th order, bi-corns. The calyx is quinquepartite; the corolla plain and quinquepartite; the capsule quinquilocular, and opening at the base. There are three species: The palustre with very narrow leaves, grows naturally upon banks and moors in many parts of Yorkshire, the flower is produced in small clusters at the end of the branches, and are shaped like those of the strawberry-tree, but spread open wider at top: these are of a reddish colour, and in the natural places of these flowers are succeeded by seeds-seeds filled with small seeds which ripen in autumn.

LEE, in the sea-language, a word of various significations, though it is generally understood to mean the part opposite to the wind. Thus lee-shore, is that shore against which the wind blows. Lee-latch, or have a care of the lee-latch, is, take care that the ship don't go to the leeward, or too near the shore; a command, put it to the leeward side of the ship; to be by the lee, or to come up to the lee, is to bring the ship so, that all her sails may lie flat against her masts and shrouds, and that the wind may come right upon her breadlips.

LEEMING, is a rope riveted into the cringles of the forecastle, to hold in the bottom of the sail, that the booms may be laced on, or the sail taken in.

LEES-WAY, is the angle that the rhumb-line upon which the ship endeavors to sail, makes with a line drawn from the place where the wind is, to the shore. See Navigation.

LEEEA, a genus of the class and order peptonandra monogynia. The calyx is one-petalled; neat; on the side of the corolla, upright, five-celled; berry, five-seeded. There are three species, grasses of America.

LEECH, See Hirudo.
LEEK, See Allium.
LEERIA, a genus of the class and order triandria digynia. Calyx none; gume, three-valved, closed. There are three species, grasses of America.

LEFT, a little court held within a manor, and called the king's court, on account that its authority to punish offences originally belonged to the crown, where it is derived to inferior persons. See Court.

LEETCH-lights, small ropes made fast to the leech of the topsails, to which they belong, and reeved into a block at the yard close by the topsails. They serve to take in the leech of the sail when the topsails are to be taken in.

LEGACY, a bequest of a sum of money, or any personal effects of a testator: and these must be paid by his representative, after all the debts of the estate are discharged, as far as the assets will extend.

All the goods and chattels of the deceased, are by law vested in the representative, who are required to see whether there be left a sufficient fund to pay the debts of the testator, and if it should prove inadequate, the pecuniary legacies must proportionately abate: a specific legacy, however, is not to abate unless there be insufficient without it.

If the legatee die before the testator, such will in general be termed a lapsed legacy, and fall into the general fund; where however, from the general import of the will, it can be collected that the testator intended such a vested legacy, it will in such case go to the representative of the deceased legatee.

If a bequest be made to a person, if or when he attains a certain age, the legacy will be lapsed, if he die before he attain that age: but if such legacy be made payable at that age, and the legatee die before that age, such legacy will be vested in his representative.

In the latter case, the testator devise interest to be paid in the mean time, it will nevertheless be a vested legacy.

Where a legacy is bequeathed over to another, in case the first legatee die under a certain age, or the like, the legacy will be payable immediately on the death of the first legatee; and though such legacy be not bequeathed over, yet if it carry interest, the representative will become immediately entitled to it.

In case of a vested legacy due immediately, and charged on land, or money in the funds which yields an immediate profit, interest shall be payable from the death of the testator; but if be charged on the personal estate only of the testator, which cannot be collected in, it will carry interest only from the end of the year after the death of the testator.

If a request be for necessities, and of small amount, the executor will be justified in advancing a part of the principal; but this should be done under very particular circumstances, as the executor may be compelled to pay the full legacy on the infant's attainder of age, but deducting the sum previously advanced.
When all the debts and particular legacies are discharged, the residue or surplus must be paid to the residuary legatee, if any be so appointed in the will; but if there be none appointed or intended, it will go to the executor or next of kin.

When this residue does not go to the executor, it is to be distributed among the intestate's next of kin, according to the statute of distributions; except the same is otherwise disposed of by particular customs, as those of London, York, &c. See Executor.

LEGATE, a cardinal or bishop, whom the pope sends as his ambassador to sovereign princes.

There are three kinds of legate, viz., legates a latere, legates de latere, and legates by office, or legati nati; of these the most considerable are the legates a latere, the next are the legates de latere.

Legates by office are those who have not any particular legation given them, but who, by virtue of their dignity and rank in the church, become legates; such are the archbishops of Rheims and Arles; but the legation of a cardinal is much inferior to that of the legates a latere.

LEGATUS, in Roman antiquity, a military officer who commanded as deputy of the chief general.

LEGEND, in music, one added to the staff of five lines, when the ascending or descending notes run very high or low.

LEGION, in Roman antiquity, a body of foot which consisted of ten cohorts.

The exact number contained in a legion, was fixed by Romulus at three thousand; though Plutarch assures us, that after the reception of the Sabines into Rome, he increased it to six thousand. The common number afterwards, in the first times of the free state, was four thousand; but in the war with Hannibal, it arose to five thousand, and after this it is probable that it sunk again to four thousand, or four thousand two hundred, which was the number in the time of Titus.

LEGNOTIS, a genus of the class and order polyandria monadynia. The calyx is five-dent; pet. 5; caps. 3-celled. There are two species, from Guiana.

LEMA, in mathematics, a proposition which serves previously to prepare the way for the more easy apprehension of the demonstration of some theorem, or construction of some problem.

LEMNA, a genus of the monoeica diandria class and order. The male cal. is one-leaved; cor. none; style one; ovary one-celled. There are six species, known by the name of duckweed, or duck-meat.

LEMINISEA, a genus of the class and order polyandria monadynia. The cal. is 5-toothed; cor. 6-petalled, recurved; nect. capp. shaped, girding; the germ. per. 5-celled, seeds solitary. There is 1 species, a tree of Guiana.

LEMON. See Citrus.

LEMON; salt of. See OXALAT of potass.

LEMYER, M. a genus of quadrupeds of the order primates; the generic character is, front-teeth in the upper jaw, four; the intermediate one remote: in the lower jaw, six; longer, stretched forwards, compressed, parallel, approximated. Canine teeth solitary, approximated; grinders several, subobtund; the foremost somewhat longer and sharper.

The genus lemur or macecon consists of animals approaching to monkeys in the form of their feet, which, in most species, are furnished with nails or claws in their manus, and void of that mischievous and pestulant disposition which so much distinguishes the monkey tribe from other quadrupeds.

In this, as in the former genus, we meet with some species without a tail, while others have that part extremely long. Of the tail-less species the most remarkable is the 1. Lemur tardigrados, slow lemur. It is about the size of a small cat, measuring sixteen inches in length; its colour is an elegant pale-brown or mouse-colour; the face flatish; the nose inclining to a sharpened form; the eyes yellow-brown, large, and extremely protrubent, so as to appear in the living animal like perfect hemispheres. They are surrounded by a circle of dark brown, which also runs down the back of the animal. This species is very slow in its motion, and is a very rare sight; it is greatly esteemed for its flesh by some naturalists among the sloths; though in no other respect resembling them. It is a nocturnal animal, and sleeps, or at least lies motionless, during the greater part of the day; its voice is shrill and plaintive.

2. Lemur indri. This is a very large species; it is entirely of a black colour, except on the face, which is greyish; greyish nails in the hands and feet. The lacteal part of the abdomen, and the rump is white. The face is of a lengthened or dog-like form; the ears shortish and slightly tufted; the hair or fur is silky and thick, and in some parts of a curly or cripped appearance; its the largest animal of this genus, and is said by Mons. Sonnerat, its first describer, to be three feet and a half high; it is said to be a gentle and docile animal, and to be trained, when taken young, for chase, in the manner of a dog. It was by the name of the carrying off of an infant. It is a native of Madagascar, where it is known by the name of Indri, which is said to signify the man of the wood. The legs of this species are flat, but pointed at the ends; and covered with short hairs.

3. Lemur macaco, rufous lemur. This is the species described by the count de Buffon, under the name of the varius, its colours often consisting of a patched distribution of black and white; though its real or natural colour is supposed to be entirely black. In size it exceeds the mongs, or brown lemur. It is said to be a fierce and almost untameable animal; it inhabits the woods of Madagascar and some of the low islands; and is said to exert a voice so loud and powerful as to strike astonishment into those who hear it, resembling, in this respect, the howling monkey of S. Bolzebach, which fills the woods of Brazil and Guiana with its dreadful cries. When in a state of captivity, however, it seems to become as gentle as some others of this genus.

The astonishing strength of voice in this animal, amounts, according to the count de Buffon, on the peculiar structure of the larynx, which widens, immediately after its diversification, into a large cavity before entering the lungs.

4. Lemur tarsier. This animal is distin-
according to Tycho, thirty-seven; and in the Prutenic catalogues, there are not less than ninety-four. The star called the horned-beetle, coriicons, regius, and tardius, is a fixed star of the first magnitude.

To go on, in the left, a genus of the monotypia is, the Goniolidae class of plants; and in the natural method ranking under the 42nd order, coriicons. The coriicon is a sessile plant, its cylinder is conical, and deciduous. There are three species, natives of the southern parts of Europe, two of which are sometimes cultivated in this country. These are, 1. The chrysogonium with winged leaves; and 2. The leontopetalum with compound leaves. But those plants are natives of the Archipelago islands, and also grow in the corn-fields about Aleppo in Syria, where they flower soon after Christmas.

LEONOTODON, donclentia: a genus of the polygynia aronsilis, in the synge-nesan class of plants; and in the natural method ranking under the 49th order, composite. The leontopetalum is naked; the calyx imbricated, with the scales somewhat loose; the pappus feathery. There are four species, of which the only remarkable one is the taraxacum, or common dandelion, found on grasslands, and on the banks of ditches. Early in the spring, the leaves whilst yet white and hardly unfolded are an excellent ingredient in salads. The French eat the roots and tender leaves with bread and butter. Children that eat it in the evening experience its diuretic effects in the night, which is the reason for its vulgar appellation. When a swarm of locusts had destroyed the harvest in the island of Minorca, many of the inhabitants subsisted upon this plant. The expressed juice has been given to the quantity of four ounces three or four times a day; and Boerhava had a great opinion of the utility of this and other lacteous plants for the deaf. Gouty eat it; swine devour it greedily; sheep and cows are not fond of it, and horses refuse it. Small birds are fond of the seeds.

LEONURUS, lint's tail; a genus of the gynopogon class, in the dicotylidae class of plants; and in the natural method ranking under the 42nd order, vertalicile. The anther are powdery with shining points, or small elevated globular particles.

The species are: 1. The Africana, with scar-shaped leaves, a native of Ethiopia. The flowers are produced in whorls, each of the branches having two or three of these whorls towards their ends. They are of the lip-like shaped somewhat like those of the dead-nettle; but are much longer, and covered with short hairs. They are of a golden scarlet colour, so make a fine appearance.

2. The nepetafolia, with oval leaves, a native of the Cape of Good Hope. The flowers come out in whorls like those of the former sort, but are not so long nor so deep-coloured. They appear at the same season with the first, and continue as long in beauty. They are the same three species, but the above are the most remarkable.

Both sorts are propagated by cuttings, which should be exposed to the air long enough to harden the shoots, and planted in the beginning of July, after which they will take root very freely. They should be planted in a loamy border to an eastern aspect; and if the soil be not well withered with a hand glass to exclude the reflection of the sun, they will forward their putting forth roots.

As soon as they have taken root good, they should be taken up and planted each in a peat pot filled with loamy earth, and placed in the shade till they have taken new root. In October they must be removed into the greenhouse.

LEPIDAPUS, see LEPAS.

LEPIDONIDAE, Lepidoptera, lepididae: a genus of insects. They are, the amara, the shells, flattened at the base, and consisting of many unequal erect valves. The lepidus antlers, or duck-dermalica, lizes the shell compressed, five valued, smooth, seated on a bermica. They inhabit most seas, and is found fixed in clusters to the bottom of vessels, and old pieces of floating timber, generally whitish with a blue cast, the margins of the valves yellow; sometimes marked with black; peduncle long, coriaceous, black, and much wrinkled towards the shell, and growing paler and pellucid towards the base. See Plate Nat. Hist. fig. 243.

LEPIDIUM, dittander, or pepperwort: a genus of the siliculea class, in the coriicon class of plants; and in the natural method ranking under the 39th order, siliquose. The silicula is emarginated, corrated, and polyporomous, with the valves carinated contrary or broader than the partition. There are 23 species, of which the only remarkable one is the latifolium or common dittander. This is a native of many parts of England. The whole plant has a hot bitting taste like pepper; and the leaves have been often used by the country-people to give a relish to their viands instead of that spice, whence the plant has got the appellation of poor man's pepper. It is reckoned an astringent, and was formerly used instead of the horse-radish. See LEPIDOITA, see SERRATITRATIS.

LEPIDOPTERA, zoology, an order of insects with four wings, which are covered with imbrications squamae. In this to this that the mouth is commonly spiral.

Under this order are comprehended the phalana, sphinx, and other genera.

LEPSIMA, the name of a genus of insects of the order aptera. The generic character is, legs six, formed for running; mouth with two setaceous and two headed feelers; body imbricated with two minute scales; tail furnished with extended bristles.

The Limnanthus genus lepsima is far from extensive, those enumerated by Limnanthus himself in the twelfth edition of the Systema Naturae, amounting to no more than three species.

Of these the chief is the lepsima saccharina (See Plate Nat. Hist. fig. 243), frequently called in our own country, from its peculiar colour and tapering form, by the name of the wood-fish. This is an insect of great elegance. Its general length, exclusive of the caudal bristles, is about half an inch, and its colour a bright silver grey, resembling, in this colour being to a covering of extreme minute oval scales, which are semitransparent, very easily detached from the animal by a slight touch; the head and thorax together form a rounded outline, the remainder of the body gradually lessening to the tail, which terminate in three long bristles, of similar appearance with the antennae. The motions of this insect are slow and mild, and it is often observed among various domestic articles, particularly sugar. It also occurs not unfrequently among old books and papers, which it is supposed often to injure. It is said to be the American animal, and to have been imported into Europe among sugars, &c. Dr. Browne, in his History of Japan, represents it as "extremely destructive to books and all manner of woddle." See LEPSIUS.

Leptogonia pulvis Lin. is a dusky or brownish cast, and has a springing or leaping motion when disturbed. It is found about the sea-coast of many northern regions, under stones, &c.

LEPROSY. See Medicine.

LEPTURA, the name of a genus of insects of the order coleoptera: the generic character is, antenna scavece; wings sheathed, attempted towards the tip; thorax sub-cylindrical. The genus leptura, greatly allied to that of cerambyx, contains several species of considerable beauty; among which may be reckoned the leptura arcanu, of a brown, with the extremity marked by transverse, yellow, banded points pointing backwards; it is found in woods during the summer months, and generally measures about three quarters of an inch in length.

The leptura is of nearly uniform appearance, but the second band of the wing-sheaths is directed forwards; both the above insects are by some referred to the genus cerambyx.

Leptura aquatica is so named from its being particularly found in the neighborhood of waters, frequenting the plants which grow near the water's edge. It is about half an inch in length, and of a golden green-colour, sometimes varying into copper-colour, purple, or blue, and is distinguished by having a tooth or process on the thighs of the hind legs.

The larvae of the leptura in general are probably allied to those of the cerambyces, but they are at present unknown.

LEPSUS, hare, a genus of quadrupeds of the order glires. The generic character is, front-teeth two both above and below, the upper pair duplicate; two small inner ones behind. This genus, when considered with anatomical exactness, exhibits particularities of structure, deviating somewhat from that of the glire, and making an indistinct approach to the peccora or ruminants. It has even been supposed that the common hare actually ruminates; an opinion owing not only to peculiar motions of the mouth, which present an obscure appearance of ruminuation, but to the structure of the lepsus stomach, which is marked into two regions by a particular fold or ridge. Other singularities relative to internal formation may be met with in the works of comparative anatomists. The most remarkable species are, 1. Lepus timidus, common hare. This hare is an animal so familiarly known as to supersede the necessity of any very minute description. It is a native not only of every part of Europe, but of almost every part of Asia. It may perhaps be doubted whether it is an aboriginal native of any part of America.

The favourite residence of the hare is in rich and somewhat dry and flat grounds, and it is rarely discovered in very hilly or mount-
taneous situations. It feeds principally by night, and remains concealed during the day in its form, beneath some bush, or slight shelter.

The pox-willin of this animal is proverbial, and on account of the conformation of its legs, the hinder of which are longer than the fore, it is observed to run to most advantage on slightly ascending ground.

The hare is a very prolific animal, generally producing three or four young at a time, and breeding several times in a year, The young require the assistance of the parent but for a short time, and in about three weeks are able to provide for themselves; they do not remove to any great distance from each other, but continue in the same neighbourhood for a considerable time. The hare feeds on various vegetables, but is observed to prefer those of a milky and succulent quality. It also occasionally feeds on the bark of trees, as well as on the young shoots of various shrubs, &c.

The nature of the soil in which the hare resides and feeds, is observed to influence in a considerable degree the colour and constitution of the white fur in elevated situations are larger and darker than those which reside in the plains.

The hare is an animal proverbially timid, and flies, if disturbed when feeding by the slightest alarm; but when seated in its form, will allow itself to be approached so near as to be reached by a stick; seeming to be fascinated by fear, and instead of endeavouring to fly, continuing to squat immovable, with its eyes fixed on its enemy. It is necessary, however, in order to conduct this movement, to approach in a gradual and circling manner.

The hare, though so nearly allied to the rabbit as to make the general descriptive distinction not very easy, is yet of different habits and propensities, and never associates with the latter animal. If taken very young, the hare may be successfully tamed, and in that state shews a considerable degree of attachment to its benefactors, though it continues shy to strangers, and is easily terrified. Those who have been accustomed to Mr. White, in his History of Selbourne, relates an instance which happened in that village, of a young leveret sucked and nursed by a cat, which received it very early under her protection, and continued to guard it with maternal solicitude till it was grown to a considerable size.

A most singular variety of this animal is something rare, which is furnished with rough and slightly branched horns, bearing a considerable resemblance to those of a roe-buck. This particularity, as strange as it is uncommon, seems to imply a kind of indistinct approach in this animal to the order perocera.

The hare is a short-lived animal, and is supposed rarely to exceed the term of seven or eight years. It may be proper to add, that in very severe winters, and especially in those of the more northern regions, the hare becomes entirely white, in which state it is liable to be mistaken for the following species.

2. Lepus variabilis, varying hare. This species is an inhabitant of the loitest alpine tracts in the northern regions of the globe; occurring in Norway, Lapland, Russia, Siberia, and Kamtschatka; and in our own island on the Alps of Scotland. The same species is also found to extend to America, particularly to the mountains of the Western States. In its general appearance it bears an extreme resemblance to the common hare, but is of smaller size, and has shorter ears and more slender legs. Its colour in a summer is a tawny grey, in winter entirely white, except the tips of the ears, which are black; the soles of the feet are also black, but are very thickly clothed with a yellowish fur. This animal is observed to confine itself altogether to elevated situations, and never to descend into the plains, or to mix with the common hare. The change of colour commences in the month of September, and the grey or summer coat reappears in April; but in the very severe climate of Siberia it continues all the year round. It has been sometimes found entirely coal-black, a variety which is also known to take place occasionally in the common hare. The varying hare sometimes migrates in great quantities to the coast to obtain food. Troops of five or six hundred have been seen to quit in this manner the frozen hills of Siberia, and to descend into the plains and woody districts, from which they again return in spring to the mountains.

3. Lepus Americanus, American hare. This animal is not much superior in size to a rabbit, measuring about eighteen inches. Its colour is usually white, but the common hare, to which it seems much allied; but the fore legs are shorter, and the hind ones longer in proportion. The belly is white; the tail black above and white beneath; the ears tipped with grey, and the legs of a pale-ferruginous colour. It is said to inhabit all parts of North America; and in the more temperate regions retains its colour all the year round, in which, while it flourishes extremely long and slivery; the edges of the ears alone retaining their former colour. It is said to be extremely common at Hudson's Bay, where it is considered as a favourite food, being caught once or twice a year, producing from five to seven at a time. It is not of a migratory nature, but always continues to haunt the same places, taking occasional refuge under the roots of trees, or in the hollows near their roots.

4. Lepus cuniculus, rabbit. The rabbit bears a very strong general resemblance to the hare, but is considerably smaller, and its feet are furnished with sharper and longer claws in proportion; thus enabling it to burrow in the ground, and to form convenient retreats, in which it conceals by day, and like the hare, comes out chiefly by night and during the early part of the morning to feed. Its colour, in the wild state, is a dusky brown, paler or whiter on the under parts, and the tail is black above and white below. In a domestic state the animal varies into black, black-and-white, silver-grey, perfectly white, &c.

The rabbit is a native of most of the temperate and warmer parts of the old continent, but is not found in the northern regions, and is not originally a native of Britain, but was introduced by the Romans. The general residence is in dry, chalky, or gravelly soils, in which it can conveniently burrow. It is so prolific an animal that it has been known to breed seven times in a year, and to produce no less than eight young each time. It is therefore not surprising, that in some countries it makes itself scarce by its increased numbers; and has occasioned a good deal of calamity, and that various arts of extirpation have been practised against it.

5. Lepus viscacia. This species is said to have the general appearance of a rabbit, but has a long bushy and bristly tail, like that of a fox, which the animal also resembles in colour; the fur on all parts, except the tail, is soft, and is used by the Peruvians in the manufacture of hats; it was also used by the ancient Peruvians for the fabric of garments, worn only by persons of distinction. In its manners this animal resembles the rabbit, burrowing under ground, and forming a double mansion, in the upper part of which it deposits its provisions, and sleeps in the other. It appears chiefly by night, and is said to defend itself when attacked by striking with its tail.

6. Lepus alpinus, alpine hare. This is a very different species from the alpine hare described by Mr. Pennant in the British Zoology, which is no other than the varying hare. The alpine hare is a far smaller animal, scarcely exceeding a guinea-pig (cavia cobis) in size, and measuring only nine inches in length. Its colour is a bright ferruginous grey, paler beneath; the head is long, and the ears short, broad, and rounded. See Plate Nat. Hist. fig. 246. It appears to have been described by Dr. Polian, who informs us that it is a native of the Altai mountains, and extends to the Lake Baikal, and even to Kamtschatka, inhabiting rough woody tracts amidst rocks and cataracts, and forming burrows beneath the rocks, or inhabiting the natural fissures, and dwelling sometimes singly, and sometimes two or three together. In their manners they greatly resemble some of the marmots or hamsters; preening, during the autumn, a plentiful asser-tion of the finest herbs and grasses, which they collect in company, and after dryng with great care in the sun, dispose into heaps of very considerable size, for their winter supply, a thing which is much dis-eased, even through the deep snow, having the appearance of so many hay ricks in miniature, and being often several feet in height and breadth. The alpine hare varies in size according to the different regions in which it is found, being largest about the Altai mountains, and smaller about Lake Baikal, &c.

7. Lepus ogotona, ogotona hare. This animal, says Dr. Pallas, is called by the Mongo- lians by the name of ogotona, and is an inhabitant of rocky mountains, or sandy plains, burrowing under the soil, or concealing itself under heaps of stones, and forming a soft nest at no great depth from the surface. It wanders about chiefly by night, and sometimes appears by day, especially in clouds of weather. In autumn it collects heaps of various vegetables for its winter food, in the manner as the alpine hare has been described, disposing them into neat hemispherical heaps of about a foot in diameter. These heaps are prepared in the month of September, and are entirely consumed by the winter.
LET

LE

LEVARI FACIAS, is a writ directed to the sheriffs for levying a certain sum of money upon the lands, &c. of a person who has forfeited his recognizance.

LEUVITE. This stone is usually found in volcanic productions, and is very abundant in the neighbourhood of Vesuvius. It is always crystallized. The primitive form of its crystals is either a cube or a rhombohedral dodecahedron, and its integrant molecules are tetrahedrons; but the varieties hitherto observed are all polyhedrons. The most common has a spherical figure, and is bounded by 24 equal and similar trapezoids; sometimes the faces are 18, 15, 30, 45, and triangular, pentagonal, &c. The crystals vary from the size of a pin's head to that of an inch.

The texture of the leuviite is foliated; its fracture somewhat conchoidal; specific gravity from 2.455 to 2.492; colour white, or greyish white. Its powder causes syrup of violets to assume a green colour. Inflatable by the blow-pipe. Gives a white transparent glass with borax. It is composed, as Klepgroth has shown, of

- 54 silica
- 23 aluminia
- 22 potassa

99.

It was by analyzing this stone that Klēphrosh discovered the presence of potas in the mineral kingdom, which is not the least important of the numerous discoveries of that accurate and illustrious chemist.

Lencis is found sometimes in rocks which have never been exposed to volcanic fire, and Mr. Dolomieu has rendered it probable, from the substances in which it is found, that the leaves of volcanoes has not been formed by volcanic fire, but that it existed previously in the rocks upon which the volcanoes have acted, and that it was thrown out unaltered in fragments of these rocks.

LEUCOJUM, great snow-drop, a genus of the monogynia order, in the hexandria class of plants, and in the natural method order, spathophyllous. The corolla is campanulate, dissipate, the segments increased at the points, the stigma simple. The species are 1. The vernum, or spring leucumin, has an oblong bulbous root, sending up a naked stalk, about a foot high, terminated by a spath, protruding one or two white flowers, appearing in March.

2. The autumnum, or summer leucomin, has a large oblong bulbous root, an upright stalk, 15 or 18 inches high, terminated by many white flowers in May. 3. The automnale has a large oblong bulbous root, narrow leaves, an upright stalk, terminated by white flowers in autumn. 4. The shumosum, with flowers white within, purplish without.

LEUCOMA. See Surgery.

LEVEL, an instrument used to make a line parallel to the horizon, and to continue it out at pleasure; and by this means to find the level of objects, or the height of ascents or descents, between two or more places, for conveying water, draining, &c.

There are several instruments, of different contrivance and matter, invented for the perfection of levelling. They may be reduced to the following kinds:

Water-Level, the which shews the hori-
LEVEL.

A common level, as the name implies, is one that has a horizontal line of sight, and is used to determine the level of surfaces, such as the ground or a building. It is based on the principle that a bubble always seeks its lowest position, which is directly above the position of the instrument when it is perfectly horizontal. The instrument consists of a glass tube, usually about 6 inches long, containing a small amount of fluid, and a bubble of air. When the instrument is perfectly horizontal, the bubble is centrally located; if it is tilted in any direction, the bubble will move to one side, indicating the degree of tilt.

The level is used in construction, surveying, and various other fields to ensure that surfaces are level or to determine the gradient of slopes. It is an essential tool for ensuring accuracy in building and construction projects.

Dr. Desaguiler's machine, described in the text, is a level with a glass object-glass, which allows for precise measurements of horizontal lines. The instrument's principle is based on the fact that a horizontal line is one where the distance between two objects is constant, regardless of the observer's position.

In conclusion, the level is a fundamental instrument in the field of construction, allowing for precise and accurate measurements, ensuring the quality and safety of structures and projects. Its simplicity and effectiveness make it an indispensable tool for professionals in the construction industry.

Lowered by means of a milled-headed screw N, which works through a collar in the lower end of the tube; the rest of the tube has a triangular hole through it, in which slides a bar k, which is part of the Y; O the female screw is turned in the eyepiece, and the screw works into it, so that by turning the milled head one way, the Y is raised, and by reversing the motion, it is lowered. The axis which connects the compass-box and the other apparatus, has a collar upon it just above where it enters the ball, fig. 3, which is embraced by a clamp P, fig. 6, which is closed by a screw Q, so as to hold the collar of the axis quite tight: and when the screw is turned back, its own distictity opens it so as to allow the axis of the compass-box to turn round freely within it; on the opposite side of the clamp is a projecting arm h, carrying the nut m of the screw Q, which screw works in a stud a, fixed to the upper plate G, figs. 7 and 6; by this means, when Q is loosened, the telescope can be turned quite round, but when it is fastened, it can only be moved by turning the screw Q. The level-tube Z is fastened in the same way as the telescope is, by a screw g at one end and a bar r at the other: the use of these are to adjust it so that it shall be exactly parallel to the axis of the telescope-tube. The level, as best explained by the section fig. 1, is a tube of glass s*, nearly filled with spirits of wine, but so as to leave a bubble of air in it; if the tube is of exactly the same diameter in every part, the bubble will rest in the middle of the tube when the axis is in the plane made by Ramsden, the inside of the tube is bent into a segment of a circle, 100 feet diameter, and the inside is ground, which causes the bubble to adhere together; if the tube is straight, it is liable to divide into several small ones. The internal parts of the telescope are explained in fig. 1: RR is the external tube of brass plate; within this slides another tube ss; A has two glasses v, w, screwed into the outer end, called object-glasses, and it has two divisions x, y, called diaphragm, with small holes in them; their use is to collect the prismatic rays with which the objects would otherwise be tinged; the glasses are fixed nearly in the middle of j, which turns into a pinion on the axis of the milled head T, figs. 1 and 7; by turning this, the glasses v, w, can be moved nearly to, or farther from, the eye to adjust the focus; to the tube R at y, are fixed the cross-wires, whose intersection is exactly in the centre of the tube. The manner of using these is explained in fig. 3: A is a brass box, which fits into the end of the telescope-tube, and has a perforated floor by four small screws; within this box is placed a brass plate B, carrying the wires, which are fastened by screwing four screws down upon their ends; when the plate B is in the box, a ring D is screwed in upon it, which prevents its falling out, but at the same time leaves it at liberty to move about in the box; the sides of the box, and also the telescope-tube, has four rectangular holes in it, through which four uprights project, and each in to the cross-piece B, so as to hold it in any position: these screws come through the external tube, and have square heads, to be turned by a key, so as to adjust the interactions in the centre: the box A has a female screw in the front, into which is screwed the eye-piece W; s is the tube which is screwed to the telescope; within this slides a tube, containing two glasses 4, 5; by sliding the glasses in or out of the tube 3, they can be adjusted so as to adapt their focus to the cross-wires. This eye-piece has a circumference of 36 feet 6 inches, and a diameter of 13 inches; but as it reverses the objects, it is sometimes more convenient to use the eye-piece fig. 2, which is much longer, but does not reverse objects. a is the tube which is screwed to the telescope; within this slides another tube hh, having at one end a tube dd, containing two glasses ef, and a diaphragm g, and at the other end a tube hh, containing two glasses h, and a diaphragm: s is a cap screwed on to the end to prevent the tubes coming out. When the instrument is to be carried, the level is unscrewed from the legs and packed in a case; the legs are shut up and kept so by the rings, as before described. The manner of using this instrument is as follows: When the difference of level between any two places is required, the observer with the level goes to the highest of the two, and his assistant goes to the lowest; with the common eye-piece of the telescope is put on a groove in it, in which slides a small rod carrying a round piece of wood, called a sight, which is to be observed through the telescope; the observer opens the legs of the instrument, and then sets the other end of the level next is screwed to them at E, as shown in fig. 7; the telescope is then brought nearly to a level by the screws HHHH, as before described; the screw e is then turned so as to adjust the focus, fig. 6; and the telescope is turned about, so as, at the point of the target, the clamp P is then closed, the observer looks through the telescope, and by tuning the nut 1, the focus is adjusted: the screw Q is then turned till the cross-wires are brought to coincide with the object, in an horizontal plane: he then takes his eye from the telescope, and works the screw N till he brings the bubble of air in the level-tube exactly in the middle, which shows that the telescope is perfectly horizontal; the observer then makes signals to the assistant to raise or lower the sight on the slider of the target, till it is brought to coincide with the intersection of the two cross-wires, which shows that the telescope and the sight of the target are on the same level; the height which the sight is from the ground where the target stands, deducted from the height the telescope stands from the ground, is the difference of level required.

LEVELLING, the art or act of finding a line parallel to the horizon at one or more stations, to determine the height or depth of one place with respect to another; for laying out grounds even, regulating descents, draining meadows, conducting water, &c.

Two or more places are on a true level when they are equally distant from the centre of the earth. Also one place is higher than another, or out of level with it, when it is farther from the centre of the earth; and a line equally distant from that centre in all its points, is called the line of true level. Hence, the property of a curve, which is a part of the earth's circumference, or at least parallel to it, or concentric with it, is that it may pass all its points equally distant from a, the centre of the earth, considering it as a perfect globe.

But the line of sight BDF, &c. given by the operations of level, is a tangent, or a right line perpendicular to the semidiameter of the earth at the point of contact B, rising always higher above the true line of level, the farther the distance is, called the apparent level or the true level, is the height of the apparent level above the true level, at the distance BC or BD; and if E is the excess of height at F, and GH at G, &c. the difference, it is evident, is always equal to the excess of the arc of the arch of distance above the radius of the earth.

The common methods of levelling are sufficient for laying pavements of walls, or for conveying water to small distances, &c.; but in more extensive operations, as in levelling the bottoms of canals, which are to convey water to the distance of many miles, and such like, the difference between the true and the apparent level must be taken into the account.

Now the difference CD between the true and apparent level, at any distance BC or BD, may be found thus: By a well-known property of the circle, 2AC + CD = BD; or BD − CD is the excess of the apparent over the true level, and which to an operation commonly extends, that 2AC may be safely taken for 2AC − CD = BD, without any sensible error, it will be 2AC = BD; or BD = CD, which therefore is BD or 2AC − nearly that is, the difference between the true and apparent level, is equal to the square of the distance between the places, divided by the diameter of the earth, and consequently it is always proportional to the square of the distance.

Now the diameter of the earth being nearly 7958 miles; if we first take BC = 1 mile, then the excess of becomes 1 = 7.938 miles, which is 7.903 miles, or almost 8 inches, for the height of the apparent above the true level at the distance of one mile. Hence, proportioning the distances in altitude according to the squares of the distances, the following Table is obtained, showing the height of the plane above the true level for every 100 yards of distance on the one hand, and for every mile on the other.

<p>| Dist. from the | Diff. of Level from | Disc. from the | Diff. of Level from |</p>
<table>
<thead>
<tr>
<th>or BC</th>
<th>or CD</th>
<th>or BC</th>
<th>or CD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yards</td>
<td>Inches</td>
<td>Miles</td>
<td>Feet. Inc.</td>
</tr>
<tr>
<td>100</td>
<td>0.000</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>200</td>
<td>0.103</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>300</td>
<td>0.205</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>400</td>
<td>0.309</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>500</td>
<td>0.413</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>600</td>
<td>0.517</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>700</td>
<td>0.622</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>800</td>
<td>0.728</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>900</td>
<td>0.835</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>1000</td>
<td>0.943</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>1100</td>
<td>1.052</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>1200</td>
<td>1.163</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>1300</td>
<td>1.274</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>1400</td>
<td>1.386</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>1500</td>
<td>1.500</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>1600</td>
<td>1.614</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>1700</td>
<td>1.730</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>1800</td>
<td>1.848</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

By means of tables of levels, we can now level to almost any distance at one operation, which the ancients could not do by a great multitude; for, being unacquainted with the correction answering to any distance, they only levelled from one 20
The operation of levelling is as follows: Suppose the height of the point A (Plate 15, fig. 153), the top of a mountain, above that of B at the foot of it, is required. Place the level along the middle distance at D, and set up pickets, poles, or staffs at A and B, which usually must attain with signals for raising and lowering, on the said poles, little marks of pasteboard or other matter. The level having been placed horizontally by the bubble, &c. look towards staff A, and cause the person there to raise or lower the mark till it appears through the telescope or sights, &c. at F; then measure exactly the perpendicular height of the point B above the point A, which suppose 3 feet 8 inches, and set it down in your book. Then turn your view the other way towards the pole B, and cause the person there to raise or lower his mark, till it appears in the visual line as before at C; and measuring the height of C above B, which suppose 13 feet, set this down in your book also, immediately above the number of the first observation. Then subtract the one from the other, and the remainder 9 feet 10 inches will be the difference of level between the places A and B, which is the height of the point A above the point B.

If the point D, where the instrument is fixed, is exactly in the middle between the points A and B, there will be no necessity for reducing the level to the true one, and the visual ray on both sides being raised equally above the true level. But if not, each height must be corrected or reduced according to its distance, before the one corrected height is doubled to the other. When the distance is very considerable or irregular, so that the operation cannot be effected at once placing of the level, or when it is required to know if there is a sufficient descent for conveying water from the spring A to the point B (fig. 154), this must be performed at several operations. Having chosen a proper place for the first station, as at F, fix a pole at the point A near the place where the first pole is to be set, and thence descend the distance to A by the level, and measure the distance from A to L, then the level being adjusted in the point L, let the mark L be raised or lowered till it is seen through the telescope or sights, &c. at those points of level, and on the staffs A and B. Then having fixed another pole at H, direct the level to it, and cause the mark G to be moved up or down till it appears through the instrument; then measure the height of the height, &c. and the distance from 1 to H, noting them down in the book. This done, remove the level forward to some other eminence as E, from whence the pole II may be viewed, as also another pole at D; then having adjusted the level to the point II, look back to the point H; and noticing the mark as before, the visual ray will give the point F; then measuring the distance HE and the height HE, note them down in the book. Then, turning the level to look at the next pole D, the visual ray will give the point D; there measure the height of E, and the distance EB, entering them in the book as before. And this proceed from one station to another till the whole is completed.

Having summed up all the columns, add those of the distances together, and the whole distance from A to B is 4735 yards, or two miles and three quarters nearly. Then the sum of the corrections taken from the sum of the apparent heights, leave the two corrected heights; the one of which being taken from the other, leaves 5 feet 11½ inches for the true difference of level sought between the two places A and B, which is at the rate of an inch and a half nearly to every 100 yards, a quantity more than sufficient to cause the water to run from the spring to the house.

Or the operation may be otherwise performed; thus: Instead of placing the level between every two poles, and taking both back-sights and fore-sights, plant it first at the spring A, and from thence observe the level to the first pole, remove it to this pole, and observe the second pole; next move it to the second pole, and observe the third pole; and so on, from one pole to another, always taking forward sights or observations only. After these, the true height and the corrected heights together, and the sum will be the whole difference of level sought.

LEVELLING-STATES, instruments used in levelling, serving to carry the marks to be observed, and at the same time to measure the heights of these marks from the ground. They usually consist each of two long wooden rulers, made to slide over one another, and divide into feet, inches, &c.

LEVER. See MECHANICS.

LEVIGATION. See PHARMACY.

LEVISANUS, a genus of the class and order pentandria monogynia. The flowers are aggregate; corolla one-leaved, superior, five-cleft; elements inserted into the base of the perianth; styles two, conjoint; seeds five or six. There are five species, shrubs of the Cape.

LEYDEN PHIAL. See ELECTRICITY.

LEYSEKA, a genus of the polygonum superbus order, in the syngenesia class of plants, and in the natural method ranking under the 49th order, composite. The receptacle is naked; the pappus paleaceous;
that of the disc plummy; the calyx scarious. There are three species, shrubs of the Cape, Liatris, being of the class and order
Syngenesio-polygamae. The calyx is oblong, inimicate, awnless, coloured down, feathered coloured; receptacle naked, hollow, dotted. There are eight species, herbs of America.

Libel, injurious reproaches or accusations written and published against the memory of one who is dead, or the reputation of one who is alive, and thereby exposing him to public contempt, censure, and ridicule.

With regard to libels in general there are, as in many other cases, two remedies; one by indictment or information, and the other by action. The former for a public offense; for every libel has a tendency to the breach of the peace, by provoking the person libelled to break it; which offence is said to be the same in point of law, whether the matter contained is true or false; and therefore it is that the defendant on an indictment for publishing a libel, is not allowed to allege the truth of it by way of justification. But in the remedy by action on the case, which is to repair the party in damages for the injury done him, the defendant may, as in other cases, spoken, justify the truth of the facts, and show that the plaintiff has received no injury at all. The chief excellence therefore of a civil action for a libel consists in this, that it not only affords a reparations for the injury sustained, but it is a full vindication of the innocence of the person traduced. 3 Black. 125.

By a late statute, the jury are acknowledged to be judges both of the law and the fact.

Libel, in the ecclesiastical court, is the declaration or charge drawn up in writing, on the part of the plaintiff, to which the defendant is answerable to.

Lobel, in the law of Scotland, signifies an indictment.

Libelula, dragon-fly, a genus of insects of the order neuroptera. The generic character is: mouth furnished with several jaws, short; wings four, extended; tail (in the male) hook-furnished.

The libelula, or dragon-flies, sometimes called by the very improper title of horse-stingers, exhibit an instance scarcely less striking than the butterfly of that strange display, in point of form under which one and the same animal is destined to appear in the different periods of its existence. Perhaps few persons not particularly conversant in the history of insects, would imagine that these highly brilliant and lively animals, which may be seen flying with such strength and rapidity round the meadows, and pursuing the smaller insects with the velocity of a hawk, had once been inhabitants of the wa- ters in which they had resided for a very long space of time in that element before they assumed their flying form. Of the libelula there are many different species, both native and exotic. The most remarkable of these various species is the libelula varia, or great variegated libelula. This insect makes its appearance principally towards the decline of summer, and is an animal of singular beauty. Its general length is about three-quarters of an inch; and when expanded, measure near four inches from tip to tip; the head is very large, and affixed to the thorax by an extremely slender neck; the eyes occupy by far the greatest part of the head, and are of a purplish blue color. The face is furnished with a little stumpy hair; the thorax of the same colour, but marked by longitudinal black streaks; the body, which is very long, slender, and subcylindrical, is black, with rich variegations of bright blue, and deep grass green; the wings are perfectly transparent, strengthened by very numerous black reticulated fibres, and exhibit a strong iridescent appearance, according to the various reflections of light. The abdomen is marked this tip by a small oblong square black spot on the outer edge; the legs are black, and the tail is terminated by a pair of black fornicated processes, with an intermediate shorter one of similar colour. Sometimes this insect varies; the spots or marks on the abdomen and thorax being red or red-brown instead of green.

The female libelula deposits or drops her eggs into the water, which sticking to the bot- tom, are hatched, after a certain period, into hexapode flatfish larvae or caterpillars, of a very singular and disagreeable aspect. They cast their skins several times before they ar- rive at a certain size, and then assume a brown colour. The rudiments of the future wings appear on the back of such as are advanced to what may be called the pupa or chrysalis state, in the form of a pair of oblong scales or ocellae, and the head armed with a most singular organ for seizing prey, viz, a kind of proboscis, of a flattened form, and furnished with a joint in the middle, the end being much dilated, and armed with a pair of large hooks or spines. This proboscis, when the animal is at rest, is folded or turned up in such a manner as to lay over the face like a mask; but when the creature sees any insect which it means to attack, it springs suddenly forwards, and by stretching forth the jointed proboscis, readily obtains its prey. They continue in their larva and pupa state for two years, when, having attained their full size, they prepare for their flight, by steeping up the stem of some water-plant, and clasping it with their feet, they make an effort, by which the skin of the back and head is forced open, and the inclosed libelula gradually emerges. The wings, at first, are rather transparent; but, except, like those of butterflies, are very short, tender, and contracted, all the ramifications or fibres having been compressed within the small compass of the oblong scales on the back of the larva, or pupa; but in the space of about half an hour, they are fully expanded, and have acquired the solidity and strength necessary for flight. This curious process of the evolution or birth of the libelula generally takes place in the morning, and during a clear sunshine. The remaining part of the animal's life is but short in comparison with that which it passed in its aquatic state, the floss of the close of autumn destroying the whole race. They are also the prey of several sorts of birds.

The libelula depressa is a smaller or shorter species than the preceding, though with a considerably broader body in proportion. The head is bright sky-blue, with the sides of the body yellow, its under side, a fine brown or bay, with yellow sides also. The wings in both sexes are transparent, ex-

cept at the shoulders, where they are each marked by a broad red or patch of brown with a stripe of yellow; the tips of each wing have a small oblong square black spot on the outer margin. The larva of this species is of a shorter form than that of the preceding, and is of a greenish-brown colour.

The libelula virgo is one of the most ele- gant of the European insects. It is much smaller than the libelula varia, and is distinguis-
ished by its very slender, long, cylindrical body, which, as well as the head and thorax, is usually either of a bright but deep golden green, or else of a deep gilded blue. The wings are transparent at the base and tips, but are each marked in the middle by a very large oval patch or bed of deep blackish or violet blue, accompanied by iridescent lines according to the direction of the light; sometimes the wings are entirely violet-black, without the least appearance of transparency either at the base or tips; and sometimes they are altogether transparent, without any appearance of the violet-black patch which usually proves the deficiency; and lastly the insect sometimes appears with transparent wings, but shaded with a strong east of gilded greenish brown, each being marked by a small white speck at the extreme edge.

A much smaller species than the preceding, and equally common, is the libelula piella of Linnaeus. This varies much in colour, but is generally of a bright and beauti-
ful olive, sometimes tinted black with black bars on the joints, and with the thorax marked by black longitudinal stripes. The wings are transparent, and each marked near the tip with a small oblong-square black marginal spot.

The exotic libelulae are very numerous. Among the most remarkable may be num-
bered the L. lucicrida. It is a native of the type of Good Hope, and is distinguished by the excessive length of its slender body, which measure not less than five inches and a half in length, though scarcely exceeding the tenth of an inch in diameter. The wings are transparent, or of a slender or narrow shape, having the tints of this species usual in form, and measure five inches and a half in extent from tip to tip. The colour of the head and thorax is brown, with a yellowish stripe on each side, and the body is of a deep mazarine-blue. See Blackburn, Nat. Hlst. figs. 250, 251.

LIBERTUS, in Roman antiquity, a per-
son who from being a slave, had obtained his freedom. The difference between the li-
bertus and libertini was this: the liberti were such as had been actually made free them- selves, and the libertini were the children of such persons.

LIBRA, in astrology, one of the twelve signs of the zodiac, the sixth in order; so called because when the sun enters it, the days and nights are equal, as it weighed in a balance.

Authors enumerate from ten to forty-nine stars in this sign.

LIBRA, in Roman antiquity, a pound weight; also a coin, equal in value to twenty denarii.

LIBRATIONS, in astronomy, an apparent irregularity of the moon's motion, whereby it seems to librate about her axis, sometimes from the east to the west, and now and
then from the west to the east; so that the parts in the western limit or margin of the moon sometimes recede from the centre of the disk, and sometimes move towards it, by which means they become alternately visible and invisible to the naked or, if engaged, by the eye.

Libration of the earth, is sometimes used to denote the parallelism of the earth's axis, in every part of its orbit round the sun.

Licence, in law, an authority given to a person to do some lawful act.

A licence is a written power, and therefore cannot be transferred to another. If the person licensed abuse the power given him, in that case he becomes a trespasser.

Licentiate, one who has obtained the degree of a licentiate. The greatest number of the officers in justice in Spain are distinguished by no other title but that of licentiate. In order to pass licentiate in common law, civil law, and physic, they must have studied seven years; and in divinity, ten. Among us, a licentiate usually means a physician who has a licence to practise, granted by the college of physicians, or the bishop of the diocese.

Lichen, freecor, a genus of the natural order of Algae, in the Cryptogama class of plants. The male receptacle is roundish, somewhat plain and shining. In the female the leaves have a farinaceous or merely substance scattered over them. There are about 216 species, all found in Britain. Among the most remarkable are the following:

1. The geographicus; it is frequent in rocks, and may be readily distinguished at a distance. The crust and ground is of a bright greenish-yellow colour, sprinkled over with numerous plain black tubercles, which frequently run into another, and form lines resembling the rivers in a map, from which last circumstance it takes its name.

2. The calcareous, or black-polished dyer's lichen, is frequent on calcareous rocks; and has a hard, smooth, white, stony, or tarsaceous crust, cracked or tesselated on the surface, with black tubercles. Dillenius relates, that this species is used in dyeing, in the same manner as the tarsaceous after-menioned.

3. The venous, or red spangled tarsaceous lichen, has a hard tarsaceous crust, cracked and tesselated on the surface, of a pale yellow colour, which is frequently seen when dry. The tubercles are of a blood-red colour at top, their margin and base of the same colour as the crust. The texture and appearance of this (according to Mr. Lightfoot) indicate that it would answer the purposes of dyeing as well as some others of this tribe, if proper experiments were made.

4. The candelarius, or yellow farinaceous lichen, is common upon walls, rocks, boards, and old pales. There are two varieties. The first has a farinaceous round orange figure, covered with numerous small greenish-yellow or olive shields, and grows commonly upon old boards. The other has a smooth, hard, circular crust, wrinkled and tuberculated at the circumference, which adheres closely to rocks and stones. In the centre are numerous shields of a deeper yellow or orange colour, which, as they grow old, swell in the middle, and assume the figure of tubercules. The inhabitants of Smaland in Sweden scrape this lichen from the rocks, and mix it with their tallow, to make golden candles to burn on festival days.

5. The tarenten, or large yellow-saucered dyer's lichen, is frequent on rocks, both in the Highlands and Lowlands of Scotland. Its crust is white or greenish white, and has a rough warted surface. The shields are yellow or buff-coloured, of various sizes, from that of a pin's head to the diameter of a silver penny. Their margin is often of the same colour with the crust. This lichen is much used by the Highlanders for dyeing a fine claret or pantaloour colour. For this purpose, after scraping it from the rocks, and cleaning it, they steep it in urine for a quarter of an year. Then taking it out, they make it into cakes, and hang them up in bags to dry. These cakes are afterwards pulverized, and the powder is used to impart the colour with an addition of alum.

6. The parcellus, or crawfish-eye lichen, grows upon walls and rocks, but is not very common. The crust spread closely upon the place where they grow, and cover them to a considerable extent. They are rough, tarsaceous, and ash-coloured, of a tough corneous substance, with numerous white or grayish, or cracked, having white or ash-coloured, shallow, plain discs, with obtuse margins. This is used by the French for dyeing a red colour.

7. The saxatilis, or grey-blue pitted lichen, is very common upon trunks of trees, rocks, tiles, and old wood. It forms a circle two or three inches diameter. The upper surface is of a blue grey, and sometimes of a whitish ash-coloured, uneven, and full of numerous small pits or cavities; the under sides is black, and covered all over, even to the edges, with short simple hairs or radicles. A variety sometimes occurs with leaves tinged of a red or purple colour. This is used by fishermen and other small birds in constructing the outside of their curiously formed nests.

8. The omphalodes, or dark-coloured dyer's lichen, is frequent upon rocks. It forms a thick, widely expanded crust of no regular figure, composed of numerous irregular leaves of a fuscous or purple-coloured, divided into small segments. The margins of the shields are a little crivelled and turned inwards, and their outside ash-coloured. This lichen is much used by the Highlanders for dyeing a dark purple colour. They steep it in urine for a considerable time, till it becomes soft and like a paste; then, forming the paste into cakes, they dry them in the sun, and preserve them for use in the manner already related of the tarenten.

9. The parietinus, or common yellow wall-lichen, is very common upon walls, rocks, tiles of houses, and trunks of trees. It generally spreads itself in circles of two or three inches diameter, and is said to dye a good yellow or orange-colour with alum.

10. The Islandicus, or eated alcedin lichen, grows on many mountains both of the Highlands and Lowlands of Scotland. It consists of nearly erect leaves about two inches long, when dry, and smooth, but soft and plant when moist, variously divided without order into broad distant segments, bifid or trifid at the extremities. The upper or interior surface of the leaves is crimson, or purple shining, but red at the base; the under or exterior surface is smooth and whitish, a little pitted, and sprinkled with very minute black warts. The margins of the leaves and all the segments from bottom to top, are ciliated with small, short, stiff, hair-like spines, of a dark chestnut-colour, turning towards the upper side. The shields are very rarely produced. Made into broth or gruel, it is said to be very serviceable in coughs and consumptions; and, according to Haller and Scopoli, is much used in these complaints in Vienna.

11. The pulmonarius, or lung-wort lichen, grows in shady woods upon the trunks of old trees. The leaves are as broad as a man's hand, of a kind of leather-like substance, hanging loose from the trunk on which it grows, and laciniated into wide angular segments. Their natural colour, when fresh, is green; but in drying, they turn first to a glaucous and afterwards to a fuscous colour. It has an astringent, bitter taste; and, according to Gmelin, is boiled in ale in Siberia, instead of hops. The antients used it in coughs and asthma, &c. but it is not used in modern practice.

12. The cactarius, or heaked lichen, grows sometimes upon trees, but more frequently upon rocks, especially on the sea-coasts, but is not very common. It is smooth, glozy, and whitish, producing a variety of the same colour as the leaves, very near the summits of the segments, which are acute and rigid, and, being often reflected from the perpendicular by the growth of the shields, appear from under the leaves to be broken back. This will dye a red colour; and promises, in that intention, to rival the famous lichen roccola or argol, which is brought from the Canary Islands, and sometimes sold at the price of 80l. per ton. It was formerly used instead of starch to make hair-power.

13. The prunastri, or common ragged hoary lichen, grows upon all sorts of trees; but it is generally most white and hoary on the sloe and old palm trees, or upon old pales. This is the most variable of the whole tribe of lichens, appearing different in figure, magnitude, and colour, according to its age, place of growth, and sex.

14. The juniperinus, or common yellow tree-lichen, is common upon trunks and branches of trees, and also upon the house walls and in the stables. Linnaeus says it is very common upon the juniper. The Gothland Sweeds dye their yarn of a yellow colour with it, and give it as a specific in the jaundice.

15. The saccaria, or ash-coloured ground liverwort, grows upon the ground among stones.
mass, at the roots of trees in shady woods, and is frequent also in heaths and stony places. The leaves are large, gradually divided towards the extremities, and divided into roundish, elevated lobes. Their upper side, in dry weather, is ash-coloured; in rainy weather, of a dull fuscous-green colour; their under-side white and hoary, having many thick downy nerves, from which descend numerous long, white, pencil-like radicles. The petiole, or shi-lis, grow at the extremities of the elevated lobes, shaped like the human nail; of a roundish oval form, convex above, and concave beneath; of a chocolate colour on the upper side, and the same colour with the leaves on the under. There are two varieties, the one called redlisch, and the other many-fingered, ground-liverwort. The former is more common than the other. This species has been rendered famous by the celebrated Dr. Mead, who asserted that it was an infallible preventative of the dreadful consequence attending the bite of a mad dog.

16. The aphthous, or green ground lvi-erwort with black warts, grows upon the ground at the roots of trees in woods, and of such places in garden cunt places. It differs very little from the foregoing, and according to some is only a variety of it. Linnaeus informs us, that the country-people of Upland in Sweden give an infusion of this lichen in milk to children that are troubled with the disorder called the thush or aphthous, which induced that ingenious naturalist to be-tow upon it the trivial name of aphthous. The same writer also tells us, that a decoction of it is used for purges upwards and downwards, and will destroy worms.

17. The coccurus, or scarlet-tipped cuplichen, is frequent in moors and heaths. It has in the first state a granulated crust for its ground, which is afterwards turned into small facinated leaves, green above, and hoary underneath. The plant assumes a very different aspect, according to the age, situation, and other accidents of its growth, but may be in general distinguished by those tubercles, which are fungous tubercles of a fine scarlet colour, placed on the rim of the cup, or on the top of the stalk. These tubercles, steeped in an alkaline liquor, are said to dye leather and yarn of a yellow.

18. The rangierius, or rein-deer lichen, is frequent in woods, heaths, and mountainous places. Its general height, when full-grown, is about two inches. The stalk is hollow, and very much branched from bottom to top: the branches are divided and subdivided, and at last terminated by two, three, four, or five very fine, short, nobby horns. The axile of the branches are often perforated. The whole plant is of a hoary white or grey colour, covered with white farinaeous particles, light and brittle when dry, soft and elastic when moist. The fructifications are very minute, round, fuscous, or red-flushed brown tubercles, which grow on the very extremities of the finest branches; but these tubercles are very seldom found. The plant seems to have no folaceous ground for the base, nor scarcely any visible roots. It is equally common and no less luxuriant, wherever it grows so luxuriant that it is sometimes found a foot high. There are many varieties of this species, of which the principal is the syriaticus, or brown-tint rein-deer lichen. The most remarkable difference between them is, that the syriaticus turns fuscous by age, while the other always continues white.

19. The pulicat, or officinal lichen lichen, grows upon the branches of old trees, but is not very common. The stalks are a foot or more in length, rigid, and string-shaped, very irregularly branched, the branches entangled together, of a cinereous or ash-coloured, brittle and stringy if doubled short, otherwise tough and pliant, and hang pendent from the trees on which they grow. The shields grow generally at the extremities of the branches, are nearly flat, or slightly concave, thin, ash-coloured above, pale-brown underneath, and radiated with fine rigid fibres. As the plant grows old, the branches become covered with a white, rough, warty crust; but the young ones are destitute of it. It was formerly used in the shops as an antiprotogot against haemorrhages, and to cure rup-atures; but is out of the modern practice. Linnaeus informs us, that the Laplanders apply it to their feet to relieve the excoriations occasioned by much walking.

20. The barbus, or beard lichen, grows upon the branches of old trees in thick woods and pine-forests. The stalks or strings are slightly branched and pendent, from half a foot to two feet in length, little bigger than a tailor's button, roundish, cylindrically jointed towards the base; but surrounded everywhere else with numerous horizontal capillary fibres, either simple or slightly branched. Their colour is a white, greyish, or brown, which has an astrignent quality. When steeped in water, it acquires an orange colour; and, according to Dillenius, is used in Pennsylvania for dyeing that colour.

21. The vulpanicus or gold wry lichen, grows upon the trunks of old trees, but is not very common. It is produced in erect tufts, from half an inch to two inches in height, of a fine yellow or lemon-coloured, which readily discovers it. The filaments which compose it are so numerous as to make the whole cly-ndrically jointed towards the base; but surrounded everywhere else with numerous horizontal capillary fibres, either simple or slightly branched. Their colour is a white, greyish, or brown, which has an astrignent quality. When steeped in water, it acquires an orange colour; and, according to Dillenius, is used in Pennsylvania for dyeing that colour.

LICONIA, in botany; a genus of the di-尼亚 order, belonging to the pentandra class of plants. There are five petals inlaid in the pit of the nectararium at its base; the capelline is bilocular and sepal-bearing.

JUCULA, a genus of the nat. order of palm. The flowers are all hermaphroditic, cal. and cor. three-parted; nect. siphonid. There is one species.

LIEUTENANTS, Lords, of counties, are officers who, upon any invasion or rebellion, have power to raise the men in 11, to give commissions to colonels and other officers, to arm and form them into regiments, troops, and companies. Under the lords-lieutenants, are deputy-lieutenants, who have the same power; these are chosen by the lords-lieutenants, out of the principal gentlemen of each county, and presented to the king for his approbation. LIEUTENANTS, Officers of the army, who are attached to the expectation of the life. Life Annuit, annually payments, to continue during any given life or lives; the value of an annuity is the sum which would be sufficient (allowing for the chance of the life failing) to pay the annuity without loss; and supposing money to bear no interest, the value of an annuity of 11. is said to be equal to the expectation of the life. Thus it will be found by the table given under the article Expectation of Life, that the expectation of a life aged 20 years, is twenty years; or, in other words, that a set of lives at this age, will, one with another, enjoy twenty-three years each of existence, some of them enjoying a duration as much longer as others fall short of. Therefore, supposing money to bear no interest, 231. in hand for each life would be sufficient to pay to any number of such lives 11. per annum, for their whole duration; or, in other words, 231. is, on this supposition, the value of a life aged forty. But if any improvement is made whereby putting interest, the sum just mentioned will be more than the value, because it will be more than sufficient to pay the annuity; and it will be as much more than sufficient as the improvement or interest made. If it is greater than twenty-three years, the man himself in possession of 231., 10s. 6d. or of 311., 2d. more than is sufficient to pay the remainder of the annuities, though he should make no further improvement of the purchase money. At whatever rate of interest the money is improved, there must be a surplus; and if it is fully improved at 6%. per cent., it will be found that 111. 16s. 8d. for each annuity, will be sufficient (instead of 231.) to make all the annual payments; or, if it may be improved at 6%. per cent., 10s. 1d. will be sufficient.

Many persons have fallen into an error with respect to the value of life-annuities, by considering the same as the same as the value of an annuity certain for a number of years equal to the life of the life. The inaccuracy of this mode of computation arises from the difference between the value of a certain number of payments to be made every year regularly till the term is completed, and the value of the same number of payments to be made at greater distances of time from one another, and not to be made till many years after the expiration of the term equal to the expectation of the life.

The true method of computing the values of life-annuities cannot be more clearly expressed than as it is given in "The Doctrine of Annuities and Assurance Rates and Survivalship, by William Morgan."—Was it certainly that a person of a given age would live to the end of a year, the value of an annuity of 11. on such a person that would increase in a year to the value of a life one year older, together with the value of the single payment of 11. to be made at the beginning of a year; and if this increased together with the value of a life aged one year older than the given life, multiplied by the value of 11. payable at the end of a year. The value of a life one year older than the given life N, and the value of 11. 20

5
It is unnecessary to insert a Table of the values of the longest of two lives, as it may be easily found from the values given in the above tables by the following general rules:

"From the sum of the values of the single lives subtract the value of an annuity on the joint lives, and the remainder will give the value of an annuity of any desired continuance of the longest of two such lives."

Example. What is the value of an annuity on the longest of two lives whose ages are thirty and forty?

By Table I. the value of a single life of 30 is 13.672, and by the same Table the value of a single life of 40 is 11.837. Their sum therefore is 25.509, from which 5.576 (the value of the joint lives of 30 and 40 by Table I.) being subtracted, leaves 19.933 for the number of years purchased.

The value of an annuity on three joint lives may be found from the preceding tables, by the following rule:

"Let A be the youngest, and C the oldest of the three proposed lives. Take the value of the two joint lives B and C, and find the age of a single life of the same value. Then find the value of the joint lives A and D, which will be the value of the annuity in question, multiplying the table which come nearest to them, gives 8.216 for the value sought.

The value of three joint lives being known, the value of the longest of any three lives may be computed by the following rule:

"From the sum of the values of all the single lives, subtract the values of all the joint lives combined two and two. The difference will give the value of the three joint lives; and this last sum will be the value of the longest of the three lives."

Example. The sum of the values of three single lives whose ages are 20, 30, and 40, is 10.363 (by Table III). 38.916. The value of two joint lives, whose ages are 30 and 40, is 9.576, and that of one joint life whose ages are 20 and 30, is 11.021. The sum of these three values is 30.920. This sum subtracted from 38.916, leaves 8.063, which remainder added to 8.216, (the value of the three joint lives in the last example), gives 16.885, the value of the longest of the three lives."

The solutions of the following Problems, in addition to the rules already given, will comprehend all the cases which most commonly occur relating to the values of annuities on lives or survivals.

PROB. I. To determine the value of an annuity on a given life for any number of years.

Solution. Find the value of a life as many years older than the given life as are equal to the term for which the annuity is proposed. Multiply this value by 11, payable at the end of this term, and also by the probability that the life will continue so long. Subtract the product from the present value of the given life, and the remainder multiplied by the annuity will be the answer.

Example. Let the annuity be 20l. the age of the given life 33 years, and the term proposed 14 years. The value of a life aged 40 years (or 14 years older than the given
*life*, appears by Table I, to be 10.443. The value of 17, payable at the end of 14 years (see Table III. of *Annuity*), is 50,006, and the probability that the life will exist so long, (See *Expectation of Life*) is 2214.

These three values multiplied together each other, produce 12.502 (the present value of the given life by Table I), we have 8.641, and this remainder multiplied by 20, gives 1627.16d. 4d. for the value required.

In a similar manner the value of an annuity for any given term, upon two joint lives, may be determined.

**Phon. II.** To find the value of an annuity certain for a given term after the extinction of any given life or lives.

**Solution.** Subtract the value of the life or lives from the perpetuity, and reserve the remainder. Then say, as the perpetuity, is to the present value of the annuity certain, so is the said reserved remainder, to a fourth proportional, which will be the number of years purchase required.

**Example.** A and his heirs are entitled to an annuity certain for 14 years, to commence at the death of B, aged 35. What is the present value of this annuity at interest? By Table I. the value of the life of B is 12.502, which subtracted from 20, the perpetuity, leaves 7.498 for the remainder to be reserved. Then, as 20, is to 9.898 (the value of an annuity certain for 14 years), so is 7.498 (the reserved remainder), to 5.7107, the number of years purchase required.

**Phon. III.** To find the value of an annuity for a term certain, and also for what may happen to remain of a given life or lives after the expiration of the term.

**Solution.** Find the value of a life or lives as many years older than the given life or lives as are equal to the term for which the annuity certain is proposed. Multiply this value by 17, payable at the end of the given term, and also by the probability that the given life or lives will continue so long. Add the product to the value of the annuity certain for the given term, and the sum will be the answer.

**Example.** Let the value be required of an annuity certain for 14 years, and also for the remainder of a life now aged 35 after the expiration of this term. By Table I. the value of A's life at 39 (or 14 years older than the given life) is 10.443. The value of 17, payable at the end of 14 years, is 30,008, and the probability that the life will exist so long is 4.918. These three numbers multiplied together produce 3,861, which being added to 9.898, the value of an annuity certain for 14 years (see *Annuities*), becomes equal to 13,759, the number of years purchase required.

**Phon. IV.** To determine what annuity any given sum will purchase during the joint lives of two persons of given ages, and also during the life of the survivor, on condition that the annuity shall be reduced one-half at the extinction of the joint lives.

**Solution.** Let twice the given sum be divided by the sum of the two single lives, and the quotient will give the annuity to be paid during the joint lives; one-half of which is therefore the annuity to be paid during the remaining of the surviving life.

**Example.** A aged 27, and B aged 33, are desirous of sinking 1000l. in order to receive an annuity during their joint lives, and also another annuity of half the value during the remaining of the surviving life. It is required to determine what annuities should be granted them under those circumstances. By Table I. the value of a life of 27 is 13.977, and the value of a life of 35 is 12.502. The present value of this sum, divided by 20, gives 25.870 (the sum of the values of the two lives), gives 77.282/ for the annuity to be granted during the joint continuance of the lives; and its half, or 38.41/1, is the annuity to be paid the survivor.

**Phon. V.** If is of a given age, will, if he lives till the decease of A, whose age is also given, become possessed of a perpetual annuity, or of an estate of a given yearly value; to find the worth of his expectation in present money.

**Solution.** Find the value of an annuity on two equal joint lives whose common age is equal to the age of the oldest of the two proposed lives, which value subtract from the perpetuity, and divide the remainder by 20, or the expectation of the younger of the two lives, is to that of the older, so is the said half remainder, to a fourth proportional; which will be the number of years purchase required.

**Example.** If is 50, and B 20, the difference will be 30, the half of which is 15. Therefore as 15 is to the expectation of A is 28.27, the expectation of B, so is 15, to 4.119, which being multiplied by 50, the given annuity, we have 205.60l. for the required value of B's expectation.

If the age of B had been 20, and that of A 30 years, then to 4.119, the value just found, add the value of the joint lives, which, by Table I, is 10.707, and the sum is 14.826. Which subtracted from the perpetuity, and the remainder multiplied by 20, gives 226.7l. for the required value in this case.

**Life Estates** are of two kinds, such as are created by the act of the parties, or such as are created by the operation of the law, as estates by curtesy or dower. 2 Black. 190.

Estates for life, created by deed or grant, are, where a lease is made of lands or tenements to a man, to hold for the term of his own life, or for that of another person, or for more lives than one; in any of which cases, he is called tenant for life: only when he holds the estate by the life of another, he is usually termed tenant pur autre vie, for another's life.

Estates for life may be created not only by the express terms before-mentioned, but also by a general grant, without defining or limiting any specific estate. 2 Black. 121.

If such persons, for whose life any estate shall be purchased, shall survive themselves five years, and no proof made of the lives of such persons, in any action commenced for the recovery of such tenements by the lessees or reversioners, the persons upon whose lives such estate depended, shall be accounted as dead; and the judges shall direct the estate to pass to the surviving consequent heirs. 19 Car. II. c. 6.

**Liggament.** See Anatomy.

**Ligature.** See Surgery.

**Light.** See Optics.

**Lightfootia.** a genus of the class and order polignydia oboe. The cal, is four-leafed; cor. none; lem., and stigma sessile; berry umbilicated. There are three species, shrubs of the E. Indies.

**Lightning.** See Electricity.

**Ligusticum*, lovage; a genus of the dianyca, in the pentandria class of plants; and in the natural method ranking under the 45th order, umbellate. The fruit is obovate, and quinquedactyl on each side; the florets are equal; the petals involuted or rolled inwards, and entire. There are eight of the fruits remarkable are the lovage, the levisticum, or common, and the Scoti- cum, or Scots, lovage. The first is a native of the Appenine mountains in Italy. The second is a native of Scotland, and grows near the sea in various parts of the country.

The root of the first species agrees nearly in quality with that of angelica: the principal difference is, that the lovage-root has a stronger smell, and a somewhat less pungent taste, accompanied with a more durable sweetness, the seeds being rather warmer than the root; but although certainly capable of being applied to useful purposes, this root is not regarded in the present practice. The leaves of the second are sometimes eaten raw, as a salad, or boiled as greens, by the inhabitants of the Hebrides. They give an infusion of the leaves in whey to calves, to purge them.

**Ligustrum. gregis.** a genus of the natural order, in the umbellaria class of plants; and in the natural method ranking under the 44th order, sesquiped. The corolla is quadrifid; the berry tetraspernum. There are three species; of the common there are two varieties, the deciduous and the evergreen. They are hardy plants, rising from ten to fifteen feet high. They are easily propagated by seed, layers, suckers, or cuttings. They are used for making hedges. The purple colour upon cards is prepared from the berries. With the addition of alum, these berries are said to dye wool and silk of a good and durable green; for which purpose they must be gathered as soon as they are ripe, and are then a bitter and slightly astrigent. Oxen, goats, and sheep, eat the plant; horses refuse it.

**Light.** in geometry, &c. denotes the same with similar. See Similar.

**Lilac.** in botany, a genus of trees, otherwise called Syringa. See Syringa.

**Lilabyte.** This stone appears to have been first observed by the abbe Foda, and to have been then described by De Bom. Lithio it has only been found in Moravia
in Germany, and Sudermannia in Sweden. There it is mixed with granite in large amorphous masses. It is composed of thin plates, easily separated, and not unlike those of mica. Not easily pulverised. Specific gravity 2.8-3.0. Colour ochreous, to yellow, purple, blue; of the thin plates, silvery white. Powder white, with a tint of red. Before the blowpipe, it frosts, and melts easily into a white semi-translucent enamel, full of bubbles. Dissolves in borax with effervescence, and communicates no colour to it. Effervescences slightly with soda, and melts into a mass spotted with red. With microcosmic salts it gives a pearl-coloured globule.

This stone was first called lillite from its colour, that of the lily. Klaproth, who discovered its component parts, gave it the name of leptolite.

It is composed of 63 silica
28 aluminium
10 potass
3 fluors of lime
3 oxides of manganese
1 oxide of iron

100.

LILLIUM, the lily; a genus of the monogynia order, in the hexantheria class of plants; and in the natural method ranking under the 10th order, corona. The corolla is hexa- petalous, andringed with a longitudinal nectariferous line or furrow; the capsules connected by small cancelled hairs. There are eleven species; all of them bulbous-rooted, herbaceous, flower perennial, ri- sing with erect stalks, 5-7 feet high, garnished with long narrow leaves, and terminated by fine clusters of large bell-shaped, hexa-petalous flowers of great beauty, of white, red, scarlet, orange, purple, and yellow colours.

All the species are propagated by sowing the seeds; and if care is taken to preserve these seeds from good flowers, very beautiful varieties are often produced.

The roots of the white lily are emollient, maturating, and suppulsive, and are used externally in catarrhal cases for these purposes with success. The common form of applying them is, boiled and bruised. Gerard recommends them internally against dropsies.

The Kambischaten, or Kambischata lily, called there sarame, makes a principal part of the food of Kambischats. Its roots are gathered by the women in August, dried in the sun, and laid up for use: they are the best bread of the country; and after being baked are reduced to powder, and serve instead of flour in soups and several dishes. They are sometimes washed, and eaten as potatoes; are extremely nourishing, and have a pleasant bitter taste. Our navigators boiled and ate them with their meat. The natives often parch it, and heat it up with several sorts of berries, so as to form of it a very agreeable confection. Providentially it is an universal plant there, and all the grounds bloom with its flower during the season. Another happiness resultant with this, while it is scarce, the sarame is plentiful; and when there is a dearth of this, the rivers pour in their provisions with redoubled pro- fusion. It is not to the labours of the females alone that the Kambischats are indebted for these roots. A species of mouse saves them a great deal of trouble. The sarame forms part of the water provisions of this little animal: they not only gather them in the proper season, and lay them up in their magazines, but those who possess the requisites of bringing them out in sunny weather to dry them, lest they should decay. The natives search for their hoards; but with prudent tendencies leave part for the owners, being unwilling to suffer such useful caterers to perish.

LIMAX, the slug, or naked snail; a ge- nus of insects belonging to the order of vernes mollusca. The body is oblong, fitted for crawling, with a kind of muscular coat on the upper part, and the body is plain. They have four tentacula, or horns, situated above the mouth, which they extend or retract at pleasure. This reptile is always destitute of shell; but besides that its skin is more clammy, and of a greater consistency, than that of the snail, the black naked slug is a furrowed cloak, almost as thick and as hard as leather, under which it withdraws its head as within a shell. The head is distinguished from the body by a black line, when the head and two thirds of the stone are found; which is a small pearedl and sand stone, of the nature of limestones: according to a popular opinion, it cures the tertian ague, if fastened to the patient's arm, and carried above on every where chimmy and shining marks of their passage. They de- posit their eggs in the earth. There are eight species, distinguished entirely by their colour: as the black slug, the white slug, the red slug, the ash-coloured slug, &c. The black slug is hermaphroditic. A black slug, powdered over with snuff, salt, or sugar, falls into convulsions, casts forth all its foam, and dies.

LIME, one of those earthy substances, which exist in every part of the known world. It is found pure in limestone, marble, and chalk. None of these substances are lime, but are capable of becoming so by burning in a white heat.

Lime may be so obtained perfectly pure by burning, than a crystalized limestone called calcareous spars, which are perfectly white and transparent, and also by burning some pure white marbles. It may be procured also in a state of pure white, by dissolving in a strong acid, filtrating the solution, mixing it with ammonia as long as a white powder continues to fall, and fil- trating again. The liquid is now to be mixed with a solution of carbon of soda: the powder which falls being washed and dried, and heated violently in a platinum crucible, is pure lime.

Pure lime is of a white colour, moderately hard, but easily reduced to a powder. It has a hot burning taste, and in some measure corrodes and destroys the texture of those animal bodies to which it is applied. Its specific gravity is 2.3. It tingles vegetable blue, and at last converts them to yellow.

If water be poured on newly burnt lime, it swells and falls to pieces, and is soon re- duced to a very fine powder. In the mean- time so much heat is produced, that part of the water lies off in vapour. If the quantity of lime shaded (as this process is termed) be great, the heat produced is sufficient to set fire to combustibles. In this manner, vessels loaded with lime have sometimes been burnt. When great quantities of lime are placed in a dark place, and set fire to a light, Mr. Pelletier has observed. When shaded lime is weighed, it is found to be heavier than it was before. This additional weight is owing to the combina- tion of part of the water with the lime; which water may be recovered by the application of a red heat; and by this pro- cess the lime becomes just what it was before being shaded. Hence the reason of the heat evolved during the shading of lime. Part of the water contents with the lime, and thus becomes solid; of course it parts with its caloric of fluidity, and probably also with a considerable quantity of caloric, which exists in water even when in the state of ice; for when two parts of lime and one part of ice (each at 32°) are mixed, they combine rapidly, and their temperature is elevated to 212°. The elevation of temperature during the shading of barytes and strontian is owing to the same cause.

The smell perceived during the shading of lime is owing to a part of that earth being elevated along with the vapour of the water; as evidently appears from this circumstance, that vegetable spices exposed to this vapour are converted to green.

Limestone and chalk, though they are capable of being converted into lime by burning, possess hardly any of the properties of that active substance. They are tasteless, scarcely soluble in water, and do not perceptibly act on animal bodies. Now, what are the new properties of lime obtained by what alteration does it undergo in the fire?

It had been long known, that limestone loses a good deal of weight by being burned or calcined. It was natural to suppose, therefore, that something is separated from it during calcination. Dr. Black, of Edin- burgh, published in 1756, those celebrated experiments on this subject, which form so brilliant an era in the history of chemistry. He first ascertained, that the quantity of air in lime, evolved from its calcination is not nearly equal to the weight which it lost. He concluded in consequence, that it must have lost something else than mere water. What this could be, he was at first a loss to conceive; but recollecting that Dr. Hales had proved, that limestone, during its solution in acids, emits a great quantity of air, he conjectured that this might probably be what it lost during calcination. He calcined it accordingly, and applied a pneumatic apparatus to receive the product. He found his conjecture verified; and that the air and water which separated from the lime were together precisely equal to the loss of weight which it had sustained. Lime, therefore, owes its new properties to the loss of air; and limestone differs from lime merely in being combined with a certain quantity of air: for he found that, by restoring again the same quantity of air to lime, it was converted into limestone. This air, because it existed in lime in a fixed state, he called fixed air. It was afterwards examined by Dr. Priestley and other philosophers, who found it possessed of peculiar properties, and to be that species of gas now known by the name of carbonic acid gas. Lime
then is a simple substance, and limestone is composed of carbonic acid and lime. It heat separates the carbonic acid, and leaves the lime in a state of purity. See Aq.

When lime is exposed to the open air, it gradually absorbs moisture, and falls to powder; after which it soon becomes saturated with carbonic acid, and is again converted into carbonat of lime or unburnt limestone.

Water, at the common temperature of the atmosphere, dissolves about 0.002 parts of its weight. This solution is called lime-water. It is limpid, has an acrid taste, and changes vegetable blue colours to green. One ounce troy of lime-water contains about one gram of lime. It is usually formed by throwing a quantity of lime in powder into pure water, allowing it to remain for some time in a close vessel, and then decanting the transparent solution from the undissolved lime. When lime-water is exposed to the air, a stony crust soon forms on its surface, composed of carbonat of lime; when this crust is broken it falls to the bottom and another succeeds it; and in this manner the whole of the lime is soon precipitated, by absorbing carbonic acid from the air.

Lime is acted on by light, neither does it combine with oxygen. Sulphur and phosphorus are the only simple combustibles with which it unites.

Sulphuret of lime may be formed by mixing its two component parts, reduced to a powder, and heating them in a crucible. They undergo a commencement of fusion, and form an acid taste. When it is exposed to the air, or moistened with water, its colour becoming greenish-yellow, sulphureted hydrogen is formed, and the sulphuret is converted into a hydrogenated sulphuret, which exhales a very fetid colour of sulphureted hydrogen gas. This hydrogenated sulphuret may be formed also by boiling a mixture of lime and sulphur in about ten times its weight of water, or by sprinkling quicklime with sulphur and then moistening it; the heat occasioned by the evaporation of the liquid is sufficient to form the compound. When this hydrogenated sulphuret is exposed to the air, it solubilizes oxygen; which combines at first with the hydrogen, and afterwards with the sulphur, and converts the compound into sulphate of lime.

Phosphuret of lime may be formed by the following process: put into the bottom of a glass tube, close at one end, one part of phosphorus; and, holding the tube horizontally, introduce five parts of lime in small lumps, so that they shall be about two inches above the phosphorus. Then place the tube horizontally among burning coal, so that the part of it which contains the lime may be made red hot, while the bottom of the tube containing the phosphorus remains cold.

When the lime becomes red-hot, raise the tube, and draw it along the coal till that part of it which contains the phosphorus is exposed to a red heat. The phosphorus is immediately volatilized, and passing through the hot lime combines with it. During the combustion a little becomes a glowing red heat, and a quantity of phosphureted hydrogen gas is emitted, which takes fire when it comes into the air. Lime does not combine with azote; but when combined with water, it unites readily with muriatic acid, and forms muriat of lime. It facilitates the oxidization of several of the metals, and it combines with several of the metallic oxides, and forms salts which have not hitherto been examined, if we except the compounds which it forms with the oxides of mercury and lead, which have been described by Berthollet.

The red oxide of mercury, boiled with lime-water, is partly dissolved, and the solution yields by evaporation on small transparent yellow crystals. This crimson has been called by some mercuriat of lime.

Lime-water also dissolves the red oxide of lead, and (still better) litharge. This solution, evaporated in a retort, gives very small transparent crystals, forming prismatic colours, and not more soluble in water than lime is. It is decomposed by all the alkaline sulphates, and by sulphureted hydrogen gas. The sulphure and muriatic acids precipitate the lead. This compound blackens wool, the nails, the white of eggs; but it does not affect the colour of silk; and, in the yeek of egg, nor animal oil. It is the lead which is precipitated upon these coloured substances in the state of oxide; for all acids can dissolve the mixture of lime and oxide of lead blackens these substances; a proof that the salt is easily formed.

Lime does not combine with alkalies. The affinities of lime are arranged by Bergman in the following order:

| Oxalic acid | Arsenic | Lactic | Citric |
| Phosphoric | Sulphurous | Acetic |
| Succinic | Sulphuric | Bitartric |
| Phosphorous | Sulphuric | Tartric |
| Tartaric | Succinic | Oxalic |
| Sulfurous | Nitric | Tartric |
| Chloric | Sulphuric | Tartric |
| Hydrochloric | Sulphuric | Tartric |

One of the most important uses of lime is in the formation of mortar as a cementing building. Mortar is composed of quicklime and sand reduced to a paste with water. When dry it becomes as hard as stone, and as durable; and adhering very strongly to the surfaces of the stones which it is employed to cement, the whole wall becomes in fact nothing else than one single stone. But this effect is produced very imperfectly unless the mortar is very well prepared.

The lime ought to be pure, completely free from carbonic acid, and in the state of a very fine powder: the sand should be free from clay, and partly in the state of fine sand, partly in that of gravel: the water should be pure; and if previously saturated with lime, so much the better. The best proportions, according to the experiments of Dr. Higgins, are three parts of fine sand, four parts of coarse sand, one part of quicklime recently slackened, and as little water as possible.

The stone consistence in which mortar acquires, is owing partly to the absorption of carbonic acid, but principally to the combination of part of the water with the lime. This last circumstance is the reason that if to common mortar one-fourth part of lime, reduced to powder without being slackened, is added, the mortar, when dry, acquires much greater solidity than if otherwise would do. This was first proposed by Lo.-riot; and a number of experiments were afterwards made by Morvean. The proportion by which this last advantage is to be obtained is left to answer best the following:

| Fine sand | .0 .3 |
| Cement of well-baked bricks | .6 |
| Slacked lime | .2 |
| Unslacked lime | .2 |

The same advantages may be attained by using as little water as possible in slackening the lime.

Higgins found that the addition of burnt bones improved mortar by giving it tenacity, and rendering it less apt to crack in drying; but they ought never to exceed one-thousandth of the lime employed.

When a little manganese is added to mortar, it acquires the important property of preventing under water, so much may be employed in constructing those edifices which are constantly exposed to the action of water. Lime-stone is often combined with manganese; in that case it becomes brown, a colour called manganese-stone.

**LIMESTONE.** See Salts, cements, limestone, primitive and secondary. See Rocks.

**LIMEUM, a genus of the class and order prostrate, including the asty rents.** The cat is five, long, equal, caps. globular, two-celled. There are three species, herbaceous plants of the Cape.

**LIMET, in a restricted sense, is used by mathematicians for a determinate quantity to which a variable one continually approaches; in which sense the circle may be said to be the limit of its circumscribed and inscribed polygons. In algebra, the term limit is applied to two quantities, one of which is greater, and the other less, than another quantity; and in this sense it is used in speaking of the limits of equations, whereby their solution is much facilitated.

The equation, $a + bx + cy + dz = 0$ is proposed; and transform it into the following equation:

$$y + 2ax + 3ay + 4z = 0$$

where the values of $y$ are less than the respective values of $x$, by the difference $c$. If you suppose $c$ to be taken such as to make all the co-efficients of the equation $y$ positive, viz.

$$c = \frac{a - b}{c - d}$$

then there being no variation of the signs in the equation, all the values of $y$ must be negative, and consequently the quantity $b$, by the values of $x$ are diminished, must be greater than the greatest positive value of $y$. And, conversing under water $z$, must be the limit of the root of the equation $a + bx + cy + dz = 0$.

It is sufficient, therefore, in order to find the limit, to employ the quantity substituted for $x$, in each of these expressions $a + bx + cy + dz = 0$, $a + bx + cy + dz = 0$, $a + bx + cy + dz = 0$, $a + bx + cy + dz = 0$, $a + bx + cy + dz = 0$, $a + bx + cy + dz = 0$, $a + bx + cy + dz = 0$.

Having found the limit that surpasses the greatest positive root, call it $m$. And if you assume $y = m - x$, and for $a$ substitute $m - y$,
the equation that will arise will have all its roots positive; because w is supposed to surpass all the values of x, its roots affirmative; for, if x were greater than any negative value of w, it follows that w + w must be positive.

What is here said of the above cubic equation, may be easily applied to others; and of all such equations, two limits are easily discovered, viz. the quadratic, which is less than the least, and the cube, found as above, which runs to the greatest; but none of the equations, but the quadratic, give the roots of the equation. But besides these, other limits may be added to the roots, which may be found by the method of which, the reader may consult Maclaurin's Algebra.

LIMITATION, a certain time prescribed by statute, within which an action must be brought. The time of limitation is twofold; first in writs, by divers acts of parliament; secondly to make a title to any inheritance, and that is by the common law.

Limitation on penal statutes. —All actions, suits, bills, indictments, or informations, which shall be brought for any forfeiture upon any penal statute, made or to be made, whereby the forfeiture shall be paid to the crown, her heirs or successors, or shall be within two years after the offence committed, and not after two years; and all actions, suits, bills, or informations, which shall be brought for any forfeiture upon any penal statute, made or to be made, except the statutes of tithes, the benefit of which is to be saved, and which are to be saved, and which is to be saved, the prosecution must be within that time. 31 Eliz. c. 5.

Limitation in regard to personal actions of assault and battery, actions arising upon contract and trespass.

All actions of trespass, of assault, battery, wounding, imprisonment, or any of them, shall be commenced and sued within four years next after the cause of such actions or suits, and not after. 21 Jac. I. c. 16.

Actions of account, &c. —All actions of trespass quare clausum fremit, all actions of trespass, detinue, trover, and replevin, all actions of account, and upon the case (other than such accounts as concern the trade of merchant, between merchant and merchant, all actions of debt grounded upon any lading, or contract without specialty, that is, not being by deed or under seal) all actions of debt for arrears of rent, and all actions of assault, battery, wounding, and imprisonment, shall be commenced within the time and limitation as followeth, and not after; that is to say, the said actions upon the case (other than for slander), and the said actions for trespass, debt, detinue, and replevin, and the said actions for trespass quare clausum fremit, within six years after the cause of such action. 21 Jac. c. 16.

Exception in relation to infants. —It has been held, that if an infant during his infancy, by his guardian bring an action, the defendant cannot plead the statute of limitation, although the cause of action accrued six years before; and the words of the statute are, that after his coming of age, &c.

Exception in relation to merchants' accounts. —As to this exception, it has been matter of much controversy, whether it extends to all actions and accounts relating to merchants and merciaclers, or to actions of account open and current only. But it is now settled, that accounts open and current only are within the statute; and that therefore, if an account be stated and settled between merchant and merchant, and a sum certain agreed to be due to one of them, if in such case, he to whom the money is due, do not bring his action within the limited time, he is barred by the statute. 2 Mod. 312.

The receiver or administrator. —If a receiver money belonging to a person who afterwards died intestate, and to whom it takes out administration, and brings an action against him, which the plaintiff pleads the statute of limitations, and the plaintiff replies, and shows that administration was committed to him such a year, which was within six years; though six years are expired since the receipt of the money, yet not being so since the administration committed, the action is not barred by the statute.

Where a debt barred by the statute shall be revived. —Any acknowledgment of the existence of the debt, however slight, will take it out of the statute, and the limitation will then run from that time; and where an acknowledgment is ambiguous, it shall be left to the consideration of the jury, whether it amounts or not to such acknowledgment. 2 Durn. & East, 760.

It is clearly agreed, that if after the six years, the debtor acknowledges the debt, and promise payment, that this revives it, and brings it out of the statute: as if a debtor by promissory note, or simple contract, promises within six years of the action brought, that he will pay the debt; though this was barred by statute, and not revolved by the statute, for as the note itself was at first but an evidence of the debt, so that being barred the acknowledgment of the debt is a new evidence of the debt, and being proved, will maintain an action for recovery. 1 Salk. 28.

Limits of a planet, its greatest excursion from the ecliptic, or which is the same thing, the points of its greatest latitude by the plane of its orbit. 1 Salk. 28.

LIMITED PROBLEM, a problem that admits of one solution, as to make a circle pass through three given points, not lying in the same right line.
LINES on the plain scale, are the line of clari, line of vases, line of tangents, line of secants, line of semitangents, line of leages; the construction and application of which see under the words SCALE, SAILING, INSTRUMENTS, &c.

LINES on Gunter's scale. See Gun-

ten's SCALE.

LINES of the sector. See INSTRU-
MENTS.

LINES, in fortification, are those of ap-
pellant, capital, defense, circumvallation, contravallation of the base, &c.

To LINES a work, signifies to strengthen a rampart with a firm wall; or to encompass a parapet or most with good turf, &c.

LINES, in the art of war, is understood of the disposition of an army, ranged in order of battle, with the front extended as far as may be, that it may not be flanked.

LINES, is also understood of the disposition of a fleet on the day of engage-
ment.

Ship of the LINES, a vessel large enough to be drawn up in the line, and to have a place in the parallel sea-sight.

LINE, also denotes a French measure containing the twelfth part of an inch, or the hundred and forty-fourth part of a foot. Geometers conceive the line subdivided into infinitesimal. The French line answers to the English barleycorn.

LINEAR Numbers, in mathematics, such as have relation to length only; such is a number which represents one side of a plane figure. If the plane figure be a square, the linear number is called a root.

LINEAR PROBLEM, that which may be solved geometrically, by the intersection of two linear lines. This is called a simple problem, and is capable of a solution.

LINEN, in commerce, a well-known kind of cloth, chiefly made of flax. See LINUM, and WEAV.

LINE. SEE GADUS.

LINIMENT. See PHARMACY.

LINNAEUS, a genus of the class and order idiananica angiosperma. The cal is double; the cor. bell-shaped; the berry dry, three-
seeded. There is one species, a herb of Sweden.

LINNET. See FRINGILL.

LINSEED. The seed of the plant linum.

LINUM.

LINSPINS, in the military art, small pins of iron, which keep the wheel of a caisson or wagon on the axle-tree; for when the end of the axle-tree is put through he nave, the lenspin is put in, to keep the wheel from falling off.

LINT, the scrapings of linen: which is used in dressing wands, and is made up in various forms, as tents, dofts, pledgets, &c. See SURGERY.

LINUM, flax: a genus of the pentagynia order, in the pantehria class of plants; and in the natural method ranking under the 4th order, genus. The calyx is unsegmented; the petals are five; the capsule is quinquavalved and decumoloculare; and the seeds are solitary. There are 32 species, of which the most remarkable are

1. The ustilaginum, or common manunit flax.

2. The paremo, or perennial Siberian flax, with umbelate clusters of large blue flowers.

3. The cathart cum, or purging flax, a very small plant, not above four or five inches high: found wild upon chalky hills near in dry pleasure-gardens.

The first species is cultivated on the fields for the use of the manufacturers. The sec-

ond sort is chiefly ornamental. The vir-

tue of the third species is expressed in its title: its growth in water or wine of a handful of the seed (than) or a dram of them in substance when dried, is said to purge without inconvenience.

Of the cultivation of flax. A skilful flax-

 raiser always sows free, open, deep loam; and all grounds that produced the preceding year a good crop of turnips, cabbages, potatoes, barley, or broad clover; or have been formerly laid down rich, and kept for some time, are fit for the cultivation of flax. If the lines be sown early, and the flax not allowed to stand for a crop, a crop of tur-

nips may be got after the flax that very year; the second year a crop of rye or barley may be taken; and third year, grass-

seeds are sometimes sown along with the lineseed. Of preceding crops, potatoes and hemp are the best preparation for flax, if the ground is free and open, it should be turned in the autumn; if more moist as in clay or shallow, as it is not so salable, not deeper than two and a half inches. It should be laid flat, reduced to a fine gar-

den mould by good harrowing, and all stumps and stones should be carried off. Ex-

cept a little pegging for cold or sour ground, no other dung should be used pre-

paratory for flax, because it produces too many weeds, and throws up the flax thin and poor. Before sowing, the bulky clods should be broken, or carried up the ground; and stones, quickenings, and every other thing that may hinder the growth of the flax, should be carefully taken away. If the brighter in colour, and heavier the seed is, so much the better; that which when bruised appears of a light or yellowish green, and fresher in the heart, oily, and not dry, and smells and tastes sweet, and not harsh, is the best seed. Of the preceding year's growth, for the most part, answers best; but it seldom succeeds if kept another year. It ripens sooner than most other flax seed. Phialadelphia seed produces fine lint and a good size of the bolls, because it is sown thick, and answers best in wet cold soils.

The quantity of lineseed sown should be proportioned to the condition of the soil; for if the ground is in good heart, and the seed sown thick, the crop will be in danger of falling before it is ready for pulling. The time for sowing lineseed is from the middle of March to the end of April, as the ground and season answer; but the earlier the seed is sown, the less the crop interferes with the corn harvest. Late-sown lineseed may grow long, but the flax upon the stalk will be thin and puny.

Flax ought to be weeded, when the crop is about four inches long. In longer defer-

red, the weeds will also much break and bend the stalks, and will perhaps never recover their natural strength; and when the flax grows crooked, it is more liable to be hurt in the rippling and swaying. Quick-

cut grass should be taken up; for, being strongly rooted, the flax of it always ceases a great deal of the flax. If there is an appearance of a settled drought, it is bet-
ter to defer the weeding, than by that opera-
tion to expose the tender root of the flax to the drought.

In watering, a running stream wastes the flax, makes it white, and frequently carries off the raip of the flax; the quantity and motion of the water, also waste and whiten the flax, though not so much as running streams. Both rivers and lochs water the flax quicker than canals. The greater way the river or brook has run, the softer, and therefore the better, will the water be.

Springs, or short runs from hills, are too cold,
unless the water is allowed to stand long in the canal. Water from coal or iron is very bad for flax. A little of the powder of galls thrown into a glass of water will discover if it comes from minerals of that kind, by turning it into a dark colour, more or less tinge in proportion to the quantity of metal it contains. When the water is brought to a proper heat, small plants will be rising quickly in it, numbers of small insects and reptiles will be generating there, and bubbles of air rising up. If two flax plants are then held very tender, it must be gently handled. The thinner it is spread the better, as it is then more equally exposed to the weather. But it ought never to be spread during a heavy shower, as the ground will be washed and the harle too much, which is then excessively tender, but soon after becomes firm enough to bear the rains, which, with the open air and sunshine, cleans, softens, and purifies the harle to the degree wanted, and makes it blister from the boon. In short, after the flax has got a little firmness by being a few hours spread in dry weather, the more rain and sunshine it gets the better. If there is little danger of high winds carrying off the flax, it will be much the better for being turned about once a week. If it is not to be turned, it ought to be very thin spread. The spreading of flax and hemp, which requires a round hand, is a great deal of labor. The flax-riser should spread his first row of flax at the end of the field opposite to the point whence the most violent wind commonly comes, and ride over the crops foremost. He makes the root ends of every other row overlap the crop ends of the former row three or four inches, and binds down the last row with a rope, by which means the wind does not easily get below the lint to blow it away; and as the crop ends are seldom so fully watered as the root ends, the overlapping has an effect like giving the crop ends more watering.

A dry day ought to be chosen for taking up the flax; and if there is no appearance of high wind, it should be loosened from the heath or grass, and left loose for some hours, to make it thoroughly dry.

As a great quantity of flax can scarcely be wholly watered and grased, and as the different qualities will be better separated at lifting the flax off the grass; therefore at that time each different kind should be gathered together, and kept by itself; that is, all of the same colour, length, and grade.

The smaller the heath lint is made up in, the better for drying, and the more convenient for stacking, housing, &c., and in making up these heaths, as in every other operation upon flax, it is of great consequence that the lint be laid together as it grew, the root ends together, and the crop ends together. The profit on five acres of flax raised in Shropshire was 40s. 4d. 5d.

LION. See Felis.

LIPARIA, a genus of the diadymbia gynaecous class and order. The calv. is five-lobed; cor. wings two lobed, below; stam., the larger, with three shorter teeth; legume ovate. There are four species, shrubs of the Cape.

LIPPIA, a genus of the din]%numia gynoecous class and order. The calv. is four-toothed; the caps. one-celled, three-valved, two-seeded; seed one, two-celled. There are five species, shrubs of America.

LIQUAMBAR. See Sweet gum tree, a genus of the polyandria order, in the monogyna class of plants, commonly called Liquidambar: it is a deciduous tree, native of the rich moist parts of Virginia and Mexico. It will shoot in a regular manner to thirty or forty feet high, having its young twigs covered with a smooth light-brown bark, while those of the older are of a darker colour. The flowers are of a kind of saffron-colour; they are produced at the ends of the branches in May, and sometimes sooner; and are succeeded by large round brown fruit, which looks singular, but is thought by many to be no ornament to the tree. 2. The peregrinus, Canad. liquidambar, or spleenwort, is a native of the United States. The young branches of this species are slender, tough, and hardy. The flowers come out from the sides of the branches, like the former; and they are succeeded by small round pods which seldom ripen in England. These may be propagated either by seeds or layers.

The leaves of this tree emit their odoriferous particles in such plenty as to perfume the air—sometimes for many miles. The tree itself excites such a fragrant transparent resin, as to have given occasion to its being taken for the sweet storax. (See Styx.) These trees, therefore, are very proper to be planted singly in large grounds, that they may amply display their fine pyramidal growth, or to be set in places near seats, pavilions, &c. The resin was formerly of great use as a perfume, and is at present no stranger in the shops.

LIQUORICE. See Glycyrrhiza, and Materia Medica.

LIRODENDRON, the Tulip-tree, a genus of the polyandria order, in the monogyna class of plants; and in the natural method ranking under the 3rd order, caudatae. The calyx is triphyllous; there are nine petals; and the seeds are embittered in such a manner as to form a cone. There are two species; the tulipera, is best known here, and is a deciduous tree, native of most part of America. It rises with a large upright trunk, branching forty or fifty feet high. The trunk, which often attains to a circumference of thirty feet high, is covered with a grey bark. The leaves grow irregularly, and the branches from long quadrilateral. They are of a particular structure, being composed of three lobes, the middlemost of which is shortened in such a manner that it appears as if it had been cut off and hollowed out at the middle, and the sides rounded off. They are about four or five inches long, and as many broad. The flowers are produced with us in July, at the ends of the branches. The number of petals of which each is composed, like those of the tulip, is six; and these are spotted with green, red, white, and yellow. The flowers
are succeeded by large cones, which never ripen in England.

LIPHYTA, a genus of the pentandria monogynia class and order. The cal.

LITTHARUM, a genus of the diandria monogynia class and order. The cal.

LITHOPHYLUM, the name of Linnæus's third order of vegetables.

LITUS, a genus of the monogynia order, in the pentadria class; of plant.

LITHOSTRÆTUM, a genus of the Linnæus's third order of vegetables.

LITHOSPERMUM, a genus of the monogynia order, in the pentandria class; of plant.

LITHOZAMIAS, a genus of the Diandria monogynia class and order. The female cal.

LIVELIY. See Anatomy.

LIVELY of seisin, in law, signifies delivering the possession of lands, &c. to him who has a right to them. There are two kinds of lively and seisin; lively in law, which implies the deliverer being in view of the land, house, &c., or other thing granted, says to the feoffor, on delivery of the deed, "I give to you the house, &c., and to hold you and to your heirs, so go into the possession of the property accordingly." And lively in deed, is where the parties or the attorneys by them authorised, coming to the door of the house, or upon some part of the land, declare the occasion of their meeting before witnesses, read the deed, or its contents, and in case it be made by attorney, the letter of attorney is also read, after which, if the delivery is of a house, the grantor, or his attorney, takes the ring, key, or latch belonging to the door, or if it be a land, a turf, or clad of earth, and a twig of one of the trees, and delivering them with the deed to the grantee or his attorney, says, I A.B. deliver to you possession, and seisin of this message or tenement, &c. to hold to you, your heirs and assigns, according to the purport, true intent, and meaning of this indenture, or deed of feoff.

Loved; for a lease and release, a bargain and sale by deed intituled, are sufficient to vest the grantees with possession, without the formality of lively.

LIVYMEN OF LONDON, are a number of men selected from among the freemen of each company. Out of this body, the common council, sheriff, and other superior officers for the government of the city are elected, and among themselves the privilege of giving their votes for members of parliament, from which the rest of the citizens are excluded.

LIVES, or insurance of Lives. See Insurance.

LIXUUM. See LEXURN.

LIZARD. See Lacerta.

LOAD, or Lodge, in mining, a word used especially in the tin-mines, for any regular vein or course of their primary positions, which must commonly load means a metallic vein. It is to be observed, that mines in general are veins within the earth, whose sides receding from or approaching to each other, make them of unequal breadth in different places, sometimes forming large spaces, which are called holes; these holes are filled like the rest with substances, which, whether metallic, or of any other nature, are called lodes. These lodes, if the forming loads are reducible to metal, the loads are by the English miners said to be alive, otherwise they are termed dead loads.

The difference between death and life is then attempted by the crossing of a vein of earth or stone, or some other metalline substance; in which case it generally happens, that one part of the load is moved to a considerable distance on one side. A miner considers himself as a funeral corps, a flogging, and the part of the load which is moved, is by them said to be heaved. This fracture or heave of a load, according to Mr. Price, is produced by a subsidence or elevation of the strata from their primary situations, which he supposes to have been so horizontal or parallel to the surface of the earth, and therefore should more properly be called a depression than a heave. This subsidence or heave was produced by a necessary load to the miner, did not experience teach him that as the loads always run on the sides of the hills, so the part heaved is always moved toward the descent of the hill so that the miner's looking toward the ascent of the hill, and meeting a flogging, considers himself as working in the heaved part; whereas, cutting through the flogging, he works upon its back up the ascent of the hill, till he recovers the load, and vice versa.

LOAMS. See Husbandry.

LOANS, in political economy, sums of money, generally of large amount, borrowed from individuals or public bodies, for the service of the state. They are either compulsory, in which case they may be more properly termed requisitions; or voluntary, which is the only mode that can be frequently resorted to with advantage. Loans are sometimes furnished by public companies as a consideration for peculiar privileges secured to them; but are much more commonly advanced by individuals on a certain interest being allowed for the use of the money, either for a term of years, or until the principal shall be repaid.

The practice of borrowing money, for defraying part of the extraordinary expenses in time of war, had been adopted in other countries long before it was introduced into Great Britain; but it has been carried to a far greater extent here than by any other state in the world. From which the government has been enabled to raise the largest sums, has arisen entirely from the strict punctuality with which it has constantly made good all pecuniary engagements.

LUCULLUS, a name given to an officer who usually conducts negotiations of this kind on the part of the government, and the agreement is afterward confirmed by parliament; the governor and company of the bank of England, having of late years been usually appointed receivers of the contributions, for which they have an allowance, at a certain rate per million; and the sums received by them are paid into the exchequer, with a fair prospect of profit, and the cost.

The money appropriated to the payment of interest or annuities, is issued at the receipt of the exchequer to the chief cashier of the bank upon account, and he is enjoined to pay the same to the several subscribers in their due course. The bank detain their allowance for receiving the contributions out of the sums received, and likewise what they have allowed as dividends to their subscribers, till they receive the money before the times fixed for the several instalments.

When the parliament has voted the supplies, and the extent of the loan found necessary, the communication is usually made to the bank or stock exchange stating the particular stock on which the loan is to be made, and fixing a day for those who intend to bid for it to wait on the minor and艾维斯 of the bank, in the mean time each person forms his list of friends who are to take different proportions with him in case he succeeds. When the day comes, each party offers as low as he thinks he can venture to, with a fair prospect of profit, and the lowest offer is generally accepted. The only step to be taken by those who are not of the number just mentioned, and who may wish to take a share in the transaction, is to pay a subscription for a part of his subscription, which at first may sometimes be had without any premium, or for a very small one, for it cannot be presumed that each person, who have subscribed the whole sum to be raised, indeed, or can keep it, but that they propose to include in their subscriptions a great number of their connections and acquaintance. Sometimes the subscription lies open to the public to the bank, as in the instance of the loan of eighteen millions for the service of the year 1797, and then every person is at liberty to subscribe what he thinks proper, and if upon casting up the whole, there is a surplus subscribed, which has generally been the case, the sum each person has subscribed, is reduced in an equal proportion, so as to make in the whole the sum fixed by parliament. As soon as conveniently may be, after the subscription is closed, receipts are made out, and delivered to the subscribers, for the several sums by them subscribed; and for the convenience of sale, every subscriber of a considerable sum has sundry receipts for different proportions of his whole sum, by which means he can readily part with what sum he wishes proper to transfer; and in this way the assignment is drawn upon the back of the receipt, which being signed and witnessed, transfers the
LOANS.

From the difference in the terms of the loan, with respect to the capital created, the rate of interest it bears, and the different periods of the terminable annuities which have been granted with most of the loans, it is evident, that in order to form a proper comparison of the interest paid for the money borrowed at different periods, various conditions must be brought into some degree of uniformity; and the most obvious mode of doing this is, by converting that part of the terminable annuities into equivalent perpetual annuities; that is, into the additional interest, which must have been paid in lieu of such terminable annuities.

The rate of interest at which such conversion is made affects the result in some instances very materially; thus, the perpetual annuity, which is equal to an annuity of 10l. for 21 years, is at 3 per cent. 4l. 12s. 6d. but at 5 per cent. 4l. 16s. 3d.; and the perpetual annuity equal to an annuity of 10l. for 60 years, which at 3 per cent. is 8l. 6s. is at 5 per cent. 9l. 9s. 3d. from which it is evident, that, if the term of the annuities, granted during different periods, are all valued at the same rate of interest, the comparison will by no means be just; for if a high rate is adopted, the loans which have been obtained at the lowest interest will be set in an unfavourable light; and if, on the contrary, they are all valued at a low rate, the charge of those loans, for which the highest interest is paid, will appear less than really is. Nor is an average rate more proper for exhibiting the real difference in the terms on which the several loans have been obtained. The least objectionable mode appears to be to convert the rate of interest into perpetual annuities, according to the current rate of interest at the time when the annuities were granted, as it is upon the rate of interest that the proportionate value of an annuity for a certain term to the perpetuity depends; and in forming the following statements, the conversion has been made at the interest produced by money invested in the three per cents. according to the price of this stock at the times when the respective loans were settled: for, though by this means, the rate is, in each case, rather lower than it would have been had the interest produced by 4 or 5 per cent. stock been adopted, it is most probable, from the nature of the principal loans, that the stock which must have been given in lieu of a long annuity, would chiefly have been three per cents.; and, therefore, the interest equivalent to the long annuity should be found according to the interest produced by this stock.

It may also be proper to remark, that, as the terminable annuities have mostly been granted for a small part of the whole interest, particularly on the loans of the last war, the difference of a quarter or even half per cent., in the rate at which they are valued has in general but little effect on the whole rate per cent. of the loan. Thus, if the long annuity of the loan of 14,500,000l., in 1797, is valued at 6 per cent. (being the interest produced by 3 per cent. at that time) it makes the whole rate per cent. 6l. 6s. 10d.; but, if the long annuity is valued at 5½ per cent. it will be 6l. 6s. 9½d.; at 5½ per cent.

Thus, the interest paid, however, focuses the real burden of each loan to the country, and is the circumstance to be chiefly attended to in all comparisons of the whole present advantage or disadvantage of the terms on which the public debts have been contracted at different periods.

During the reign of Queen Anne, loans were chiefly raised on annuities for 99 years, till 1711, when, by the establishment of the South Sea company, a variety of debts were consolidated and made a permanent capital, bearing 6 per cent. interest. About this period lotteries were also frequently adopted for raising money for the public service, under which form a considerable premium was given, in addition to a high rate of interest. This mode of raising money was followed in 1712, 1713, and 1714. In the latter year, though the interest paid was equal to only 5l. 7s. 2d. per cent. on the sum borrowed, the premium allowed was upwards of 34l. per cent.; but as peace was restored, and the legal rate of interest had been reduced to 5 per cent., it seemed that a larger premium was allowed, for the sake of appearing to borrow at a moderate rate of interest.

In the reign of George I., the interest on a considerable part of the public debts was reduced to 5 per cent. and the few loans that were raised at a small amount: that of the year 1720 was obtained at little more than 4 per cent. interest.
About 1730 the current rate of interest was 5 per cent.; and in 1736, government was limited to 9 per cent. per annum. The extraordinary sums necessary for defraying the expenses of the war which began in 1739, were at first obtained from the sinking fund and the lottery; a payment from the bank, in 1742, rendered by only a small loan necessary in that year, which was obtained at little more than 3 per cent. interest. In the succeeding years the following sums were raised by loan:

Loans of the seven years war.

1737 - 2,000,000 - 3 12 0
1738 - 3,000,000 - 3 14 3
1739 - 5,000,000 - 3 6 0
1740 - 6,000,000 - 3 10 9
1741 - 8,000,000 - 3 13 7
1742 - 12,000,000 - 4 10 9
1743 - 12,000,000 - 4 10 9
1744 - 3,000,000 - 4 4 2

Loans of the American war.

1776 - 2,000,000 - 3 9 8
1777 - 5,000,000 - 4 5 2
1778 - 6,000,000 - 4 18 7
1779 - 7,000,000 - 5 18 10
1780 - 12,000,000 - 5 18 10
1781 - 12,000,000 - 5 11 1
1782 - 13,500,000 - 5 18 1
1783 - 12,000,000 - 4 13 9
1784 - 6,000,000 - 5 6 1

Loans of the war with the French republic.

1793 - 4,500,000 - 4 3 4
1794 - 11,000,000 - 4 10 7
1795 - 18,000,000 - 4 15 8
1796 - 18,000,000 - 4 14 9
1797 - 7,500,000 - 4 12 2
1798 - 15,000,000 - 5 14 1
1799 - 18,000,000 - 5 6 1
1800 - 17,000,000 - 6 4 0
1801 - 3,000,000 - 5 12 5
1802 - 15,500,000 - 5 5 0
1803 - 20,500,000 - 4 14 2
1804 - 28,000,000 - 5 5 5

Loans of the war with the French empire.

1803 - 12,000,000 - 5 2
1804 - 14,500,000 - 5 9 2
1805 - 22,500,000 - 5 3 2
1806 - 20,000,000 - 4 10 7

LOASA, a genus of the polyandria monogynia class and order. The caly is five-leafed; cor. five-petalled; nect. five-leaved; caps. four-foliaged, one-celled, three-celled, many-seeded. There is one species, an animal of South America.

LOBE. See Anatomy.

LOBELIA, cardinal-flower, a genus of the monogynia order, in the syngnesia class of plants, and in the natural method ranking under the 9th order, campanaceae. The calyx is quinquenatus; the corolla monopetalous and irregular; the capsule inferior, bilocular or unilocular; there are five petals in the corolla, but only four of them are cultivated in our gardens, two of which are hardy herba- ceous plants for the open ground, and two

shrubby plants for the shade. They are all fibrous-rooted perennials, rising with erect stems of two to six feet high, ornamented with oblong, oval, spear-simped, simple leaves, and spikes of beautiful monopetalous, somewhat tinged, five-petalled flowers, of scarlet, blue, and violet colours, and numerous aborted fruits, and cuttings of their stalks. The tender kind require the common treatment of other exotics. They are natives of America, from which they are introduced in England.

The root of the species called the sphyllumata (see Plate Nat. Hist. fig. 292) is an article of the materia medica. This species grows in most places in Virginia, and bears our winters. It is perennial, has an erect stalk three or four feet high, blue flowers, a milky juice, and a rank smell. The root consists of white fibres about two inches long, resembles tobacco in taste, which remains on the tongue, and is apt to excite vomiting. It is used by the North American Indians as a specific in the venereal disease. The benefit, however, to be derived from this article has not, as far as we know, been confirmed either in Britain or by the other nations who have made admission of this herb, likewise to other instruments. The office, therefore, which in other locks is performed by the extreme point of the key, is here accomplished by a lever, which, when it approaches the bolt till every part of the lock has undergone a change of position. The necessity of this change to the purposes of the lock, and the absolute impossibility of effecting it otherwise, without the proper key, are the points to be ascertained.

Plate Lock and Loom, fig. 4, represents a mortice lock, made under the patent which Mr. Stansbury took out in 1805, for various purposes, and which is the springleatch, as in common; the end B of this is bent, and has a frame D screwed to it, carrying a roller E; against this roller a wedge F called a pusher, shown separately in fig. 5, acts, the spindle G on which this pusher is fixed, slides through holes in the side-plate of the lock, so as to have no shake, and on each end is fastened a handle; by this arrangement it is plain that the handle of the wedge is pushed from without the door, its wedge E will act against the roller E, fig. 4, draw back the bolt A, and release the door; a continuation of the same motion opens it. The operations from within the room are the same, except that the handle of the pusher must be pulled instead of pushed; but as it is on the other end of the spindle, the operation on the wedge and bolt is the same.

For the convenience of persons not acquainted with the new method, the bolt may be drawn back by turning the handle, as in the common lock, ii is a piece of metal, figs. 4 and 5, which has a round collar a above, and to this is applied b, which work in holes in the side-plates of the lock, so as to turn easily round; this piece has a hole through it, large enough to admit the pusher to move up and down, and having in one side thereof admits the wedge F; so that when the spindle is turned round, one of the two arms d of this piece, acts against the arm b of the bolt A, fig. 4, and draws back the bolt at the same time, in the common way. In order to reduce the friction against the bolt, in shutting the door, a small roller e, fig. 1, is applied to it. In lieu of the slip-
If this sheet is cut out, the second order of the conic sections, viz., either the parabola, the circle, ellipse, or hyperbola: if an equation, therefore, is given, whose locus is of the second degree, and it is required to draw the conic section which is the locus thereof, first draw a parabola, ellipse, or hyperbola, so as that the equation expressing the nature thereof may be as compound as possible, in order to get general equations or formulas, by examining the peculiar properties whereof we may know which of these formulas the given equation ought to have regard to; that is, which of the conic sections will be the locus of the proposed equation. This known, compare all the terms of the proposed equation with the terms of the general formula of that conic section, which you have found will be the locus of the given equation; by which means you will find which section is the equation given.

An equation, whose locus is a conic section, is given, and the particular section whereof it is the locus is required; all the preceding terms of this section being brought over to one side, so that the other is equal to nothing, there will be two cases.

Case I. When the rectangle \(xy\) is not in the given equation. 1. If either \(y\) or \(x\) is in the same equation, the locus will be a parabola, ellipse, or hyperbola, in the equation with the sign, the lines will be an ellipse or a circle. 3. If \(x\) or \(y\) have different signs, the locus will be an hyperbola, or a hyperbola opposite sections regarding their diameters.

Case II. When the rectangle \(xy\) is in the given equation. 1. If neither of the squares \(x^2\) or \(y^2\) or their product one, is in the same, the locus of it will be an hyperbola between the asymptotes. 2. If \(y\) and \(x\) are therein, having different signs, the locus will be an hyperbola regarding its diameters. 3. If both the squares \(x^2\) and \(y^2\) are in the equation, you must free the square \(xy\) from fractions; and then the locus will be an hyperbola, when the square of \(x\) or \(y\) multiplying \(xy\), is equal to the fraction multiplying \(xy\); or an ellipse, or circle, when the same is less; and an hyperbola, or the opposite sections, regarding their diameters, when greater.

LOCUST. See Gryllus.

LOGBOARD, in military affairs, is a work raised with earth, gibbons, fascines, woolpacks, or matelots, to cover the besiegers from the enemy's fire, and to prevent their losing a place which they have gained, and are resolved, if possible, to keep. For this purpose, when a logboard is to be made on the glades, covered way, or in the breach, there must be great provision made of fascines, sand-bags, &c. in the trenches; and during the action, the pioneers with fascines, sand-bags, &c. should be making the logboards at their leisure, or at such a time and in an advantageous manner as possible from the opposite bastion, or the place most to be feared.

LOEINGIA, a genus of the class and order Tritoncea monogynia. The calyx is five-leaved; corolla five-petalled; capsule one-celled, three-valved. There is one species, an annual of Spain.

LOESELIA, a genus of the dicotyledonous angiospermous class of plants, the flower of which is monoeocious and unisexual at the limb; the fruit is a twilled capsule, with several angulated seeds in each cell. There is one species, a herb of South America.

LOG, in naval affairs, is a flat piece of wood, shaped somewhat like a drawer, with a piece of lead fastened to its bottom, which makes it stand or swim upright in the water. To this log is fastened a long line, called the log-line; and this is commonly divided into certain spaces, or log length, by knots, which are pieces of knotted twine inerced between the strands of the line; which, shew, by means of a half-minute glass, how many of these spaces or knots are run out in half a minute. They commonly begin to count at the distance of about 10 fathons or 60 feet from the log; so that the log, when it is hoven overboard, may be out of the eddy of the ship's wake before they begin to count; and for the ready discovery of this point of commencement, there is commonly fastened at it a red rag.

The log being thus prepared, and hoven overboard, the log-line, and the line veered out by the helm of a real, as the ship sails, will, shew how far the ship has run in a given time, and consequently her rate of sailing.

Hence it is evident, that as the distance of the knots bears the same proportion to a mile as half a minute does to an hour, whatever number of knots the ship runs in half a minute, the same number of miles she will run in an hour, supposing the ship to sail with the same degree of velocity during that time; and therefore, in order to know her rate of sailing, it is the general way to have the log every hour; but if the force or direction of the wind and weather, they do not continue the same during the whole hour, or if there has been more sail set, or any sail handed in, by which the ship has sailed faster or slower than she did at the time of having the log, there must then be an allowance made for it accordingly.

LOGBOARD, a table generally divided into five columns, in the first of which is entered the time of the day; in the second the course steered; in the third, the number of knots run on the reel each time of having the log; in the fourth, from what point the wind blows; and in the fifth, observations on the weather, variation of the compass, &c.

LOGBOOK, a book ruled in columns like the log-board, into which the account on the log-board is transcribed every day at noon; whence, after it is corrected, &c. it is entered into the journal. See LOG-JOURNAL.

LOGWOOD, in commerce. See HEMATOXYLUM.

Logwood is used by dyers for dying blacks and blues.

LOGARITHMIC, in general, something belonging to logarithms. See LOGARITHMS.

LOGARITHMIC CURVES, on the line AN (Plate Miscell., fig. 153) both ways indispensably extermated, and taken, AC, CF, EG, GI, HL, on the right hand, and AE, CE, &c. on the left, all equal to one another, and if at the points P, g, c, e, G, i, l, be erected to the right line AN, the perpendiculars PG, GA, CB, ED, EF, GI, IK,
L. M, which let be continually proportional, and represent numbers, viz. AB, 1; CD, 10; EF, 100, &c. shall we have two progressions of lines, arithmetical and geometrical: for the lines AC, AE, AG, &c. are in arithmetical progression, or, as 1, 2, 3, 4, 5, &c. and so represent the logarithms to which the geometrical lines AB, CD, EF, &c. do correspond. For since AC is triple of the right line AG, and the right line GH shall be in the third place from unity, if CD is in the first; so likewise shall LM be in the fifth place, since AL = 3 AC. If the extremities of the progression, D and E, are joined by the right lines, the figure SBNML will become a polygon, consisting of more or less sides, according as there are more or less terms in the progression.

In the parts AC, CE, EG, &c. are bisected in the points \( \xi, \eta, \zeta \), and there are again raised the perpendiculars \( cd, ef, gh, li, \) which are mean proportions between \( AB, CD \); \( CD, EF \), &c. then there will arise a new set of proportions, whose terms beginning from that which immediately follows unity, are double of those in the first series, and the difference of the terms is becomes less, and approaches nearer to a ratio of equality. For, following, in this new series, the right lines AL, AC, express the distances of the terms LM, cd, from unity, viz. since AL is ten times greater than AC, LM shall be the tenth term of the series from unity; and because this is three times greater than \( AC \), \( ef \) will be the third term of the series if \( cd \) is the first, and there shall be two mean proportions between \( AB \) and \( ef \); and between \( AB \) and \( LM \) there will be nine mean proportions. And if the extremities of the lines \( bd, df, ef \), &c. are joined by right lines, there will be a new polygon made consisting of more or shorter sides than the first.

If, in this manner, mean proportions are continually placed between every two terms, the number of terms at last will be made so great, as also the number of the sides of the polygon, as will be greater than any given number, or to be infinite; and every side of the polygon so lessened, as to become less than any given right line; and consequently the polygon will be changed into a curve-line, or into a curved-line figure, as is the case in the first case, it may be conceived as a polygon whose sides are infinitely small and infinite in number. A curve described after this manner, is called logarithmic.

It is manifest, from this description of the logarithmic curve, that all numbers at equal distances are continually proportional. It is also plain, that if there are four numbers, \( AB, CD, \) \( \xi, \eta \), \( M, L \), such that the distance between the first and second, is equal to the distance between the third and fourth, let the distance from the second to the third be what it will, these numbers will be proportional to the distances \( AC, CD, \xi M, L \), equal, \( AB \) shall be to the increment of \( \xi D \), as \( 1K \) is to the increment of \( 1T \). Wherefore, by composition, \( AB : CD : : 1K : M L \). And conversely, if four numbers are proportional, the distance between the first and second shall be equal to the distance between the third and fourth.

The distance between any two numbers, is called the logarithm of the ratio of those numbers; and, indeed, does not measure the ratio itself, but the number of terms in a given series of geometrical proportions, proceeding from one number to another, and defines the number of equal ratios by which the greater may be divided into, and shew, the products and quotients of the latter.

LOGARITHMS are numbers so contrived and adapted to other numbers, that the sums and differences of those numbers correspond to, and show, the products and quotients of the latter.

Or, more generally, logarithms are the numerical exponents of ratios; or a series of numbers in arithmetical progression, answering to another series of numbers in geometrical progression.

Thus,
\[ 0, 1, 2, 3, 4, 5; \text{Indices, or logarithms.} \]
\[ 1, 2, 3, 4, 5; \text{Ind. or log.} \]

Thus, if a fraction is required, the logarithm of its numerator will be found, and that of its denominator multiplied, and their sum will be the logarithm of the quotient.

Thus, the series 1, 2, 3, 4, 5, &c. is the geometrical progression applied to the calculation of numbers, and will, for all practical purposes, be sufficient, because the operations of addition are the most frequent in calculations, and the principle of resemblance is sufficient for finding the differences of such numbers, and for the computation of any other calculations required; and those numbers are easily found and applied, and are sufficient for all calculations, and are for that reason preferred to any other numbers for that purpose.

LOGARITHMS are more generally considered as numbers proportional to those of any other series in which the sum of the terms is, and the difference of the terms is, constant. And such an increasing series is continued by each term being added to the last term, and the last term increased by the original difference, until the number of terms is such as will answer the purpose. And thus the logarithms of the numbers 1, 2, 3, 4, &c. are numbers proportional to the numerical series of the same numbers, and such as will answer the same purpose for the calculation of numbers.
LOGARITHMS.

numbers such terms of that series as are nearest to them, and their indices for the logarithms. But then, to construct logarithms in this manner, to suit an exact number, and degree of exactness, as would be necessary to make them of any considerable use, is next to impossible, because of the almost infinite labour and time it would require. This, however, is an introduction for understanding the method of the noble inventor, who undoubtedly first took the hint of making logarithms from the consideration of the indices of a geometrical series; and by means of the principles and known properties of these progressions he first formed his tables, and advanced them to the practical purposes intended.

To find the logarithm of any of the natural numbers, 1, 2, 3, 4, 5, &c., according to the method of Napier. — Let the geometrical series, 1, 10, 100, 1000, &c. and apply to it the arithmetical series 1, 2, 3, 4, &c. as logarithms. 2. Find a geometric mean between 1 and 10, 10 and 100, or any other two adjacent terms of the series between which the number proposed lies. 3. Between the means, thus found, and the nearest extreme, find another geometric mean, in the same manner; and so on, till you are arrived within the proposed limit of the number whose logarithm is sought. 4. Find as many arithmetical means as you desire, by the same process as you found the geometric ones, and the last of these will be the logarithm answering to the number required.

Example. Let it be required to find the logarithm of 9.

Here the numbers between which 9 lies are 1 and 10.

First, then, the log. of 10 is 1, and the log. of 1 is 0, therefore \( \log \frac{10}{2} = 0.5 \) is the arithmetical mean, and \( \log (1 \times 10) = 1 \) is the geometric mean; whence the logarithm of 5 is obtained. Secondly, the log. of 10 is 1, and the log. of 5 is 0.777; therefore \( \log \frac{10}{5} = 0.75 \) is the arithmetical mean, and \( \log (10 \times 5) = 1.5777 \) is the geometric mean; whence the logarithm of 10 is obtained.

Thirdly, the log. of 10 is 1, and the log. of 5 is 0.777; therefore \( \log \frac{10}{5} = 0.75 \) is the arithmetical mean, and \( \log (10 \times 5) = 1.5777 \) is the geometric mean; whence the logarithm of 10 is obtained.

Fourthly, the log. of 10 is 1, and the log. of 5 is 0.777; therefore \( \log \frac{10}{5} = 0.75 \) is the arithmetical mean, and \( \log (10 \times 5) = 1.5777 \) is the geometric mean; whence the logarithm of 10 is obtained.

Fifthly, the log. of 10 is 1, and the log. of 5 is 0.777; therefore \( \log \frac{10}{5} = 0.75 \) is the arithmetical mean, and \( \log (10 \times 5) = 1.5777 \) is the geometric mean; whence the logarithm of 10 is obtained.

Sixthly, the log. of 10 is 1, and the log. of 5 is 0.777; therefore \( \log \frac{10}{5} = 0.75 \) is the arithmetical mean, and \( \log (10 \times 5) = 1.5777 \) is the geometric mean; whence the logarithm of 10 is obtained.

And, proceeding in this manner, after 25 extractions, the logarithm of 5 is obtained. This process may be continued till the logarithm of 9 is found, and it is sufficiently exact for all practical purposes.

Vol. II.
To reduce Powers by Logarithms.---Multiply the logarithm of the number given, by the index of the power required, the product will be the logarithm of the power sought.

Example. Let the cube of 22 be required by logarithms. The logarithm of 22 = 1.360150, which multiplied by 3, is 4.080450, the logarithm of 32768, the cube of 22. But in raising powers, viz. squaring, cubing, &c. of any decimal fraction by logarithms, it must be observed, that the first significant figure of the power be put so many places below the place of units, as the number of digits in the logarithm wants of 10, 100, &c. multiplied by the index of the power.

To extract the Roots of Powers by Logarithms.---Divide the logarithm of the number by the index of the power, the quotient is the logarithm of the root sought.

To find Means Proportional between any two numbers, find the logarithm of one, and subtract the logarithm of the other, from it, the number answering to the difference, is the mean proportional required.

Example. Let three mean proportional be sought, between 100 and 1000.

Logarithm of 100 = 2.000000
Logarithm of 1000 = 3.000000

Divide by 3.000000 2.000000

Log of the least term 100 added 3.000000

Log of the 1st mean 101.467384 2.000000
Log of the 2d mean 102.956014 2.000000
Log of the 3d mean 104.467048 2.000000
Log of the greatest term 106. 2.000000

LOGIC.---The professional business of logic is to explain the nature of the human mind, and the proper manner of conducting its several powers, in order to the attainment of truth and knowledge.

There are two fundamental prophecies of logic: the first, that the logic of the least term, have endeavored first to define and describe the several faculties and operations of the human mind, as perception, judgment, memory, invention, &c. The second is to lay down rules for correct reasoning and argument. Every act of the judgment they term a proposition, and all propositions are either affirmative or negative. All questions or arguments they reduce to syllogisms; that is, from two axioms or propositions (called terms, in the technical language) laid down, they deduce a third, or conclusion, and the previous propositions they divide into major and minor. Thus, let the question be, whether God is an intelligent being? Here the major or principal proposition proceeds from the word intelligent, and the minor respects God. They would then arrange the syllogism as follows:

Affirmative

Minor

Major

Conclusion.

Let God have disposed creation in right and perfect order;

Therefore God is an intelligent being.

3. They next class or arrange the different kinds of syllogisms according to the nature of them. Propositions are not only affirmative and negative, but they are also particular or universal. These syllogisms will vary, not only as the major or minor proposition is negative or affirmative, but as either is an universal or particular affirmative.
chalky, or sandy soils. It is advantageously cultivated along with clover, and springs earlier than other grasses, supplying food for cattle at a time when it is most difficult to be obtained. - Cattle, sheep, and, eat it; goats are not fond of it.

2. The temulentum, or white dandel, grows spontaneously in ploughed fields. If the seeds of this species are matted with barley, the ale soon occasions drunkenness; mixed with bread-corn, they produce but little effect, unless the bread is eaten hot.

LONCHITTS, spleenwort, a genus of the cryptogamia class of plants, the fructifications of which are arranged into fleshy filaments, and disposed separately under the surfaces of the leaves. There are five species. The leaves of this plant are of use in healing wounds, and in preventing inflammations of them: they are also used against the spleen. The root is aperient and diuretic.

LONGEVITY, long life. The duration of human life is a subject so universally interesting, that instances of persons who have considerably exceeded the usual term of life have at all times attracted notice, although very few attempts have been made to ascertain the circumstances under which life may be prolonged to its greatest extent. Buffon, d'Arsonval, d'Herblay, d'Herbelin, and a few others who have noticed this subject, appear to have considered but a very small number of the instances of longevity which have occurred. Mr. J. Easton, in order to supply better materials for others, published, a few years since, a much greater collection of instances of this kind, though probably but a small part of what have actually occurred. His list consists of 1712 persons, who are stated to have died at the following ages:

<table>
<thead>
<tr>
<th>Age (years)</th>
<th>Persons</th>
</tr>
</thead>
<tbody>
<tr>
<td>From 100 to 110 years</td>
<td>1310</td>
</tr>
<tr>
<td>110 to 120</td>
<td>277</td>
</tr>
<tr>
<td>120 to 130</td>
<td>84</td>
</tr>
<tr>
<td>130 to 140</td>
<td>20</td>
</tr>
<tr>
<td>140 to 150</td>
<td>7</td>
</tr>
<tr>
<td>150 to 160</td>
<td>3</td>
</tr>
<tr>
<td>160 to 170</td>
<td>2</td>
</tr>
<tr>
<td>170 to 185</td>
<td>3</td>
</tr>
</tbody>
</table>

1712

Such a number of instances would furnish many useful conclusions; but most accounts of this kind contain little more than the name, age, and place of the death of the person mentioned, from which little or no information can be gained. Sir J. Sinclair, in an Essay on Longevity, has endeavoured to excite a more general interest on this subject, which has by no means been investigated with the attention it deserves.

That long life is principally on account of the laws of nature, appears an indisputable fact; but from all appearances which have been made, it likewise appears, that there are other circumstances which may considerably influence the life of men, and are perhaps the most certain is descent from long-lived ancestors. Dr Rush, of Philadelphia, remarks, that he has not found a single instance of a person who lived to be 80 years old, of whom this was not the case; and the accounts collected by others strongly confirm this observation.

The climate of some countries has been supposed to be much more favourable to longevity than others: thus Mr. Whitehurst, asserted, that Englishmen in general were longer-lived than North Americans; and Mr. W. Barlow, endeavoured to prove the contrary: but whatever inferences of this kind national partiality may attempt to support, more extensive observations will in general confirm the conclusion, that although longevity evidently prevails more in certain districts than in others, and those regions which lie within the temperate zones are best adapted to promote long life, yet it is by no means confined to any particular district, nor can remarkable instances of it be produced both from very hot and very cold countries. It is highly probable that the human frame is so constituted as to adapt itself easily to the atmosphere and peculiarities of the country in which it receives life, or even into which it is afterwards removed. Thus France and Sweden are countries differing materially in soil and climate: the general age of life of the inhabitants in both is very different; yet the usual rate of mortality has been found nearly the same in both. Men can live equally well under very different circumstances. It is a small change that machines for the health of the inhabitants than others; and the cause of this superiority is chiefly a free circulation of air, uncontaminated with the noxious vapours and exhalations which destroy its purity in other parts, as remarkable instances of it almost universally found more healthy than low and muddy places, or than close and crowded cities.

From a list of 145 persons who are recorded to have lived to the age of 120 years and upwards, it appears, that more than half were inhabitants of Great Britain and Ireland. Of these, 63 of England and Wales, 23 of Scotland, 29 of Ireland, and 30 of other countries.

The number of instances in Scotland, compared with those in England and Ireland, shews by this account to have been more than twice the proportion of the population, which certainly seems to shew that the climate of the former is very favourable to long life. The great proportion of inhabitants of Great Britain and Ireland, though perhaps arising in some measure from circumstances of great age not being so generally noticed and recorded in other places, at least shews, that these countries are not unavourable to longevity.

It is a fact pretty well established, that more males are born than females; it is also well known, that in almost every form which animal life assumes, the male appears to possess a smaller degree of bodily strength to the female. From these circumstances it might be expected that the number of males living would be found greater than that of the females, and that in general the latter did enjoy a greater duration of life. On the contrary, however, has been asserted, and evidence produced which appeared to justify such an opinion; but it seems probable, that in forming the accounts from which the number of females living appeared greater than that of the males, sufficient attention was not paid to the number of males engaged chiefly abroad in the army and navy, and of the emigrations to foreign parts being chiefly of males. That the male constitution is naturally more durable than that of females, may be inferred from the list more referred to of 145 persons, who have attained unusually great age, more than two-thirds of the number being males. Dr. Hufeland remarks, that the equilibrium and pliability of the female body seems, for a certain time, to give it some advantage, and to render it less susceptible of injury from destructive influences than that of men; but that male strength is, without doubt, necessary to arrive at a very great age. More women are, however, much longer-lived; and if the registers of mortality, from which tables of the probability of the duration of human life are formed, were more extensive, and comprehended a greater number of years, so as to lend the instances of great longevity, the difference between the value of male and female lives would appear less than it is supposed to be, and probably the sum of life of each sex would nearly to equality.

The form of the individual appears to be of considerable importance: moderate-sized and well-proportioned persons have certainly the best chance of long life. There are, however, a few instances, of a different description having attained considerable age. Mary Jones, who died in 1783, at Worm, in Shropshire, aged 100, was only two feet eight inches in height, very middling and small; and James McDonald, who died near Cork in the year 1760, aged 117, was seven feet six inches high.

Matrimony, if not entered into too early, appears to be very conducive, both to a long life, the proportion of unmarried persons attaining great age, being remarkably small; Dr. Rush says, that in the course of his enquiries, he met with only one person beyond eighty years of age, who had never been married. This is a very limited remark; Mrs. Malton, who died in 1733, aged 105; Ann Kerney, who died the same year, aged 110; Martha Dunridge, who died in 1752, in the 100th year of her age, and never married, who died in 1753, aged 104, had never been married: and in the list prefixed to Sir John Sinclair's Essay on Longevity, of pensioners in Greenwich hospital, who were upwards of eighty years of age, there are sixteen who never were married: the same list, however, contains five times as many persons who had been married, and other accounts are in a still greater proportion.

The Chinese erect triumphal or honorary arches to the memory of persons who have lived, a century, thinking, that without a sober and virtuous life it is impossible to attain so great an age. Temperance is certainly the best security of health; and no man can reasonably expect to live long who impairs the vital powers by excess, which converts the most natural and beneficial enjoyments into the most certain means of destruction. The few instances of individuals who, notwithstanding their licentious mode of life, have attained considerable age, cannot be put in comparison with the immense number whose lives have been materially shortened.
LONGITUDE.

Suppose I examine the rate of a watch for 30 days; on some of those days I find it has gained, and on some it has lost: add together all the quantities it has gained, and suppose they amount to 17°; and together all the quantities it has lost amount to 15°; then upon the whole, it has gained 2° in 30 days; and this is called the mean rate for that time; and this divided by 30, gives 0°.133 for the mean daily rate of gaining: so that if the watch had been exactly regular, 0°.133 every day, at the end of the 30 days it would have gained just as much as it really did gain, by sometimes gaining and sometimes losing. Or you may get the difference between what the clock was too fast or too slow on the first and last days of observation, if it be too fast or too slow on each day; but take the sum, if it is too fast on one day and too slow on the last day, &c; the difference is the mean rate of gaining. But if the watch was too fast on the first day 18°, and too fast on the last day 32°, the difference is 14° and the mean daily rate of gaining, is 0°.463, the mean daily rate of gaining.

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In the year 1726, Mr. John Harrison pro-
LONGETHE.

duced a time-keeper of his own construction, which did not err above one second in a month for ten years together; and in the year 1736 he had a machine tried in a voyage to and from Lisbon, which was the means of correcting an error of almost a degree and a half in the compass. He returned, and in 1739 published a paper on the subject. His own experiments were supported by those of his contemporaries, and it is a great question whether any improvement in the art of time-keeping was ever made by any other person. He had also a very great exactness in the regulation of his time-keepers, for he had them adjusted at the time of the day, when the moon was new, and he had no more than a few minutes of the mean time, for which this last time-keeper was sent down to the Royal Observatory at Greenwich, to be tried in consequence of his success. Mr. Harrison received public encouragement to proceed, and he made three other time-keepers, each more accurate than the former, which were tried successively in the years 1739, 1758, and 1791; the last of which proved so much to his own satisfaction, that he applied to the commissioners of the longitude to have this instrument tried in a voyage to the West Indies according to the directions of the statute of the 12th of Anne above cited. Accordingly, Mr. William Harrison, son of the inventor, embarked in November 1781, on a voyage for Jamaica, and in the beginning of the 17th year of his age, he returned to England with the time-keeper, in March 1782, when he found that it had err'd in the fourth month, no more than 1° 40' 45" in time, or 285 minutes of longitude; whereas the act required that the act should be corrected by the geographical miles, or minutes of a great circle, in such a voyage. Mr. Harrison now claimed the whole reward of 20,000l., offered by the said act, but some doubts arising in the minds of the commissioners, as to the true situation of the island of Jamaica, and the manner in which the time at that place had been found, as well as to Portsmouth, and it being further suggested by some, that although the time-keeper happened to be right at Jamaica, and after its return to England, it was by no means a proof that it had been always so in the intermediate time; another trial therefore was therefore proposed, in a voyage to the island of Barbadoes, in which precautions were taken to obviate as many of these objections as possible. Accordingly the commissioners previously sent one of their own persons to make astronomical observations; and, by the aid of their time-keeper, which, when compared with other corresponding ones made in England, would determine beyond a doubt, its true situation; and Mr. William Harrison again set out with his father's time-keeper, in March 1764, the watch having been compared with equal altitudes at Portsmouth before he set out, and he arrived at Barbadoes about the middle of May; where, on comparing it again by equal altitudes of the sun, it was found to shew the difference of longitude between Portsmouth and Barbadoes to be 3° 35m. 3s.; the true difference of longitude between these places, by astronomical observation, being 3° 3m. 20s.; so that the error of the watch was 38s., or 10° 45' 20" of longitude. In consequence of this and the former trials, Mr. Harrison received one moiety of the reward offered by the 12th of queen Anne, after explaining the principles on which his watch was constructed, and delivering this, as well as the three former, to the commissioners of the longitude for the use of the public; and he was promised the other moiety of the reward, when other time-keepers should be made.
still further improved under his direction, by the
life Mr. Charles Mason, by several new
equations, and the whole computed to tenths of a second. These tables, when
compared with the above-mentioned series of ob-
servations, a proper allowance being made for the
ternal error of observation, seem always to give the
longitude in the heavens correctly within 30 seconds of a degree;
which greatest error, added to a possible error of one minute in taking the longitude
differences from the sun or a star at sea, will at
a medium only produce an error of 42 minutes of longitude. To facilitate the use of
these tables, Dr. Maskelyne proposed a nauti-
cal Ephemeris, the scheme of which was
adopted by the commissioners of longitude,
and first executed in the year 1767, which
from that time has been regularly continued.
But as the rules that were given in the
appendix to one of these publications, for cor-
recting the effects of refraction and parallax,
were thought too difficult for general use,
they have been reduced to tables. So that,
by the help of the ephemerides, these tables,
and others that are also provided by the
Board of Longitude, the calculations relating
to the longitude, which could not be per-
formed by the most expert mathematician
in less than four hours, may now be com-
puted with great ease and accuracy in half an hour.

As this method of determining the longitude
depends on the use of the tables an-
nually published for this purpose, those who
wish for further information are referred to
the instructions that accompany them, and
particularly to those that are annexed to the tables requisite to be used with the Astro-
nomical and Nautical Ephemerides.

4th. The phenomena of Jupiter's satellites have commonly been preferred to those
of the moon, for finding the longitude; because
they are less liable to parallaxes than these
are, and besides they afford a very conno-
sognous observation whenever the planet
is above the horizon. Their motion is very
very rapid, and may be calculated for every hour.

Now, to find the longitude by these satel-
ilites: with a good telescope observe some of
their phenomena, as the conjunction of two of
them, or of one of them with Jupiter, &c.
and at the same time find the hour and minute,
from the altitudes of the stars, or by
means of a clock or watch, previously regu-
lated for the place of observation; then, con-
sulting tables of the satellites, observe the
time when the same appearance happens in
the meridian of the place for which the tables
are calculated; and the difference of time,
as before, will give the longitude.

The eclipses of the first and second of Jupi-
ter's satellites are the most proper for this
purpose; and as they happen almost daily, they
afford a ready means of determining the
longitude of places at land, having indeed contributed much to the modern improve-
ments in geography; and if it were possible to
observe them with proper telescopes, in a
ship under sail, they would be of great ser-
vice in ascertaining its longitude from time
to time. To obviate the inconvenience to
which these observations are liable from the
motion of the ship, Mr. Irwin has written
what he called a marine chair: this was tried
by Dr. Maskelyne, in his voyage to Barba-
dos, when it was found that no benefit
could be derived from the use of it. And
indeed, considering the great power requi-
site in a telescope proper for these ob-
servations, and the violence as well as irregulari-
ties in the motion of the ship, it is
that the complete management of a telescope
on board ship will always remain among the
desiderata in this part of nautical science.

And further, since all methods that depend
on the phenomena of the heavens, have also
this other defect, that they cannot be ob-
served at all times, this renders the improve-
ment of timekeepers of the greater impor-
tance.

LONICERA, honeysuckle, a genus of the
monogynia order, in the pentandria class
of plants. The corolla is monopetalous and ir-
regular; the berry polyspernum, bilocular,
and inferior. There are 19 species, of which
the most remarkable are:

1. The alpigena, or upright red-berried
honeysuckle, rises with a shrub, short, up-
right stem, four or five feet high.

2. The cereum, or blue-berried hone-
ysuckle, has a rather shrub-like
stem, which is commonly 4 or five feet
high, and many white flowers proceeding
from the sides of the branches.

3. The nigra, or black-berried upright
honeysuckle, with a shrubby stem three or
four feet high, and white flowers succeed-
ning by single and distinct black berr-
ies.

4. The tartarica, or Tartarian honeysuckle,
with a shrubby upright stem, three or four
feet high, heart-shaped opposite leaves,
and white flowers succeeded by red ber-
rries, sometimes distinct, and sometimes
double.

5. The dicrilla, or yellow-flowered Area-
cadian honeysuckle, with shrubby upright
stems, to the height of three or four feet,
and clusters of pale yellow flowers,
appearing in May and June, and sometimes
continuing till autumn, but rarely ripeing
seeds here.

6. The xystostoma, or fly honeysuckle,
with a strong shrub stem, branching erect
to the height of seven or eight feet, and erect
white flowers proceeding from the sides of
the branches.

7. The symphoricarpos, or shrubby St.
Peter's-wort, with a shrubby rough stem,
four or five feet high, and small greenish
flowers.

8. The perennialum, or common climb-
ing honeysuckle, has two principal varieties,
viz. The English wild honeysuckle, or wood-
bine of our woods and hedges, and the Dutch
or German honeysuckle, with a shrubby de-
clinated stalk, and long trailing purplish
branches, forming large beautiful red flow-
ers of a fragrant odour, appearing in June
and July.

9. The caprifolium, or Italian honeysuckle,
with shrubby terminated stalks, or by
long slender trailing branches, terminated by
verdant or whitish white clusters of close-sit-
ing flowers, very fragrant, and white, red,
and yellow colours.

10. The camporum, or evergreen trump-
eter-flowered honeysuckle, with a shrubby de-
clinated stalk, sending out long slender trailing
branches, terminated by naked ver-
dicillate spikes, of long, unreflected, deep-
scarlet flowers, very beautiful, but of little
fragrance.

LOOF, in the sea language, is a term used
in various senses; thus the loof of a ship
is that part of her aloft which lies just before
the chest-tree; hence the guns which lie
there are called loof-pieces: keep your loof,
signifies, keep the ship near to the wind:
to close by the wind: loof up, is to keep nearer
the wind: to spring the loof, is when a ship
that was going large before the wind, is brought
close by the wind.

LOOM-TACKLE, is a tackle in a ship which
serves to lift goods of small weight in or out
of her.

LOOKING-GASSES. See Optics.

LOOM, the weaver's frame, a machine
whereby several distinct threads are woven
into one piece. Looms are of various struc-
tures, accommodated to the various kinds of
materials to be woven, and the various man-
ner of weaving them, viz. for woollens, silks,
and cloths ; and sometimes for gowns, and other
works, as tapestry, ribands, stockings, &c.

See Weaving.

The weaver's loom-engine, otherwise called
the Dutch loom-engine, was brought into use
from Holland to London, in or about the
year 1676.

The lower compartment of Plate Lock and
Loom, represents a loom for weaving silks or
other plain work. A, fig. 6, is a roll called
the loof, on which the warp is wound as it is
wove; at one end it has a ratchet-wheel a,
and a click to prevent its running back; at
the same end it has also four holes in it, and
is turned by putting a stick in these holes; at
the other end a roller b, on which the yarn is wound; this has two small
cords bb wrapped round it, the ends of
which are attached to a bar d, which has a
weight D hung to it; by this means a fric-
tion is caused, which prevents the roll turn-
ing by accident. EF are called lambs; they
are composed of two sticks eF, between
which are fastened a great number of threads;
which are called the warp, as passed; the
first thread of the warp goes through
the loops of the lambs E, the next attached to
the lamb F; and so on alternately; by this
means, when the weaver presses down one of
the treadles with his foot, and raises the other,
one lamb draws up every other thread,
and the other sinks all the rest, so as to make
an opening between the sets of thread; LL
is a frame moving up a centre at the top of
the frame of the loom; the longer part of
this frame is shewn in fig. 8; LL are the two
uprights of the frame, / is the bar that con-
nects them, M is a frame carrying a great
number of pieces of split reeds or sometimes fine
wire at equal distances; between these threads
of the warp are passed; the frame M is
supported by a piece of wood m called the
shuttle-race, which is fastened into the front of the pieces LL; each end of this piece has boards nailed to the sides, so as to form troughs NO; at a small distance above each trough are fixed two very smooth wooden pieces mn; their use is to guide the two pieces py, called peckers or drivers; to each of these pieces a string is fastened, and these strings are tied to a piece of wood, which the weaver holds in his hand, and by matching the stick to either side, draws the peckers forward very quick, and gives the shuttle, fig. 7, (which is to be laid in the trough before the pecker) a smart blow, and drives it along across the race as into the other trough, where it pushes the pecker along to the end of the wire, ready for the next stroke which throws it back again, and soon. Fig. 7 represents the under side of the shuttle on a larger scale. LOOP, in the iron works, denotes a part of a large morse through the middle of it, in which is placed a quill a containing the yarn b, in a piece of glass, called the eye of the shuttle, with a body, cd, through which comes the thread of the frame LL with its left; presses his foot on one of the treadles G1, which by means of the lambs EF, as before described, divides the warp; he then snatches the stick PI and by that means throws the shuttle, fig. 7, which unwinds the thread in it, and leaves it lying between the threads of the warp; he then relieves the shuttle before he keeps down, and presses down the other, while he draws the frame LL towards him, and then returns it. The use of this is to beat the last thread thrown by the shuttle close up to the one that was thrown before it by the split peckers M, fig. 8, which has brought the frame LL back to its original position, and again divided the warp by the shuttle, he throws the shuttle again: when he has in this manner finished about 12 or 14 inches of the piece, he will have the roll A with the stick, as before described. Some very expert weavers will throw the shuttle and perform the other operations at the rate of 120 times per minute.

Loom-gale, a gentle easy gale of wind, in which a ship can carry her topsails on.

LOOP, or a piece of a saw or block of cast iron, broken or melted off from the rest.

LOPHIUS, fishing-frog, toad-fish, or sea-devil, a genus of the branchiosseous order of fishes, whose head is in size equal to all the rest of the body. There are three species, the most remarkable of which is the piscatorius, or common fishing-frog, an inhabitant of the British seas. This singular fish grows to a large size, some being between four and five feet in length; and Mr. Pennant mentions one taken near Scarborough, whose mouth was a yard wide. The fishermen on that coast have a great regard for this fish, from the end of the season it is a great enemy to the dog-fish; and whenever they take it with their lines, set it at liberty. The head of this fish is much larger than the whole body, is round at the circumference, and flat above; the mouth of prodigious widthiness. The under jaw is much longer than the upper; the jaws are full of slender sharp teeth; in the roof of the mouth are two or three rows of the same. On each side the upper jaw is two sharp spines, and others are scattered about the upper part of the head. The body grows slender near the tail, the end of which is quite even. The colour of the upper part of this fish is dusky; the lower part white; the skin smooth.

LORANTHUS, a genus of the monocotyledonous order, in the hexadernia class of plants, and in the natural method ranking under the 14th order, aggregata. The genus is inferior; there is no calyx; the corolla is sessile and revolute; the stamens are at the top of the petals; the berry is monospermous. There are 18 species, natives of America.

LORD. See Peer.

LORD'S DAY. All persons not having a reasonable excuse shall resort to their parish church or chapel (or to any congregation of religious worship allowed by thetoleration act) on every Sunday, on pain of punishment by the censures of the church, and of forfeiting 1s. to the poor for every offence; to be levied by the churchwardens by distress, by warrant of one justice.

The hundred shall not be answerable for any robbery committed on the Lord's day.

No carrier shall travel, or drover drive cattle, on the Lord's day, under the penalty of 20l.

No person upon the Lord's day shall serve or execute any writ, process, warrant, order, judgment, or decree (except in cases of treason, felony, or breach of the peace), but the service thereof shall be void.

LOTTERIES are declared to be public nuisances, 5 Geo. I. c. 9; but for the public service of the government, lotteries are frequently established by particular statutes, and managed by special officers and persons appointed.

By statute 42 Geo. III. c. 54, lottery-office keepers are to pay 50l. for every licence in London, Edinburgh, and Dublin, or within twenty miles of either, and 10l. for every licence in every other place. Any unlicensed person shall deposit 30 tickets with the receiver-general of the stamp-duities, or licence to be void.

By statute 22 Geo. III. c. 47, lottery-office keepers must take out a licence; and officers are to be open only from eight in the morning to eight in the evening, except the Saturday evening preceding the drawing. The sale of chances and shares of tickets, by persons not being proprietors thereof, is prohibited under penalty of 50l.; and by 42 Geo. III. c. 119, all games or lotteries called little goes, are declared public nuisances, and all persons keeping any office or place for any game or lottery, not authorized by law, shall forfeit 500l. and be deemed rogues and vagabonds. The proprietor of a whole ticket may nevertheless insure it for its value only, with any licensed office for the whole time of drawing from the time of insuring, under a bona fide agreement without a stamp.

LOTUS, or birds-foot trefoil, a genus of the deciduous order, in the diadelphia class of plants, and in the natural method ranking under the 32d order, papilionaceous. The legume is cylindrical, and very erect, the end closing upwards longitudinally; the calyx is tubular. There are 23 species, but only six are usually cultivated in our gardens.

1. The siliquous, or winged pea, has trailing, slender, branchy stalks, about a foot long, with trifoliolate oval leaves, and from the weaver legumes, large, yellow, or scarlet, red-figured flowers, one on each footstalk, succeeded by tetragonal solitary pods, having a vernaceous wing or lobe, running longitudinally at each corner. It flowers in June and July; and the seeds ripe in autumn.

2. The crucifer, or Cretan silvery lotus. 3. The Jucundus, or black lotus of St. James's island. 4. The hisbatus, or hairy Italian lotus. 5. The doreynium, white Austrian lotus, or double-twig of Montpellier. 6. The ecuils, with yellow flowers.

The first species is a hardy annual. The other species may be propagated either by seeds or cuttings, but require to be kept in pots or boxes in the greenhouse during the winter seasons.

LOTUS, or Knights of St. Louis, the name of a military order in France, instituted by Louis XIV. in 1693.

LOUSE. See Pediculus.

LOXIA, a genus of birds of the order of passerines, the distinguishing characters of which are: the bill is strong, convex above and below, and very thick at the base; the nostrils are small and round; the tongue is as if cut off at the end; the toes are four, placed three before and one behind, excepting one species, which has only two toes before and one behind. The most remarkable are:

1. The cur' rostra, or common cross-bill, is about the size of a lark, is known by the singularity of its bill, both mandibles of which turn outwards, the general colour of the plumage in the male is a red or lead, inclining to rose-colour, and more or less mixed with brown; the wings and tail are brown; the legs black. The female is the same colour, but tends to a chocolate or brown, blended with brown in those parts where the male is red. This species is a constant inhabitant of Sweden, Germany, Poland, Switzerland, Russia, and several parts of Africa, where it breeds, but migrates sometimes in vast flocks; it is now and then the case in respect to England; for though in some years a few are met with, yet in others it has been known to visit us by thousands, sitting on such spots as are planted with pines, for the sake of the seeds, which are its natural food; it is observed to hold the cone in one claw like the parrot, and to have all the actions of that bird when kept in a cage. It is also found in North America and Greenland; and is said to make its nest in the highest parts of the fir-trees, fastening it to the branch with the resinosous matter which exudes from the trees.

2. The coccothraustes, or hawfinch, is in length seven inches. This species is ranked among the British birds; but only visits this country occasionally, and for the most part in winter, and is never known to breed here. It is more plentiful in France. It feeds on oak and elm seeds, &c., and is noted for the great strength of the bill, it cracks the stones of the fruit of the haws, cherries, &c., with the greatest ease.
3. The pyrrhula, or bullfinch, is so generally known as almost to supersede description. This species is common in most parts of the Continent of Europe, throughout Russia and Siberia, at which last place it is caught for the table. In winter it approaches gardens and orchards, and has been generally stipulated for making havoc among the buds of trees. It is of a very brilliant black, with oyster or greenish white, and is very destructive when once their entrances are gained; however, it would appear, that the object of these birds is not the bud, but "the worm in the bud," and that this species, in conjunction with various other species of small birds, are the destroyers of every hope of fruit, on any trees, bringing forward a numerous race already in a caterpillar state, that now issue from their concealments, and make their excursion along the budding branches, and would probably, under the most favorable circumstances, make those useful instruments for its preservation, whose young are principally fed by eating caterpillars. The bullfinch, in its wild state, has only a plain note; but when tame, it becomes remarkably musical, and will whistle at any time after a pipe, or to whistle any notes in the best manner; it seldom forgets what it has learned; and will become so tame as to come at call, perch on its master's shoulders, and in some cases, think nothing of affixing a superficial lesson. They may be also taught to speak, and some thus instructed are annually brought to London from Germany.

4. The cardinals, or cardinal grosbeak, is near eight inches in length. The bill is stout, and of a pale-red colour; the irides are hazel; the head is greatly crested, the feathers rising up to a point when erect; round the eye are found black and red rings, and the rest of the bird is of a fire-red. The female differs from the male, being mostly of a reddish brown. This species is met with in several parts of North America, and has attained the highest degree of brilliant notice, not only for the fineness of its song, the note of which resembles that of the nightingale.

5. The orix, or grenadier grosbeak, is about the size of a house-sparrow. The forehead is red-brown, and the upper surface of the breast and belly the same; the wings are brown, with pale edges; and the rest of the body of a beautiful red colour. These birds are inhabitants of Saint Helen; they are also in plenty at the Cape of Good Hope, where they frequent wetery places that abound with reeds, and among which they are supposed to make their nests. If, as is supposed, this is the same with Kolben's finch, he says that the nest is of a peculiar construction, made of reeds with small twigs, interwoven very closely and tightly with cotton, and divided into two apart nests with but one entrance, the upper for the male, the lower for the female, and is so tight as not to be penetrated by any weather. He adds, that the bird is scarlet only in the summer, being in the winter wholly ash-coloured. These birds, seen among the green reeds, are said to have a wonderful effect: for, from the brightness of their colours, they appear like so many scarlet lilies. See Plate Nat. Hist. fig. 253.

6. The penalis, or penalis grosbeak, (the toady-bird of Fryer) is about the size of the house-sparrow; the bill is black; the irides are yellow; the head, throat, and fore-part of the neck, of a beautiful red; the back, black, and tail, are black; the wing-covers, brown, edged with white; quills brown, with greenish edges; and legs a dull red; the wings reach half-way on the tail. This species inhabits Abyssinia, and frequents woods, and is a solitary species.

According to Linnaeus there are 48 species of the loxia.

7. The Bengalensis, or Bengal gros beak, is a trifle bigger than a house-sparrow; the female lays three or four eggs.

8. The Bengali gros beak, is about the size of a bullfinch; the general colour of the body above is a rufous brown, the under parts whitish. It inhabits the interior country of the Cape of Good Hope, and is found in a wild state, or in gardens in the same islands. These birds, according to our author, live together in large societies, and their mode of multiplication is extremely uncommon. They lay in a species of mound, which is of an uncommon size. In one described by Paterson, there could be no less a number than from 800 to 1000 resting under the same roof. He calls it a roof, because it perfectly resembles a roof of a thatched house, and the ridge forms an angle so acute and so smooth, projecting over the entrance of the nest below, that it is impossible for any reptile to approach them. The industry of these birds, in the construction of this roof (by an author) to that of the bee: throughout the day they appear to be busily employed in carrying a line species of grass, which is the principal material they employ for the purpose; in some cases, it is so well covered, as well as for additions and repairs. Though my short stay in the country was not sufficient to satisfy me by ocular proofs, that they added to their nest as they annually increased in numbers, still from the many trees which I have seen hewn down with the weight, and others which I have observed with their boughs completely covered over, it would appear that this is really the case. When the tree which is the support of this aerial city is obliged to give way to the increase of weight, it is obvious that they are no longer protected, and are under the necessity of rebuilding in other trees. One of these deserted nests I had the curiosity to break down, so as to inform myself of the internal structure of it, and found it equally ingenuous with that of the external. There are many entrances, each of which forms a regular street, with neat rows of sided rooms at about two inches distant from each other.

9. The tridactyla, or three-toed grosbeak, (the gufo balato of Buffon) has only three toes, two before and one behind. The bill is toothed on the edges; the head, throat, and fore-part of the neck, are of a beautiful red; the other part of the neck, back, and tail, are black; the wing-covers, brown, edged with white; quills brown, with greenish edges; and legs a dull red; the wings reach half-way on the tail. This species inhabits Abyssinia, and frequents woods, and is a solitary species.

According to Linnaeus there are 48 species of the loxia.

LOZENCE, Lozange, rhombus, in geometry, a triangle or parallelogram, figure consisting of four equal and parallel sides, two of which opposite angles are acute, and the other two obtuse; the distance between the two obtuse ones being always equal to the length of one side; when the sides are unequal, this figure is called a rhomboid.

LOZENCE, in heraldry, a rhombus, or figure of equal sides, but unequal angles.

LOZENGIE, in pharmacy, the same with what is usually called the lozenge.

LUCANUS, stag chaffer, a genus of insects of the order coleoptera: the generic character is, antennae clavated, with compressed tip, divided into lamellae on the inner face; jaws strongly expanded, elongated, and toothed. The principal species is the lucanus cervus, commonly known by the name of the stag-beetle, or stag-chaffer. It is the largest of all the European coleopterous insects, sometimes measuring nearly two inches and a half in length, from the tip of the jaws to the end of the body. Its general colour is a deep chestnut, with the thorax and head, which is of a sparrow form, of a blacker cast; and the legs and under-parts are chestnut-colour, excepting that the wings and the wings, which, except during flight, are concealed under the shells, are large, and of a fine pale yellowish-brown. This remarkable insect is chiefly found in the neighbourhood of oak-trees, delighting in the sweet exudation or honey-dew so frequently observed on the leaves. Its larva, which perfectly resembles a caterpillar, is sometimes found in nearly two inches and a half in length, in the hollows of oak-trees, residing in the fine vegetable mould usually seen in such cavities, and feeding on the softer parts of the decayed wood. It is of very considerable size, and the shell-bones are reddish-brown in colour; and when stretched out at full length, measures nearly four inches. When arrived at its full size, which, according to some, is hardly sooner than the fifth or sixth year, it flies, by frequently turning itself, and moistening it with its glutinous saliva, a smooth oval hollow in the earth, in which it lies, and afterwards remaining perfectly still for the space of near a month, winters itself in its skin, and commences pupa or chrysalis... It is now of a shorter form than before, of a rather deeper colour, and exhibits in a striking manner the rudiments of the large extended jaws and broad head, conspicuous in the perfect insect: the legs are also proportionally larger and longer than in the larva state. The ball of earth in which this chrysalis is contained is considerably larger than a hen's egg, and of a glistening surface, but perfectly smooth and polished within. The chrysalis lies about three months before it gives birth to the complete insect, which usually emerges in the months of July and August. The time, however, of this insect's
growth and appearance in all its states varies much, according to the difference of seasons. It is not very uncommon in many parts of England.

The commonly supposed female differs so much in appearance from the male, that it has by some been considered as a distinct species. It is not only smaller than the former, but totally destitute of the long and large ramified jaws, instead of which it has a pair of very short curved ones, slightly dentilicated or denticulated on one side: the head is also of considerably smaller diameter than the thorax. In point of colour it resembles the former.

The exotic species of this genus are mostly natives of the cold regions, in particular, frequently found in Virginia, is so nearly allied to the English stag-beetle as hardly to differ, except in having fewer denticles or divisions on the jaws.

A highly esteemed species has lately been discovered in New Holland. This differs from the rest in being entirely of a beautiful golden-green colour, with short, sharp-pointed, denticulated jaws of a brilliant coppery-colour. The breadth of the width of the insect is rather more than an inch. There are seven species of the lucanus.

LUCIDA, in astronomy, an appellation given to several fixed stars on account of their surpassing brilliancy, as a star of the second magnitude in the northern crown; the lucida hydra, or cor hydrae; and the lucida lyra, a star of the first magnitude in that constellation.

LUDWIGIA, a genus of the monogyne order, in the tetragonia class of plants, and in the natural method ranking under the 17th order, calycanthaceae. The corolla is tetra- petal; the capsule tetragonal, quadrilateral, inferior, and polyperspermous. There are four species, annuals of the West Indies.

LUES. See Medicine.

LUMBAGO. See Medicine.

LUMBICRUS, the worm, in zoology: a genus of insects belonging to the order of vernum intestinus. The body is cylindrical, annulated, with an elevated belt near the middle, and its side. One of the uterus is the genus coreus, a star of the second magnitude in the northern crown; the lucida hydra, or cor hydrae; and the lucida lyra, a star of the first magnitude in that constellation.

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the form given to it. It is generally rolled into cylinders of a convenient size. These are to be applied, by folding them, to the joints of the veins of England, which ought to be perfectly dry; because the least moisture would prevent the lute from adhering. When the joints are closed with this fat-lute, the whole is to be covered with slips of linen seconded with lute and with veils of gauze. These slips are to be fastened with pack-thread. The second lute is necessary to keep on the fat-lute, because the latter remains soft, and does not become solid enough to stick on closely.

Ground lissead made into a paste with water makes also a very useful lute for most occasions.

LUTHERANS, the Christians who follow the opinion of Martin Luther, one of the principal reformers of the church in the sixteenth century. See Gregory's Church History, vol. ii.

LYCÉON. See Surgery.

LYCHNIS, campion, a genus of the pentapigmy order, in the pentadactyla class of plants, and in the natural method ranking under the 23rd order, Caryophyllaceae. The plants are, in general, compact and smooth; there are five unguiculate petals, with the segments of the limbs almost bident; the capsule quinquilocular. There are 12 species, the principal are, 1. The chalybean, or clavate Lyc. 2. The diurna; the varieties are, the common single red-flowered bachelor's button, double red, double white, and single white-flowered. The double variety is the only one ornamented in their bloom; the flowers large, very double, and continue long in blow; the single red sort grows wild by ditch-sides and other moist places of England, from which the doubles were accidentally obtained by culture in gardens. 3. The viscaria, or viscous German Lyc., commonly called catch-fly. Of this also there are varieties with single red flowers, with double red flowers, and with white flowers. The double variety is considerably the most eligible for general culture, and is propagated in plenty by parting the roots. All the varieties of this species emit a glutinous liquid matter from their stalks, flies happening to light on them sometimes stick and entangle themselves, whence the plant obtains the name catch-fly. 4. The flos coccii, cocciflorus Lyc. used for the cultivation of Lyc. Cus. mossa, a genus of the natural order of muco, belonging to the Caryophyllaceae class of plants. The anthers are bivalved and sessile; there are no calyptrae. There are there species, of which the following are remarkable: 1. The clavatum, or common club-moss, is common in dry and mountainous places, and in fir forests. The stalk is prostrate, branched, and creeping from a foot to two or three yards long; the radications are formed of lacerated segments, in some varieties reliefed. The powder is believed to be the seeds, which through a microscope appear of a spheroidal form, and to be annexed to elastic hairs. 5. The Lyc. Cus. mossa, a genus of the natural order of mucus, belonging to the Caryophyllaceae class of plants. The anthers are bivalved and sessile; there are no calyptrae. There are there species, of which the following are remarkable: 1. The clavatum, or common club-moss, is common in dry and mountainous places, and in fir forests. The stalk is prostrate, branched, and creeping from a foot to two or three yards long; the radications are formed of lacerated segments, in some varieties reliefed. The powder is believed to be the seeds, which through a microscope appear of a spheroidal form, and to be annexed to elastic hairs. 6. The Lyc. Cus. mossa, a genus of the natural order of mucus, belonging to the Caryophyllaceae class of plants. The anthers are bivalved and sessile; there are no calyptrae. There are there species, of which the following are remarkable: 1. The clavatum, or common club-moss, is common in dry and mountainous places, and in fir forests. The stalk is prostrate, branched, and creeping from a foot to two or three yards long; the radications are formed of lacerated segments, in some varieties reliefed. The powder is believed to be the seeds, which through a microscope appear of a spheroidal form, and to be annexed to elastic hairs.

LYCOPODIS, a genus of the monogynia order, in the pentadactyla class of plants, and in the natural method ranking under the 41st order, Asperifolia. The corolla has an incurved tube. There are eight species, chiefly annuals.

LYCOPODIS, a genus of the monogynia order, belonging to the diadactyla class of plants, and in the natural method ranking under the 42nd order, Cardiactylaceae. The corolla is quadrifid, with one of the segments reniform; the stamina standing asunder, with four free stamens. There are three species, of which the water-lehornes might probably be of use in dyeing.

LYCENUS, a genus of the monogynia order, in the dendraclava class of plants, and in the natural method ranking under the fourth order, Gramina. The spatha or sheath is monoplyphenous; there are two corola of the same genus; the nut is biliocular. There is one species, a grass of Spain.

LY DIAN STONE, in mineralogy, is commonly intersected by veins of quartz. Fracture even, and sometimes inclining to concave. Specific gravity, 2.96. Powdery, black, or greyish black. This stone, or one similar to it, was used by the Etruscans as a touchstone. They drew the metal to be examined along the stone, and judged of its purity by the colour of the streak. On this account it was called Bauxite, the Etruscan. It was called the Lydian stone, as being found in the river Molosius in Lydia.

LYMPH. See Anatomy, and Physiologist.

LYNX. See Felis.

LYRE, lyra, a musical instrument of the string kind, much used by the ancients.

LYRE, lyra, in astronomy, a constellation of the Lower hemisphere, the number of whose stars, in Ptolemy's and Tycho's catalogues, are only 10, but 19 in the British catalogue.

LYRIC. See Poetry.

LYSIMACHIA, Loosestrife, a genus of the monogynia order, in the pentadactyla class of plants, and in the natural method ranking under the 20th order, Rotenaceae. The corolla is rotund, the calyx, beaked. There are three species, but only four are commonly cultivated in gardens. These are hardy herbaceous perennials and biennials, rising with erect stalks from inches to two or three feet in height, and terminated by spikes and clusters of monopetalous, rosetted, five-petalled spreading flowers of white and yellow colours. The mugunmul, or yellow moneywort, or herb jevoperuse, is particularly beautiful.

LYTHRIUM, purple Loosestrife, a genus of the monogynia order, in the dendraclava class of plants, and in the natural method ranking under the 17th order, Calycanthaceae. The calyx is short, the corolla long, and there are six petals inserted into it; the capsule is biliocular and polyspernum. There are 18 species, of which the most remarkable is 1. The salicaria, or common purple Loosestrife, with oblong leaves, is a native of Britain, and grows very naturally by the sides of ditches and rivers. 2. The hispanus, or Spanish Loosestrife, with a hyssop leaf, grows naturally in Spain and Portugal. The flowers are larger than those of the common sort, and make a fine appearance in the month of July, when they are in beauty.
M. The twelfth letter of our alphabet. As a numeral it stands for mille, a thousand; and with a dash over it, thus M, for a thousand times a thousand, or 1,000,000. Used as an abbreviation M. signifies Marinus, Marcus, Maurus, Maximus; and M. and M. for manumitter bond; Mag. Eq. magister equitum; Mag. Ml. magister militum; M. M. P. magnum magnificat poestate; M. A. magister articulus; M. S. into subscript, and M. S. S. manuscripts, in the plural form the prescribers of physicians, M. stands for manipulus, a handful; and sometimes for missiles, or mixtura.

MAB, a genus of the triandria order, in the discus, or the stigmas, the perianthium of the male is triusth; that of the female is as in the male; the fruit is a plum two-celled, superior. There is one species, a tree of the Friendly Islands.

MACROLOBIUM, a genus of the monocotyledonous, or milk-seed family. The caryx is one-seeded; corolla none. There are two species, called plicepod, shrubs of the West Indies.

MACRONE, MACRONE, an application given to a horticultural kind of poetry, made up of a jumble of words of different languages, and words of the vulgar tongue Latinized.

MACRE, the second or covering of the kernel of the nutmeg, is a thing of the nutmeg and branched substance, of an ocelalous nature and a yellowish colour; being met with in flakes of an inch and more in length, which are divided, in a multitude of ramifications. It is of an extremely fragrant, aromatic, and agreeable flavour, and of a pleasant, but acid and ocealous taste. See MYRTICALE.

MACEANION, in pharmacy, is an infusion or soaking ingredients in water, or any other liquid, in order either to soften them, or draw out their virtues. MACHINE. See MECHANICS.

MACKREL. See SEAFISH.

MACROQUEL, a genus of the class and order pentandria monognay. The cor. is bell-shaped; the capsule two-celled, two-valved; seeds imbricate. There are three species, small trees of the West Indies.

MACULE, in astronomy, are dark spots appearing on the luminous surface of the sun. They are produced by the action of the sun on the outer parts of the sun, and are visible in the sun's disk. The solar maculae are dark spots of an irregular and changeable figure, observed in the face of the sun. These were first observed in November and December of the year 1610, by Galileo in Italy, and Hariot in England, unknown to, and independent of, each other, soon after they had made or procured telescopes.

There have been various observations made of the phenomena of the solar macule, and hypotheses invented for explaining them. Many of these macule appear to consist of heterogenous parts: the darker and denser being called, by Hevelius, nuclei, which are encompassed as it were with atmospheres, somewhat rarer and less obscure; but the figure, both of the nuclei and entire macule, is variable. These macule are often subject to sudden mutations. In 1644 Hevelius observed a small thin macule, which in two days time grew to ten times its bulk, appearing also much darker, and having a larger nucleus; the nucleus began to fail sensibly before the spot disappeared; and before it quite vanished, it broke into four, which resolved into many, but were not sensible upon the first appearance in the middle parts; that they contract themselves near the limb, and the middle appear larger; that they often run into one in the disc, though separated near the centre; that many of them first appear in the middle, and many disappear there; but that none of them deviate from their path near the horizon; whereas Hevelius, observing Mercury in the sun near the horizon, found him too low, being depressed 27° beneath his former path.

From these phenomena are collected the following consequences:

1. That since Mercury's depression below his path arises from his parallax, the macule having no parallax from the sun, are much nearer than that planet.

2. That since they rise and disappear again in the middle of the sun's disc, and undergo various alterations with regard both to bulk, figure, and density, they must be formed de novo, and again dissolved about the sun; and hence some have inferred, that they are a kind of solar clouds, formed out of his exhalations, and if so, the sun must have an atmosphere.

3. Since the spots appear to move very regularly about the sun, it is hence inferred, that it is not that they really move, but that the sun revolves round his axis, and the spots accompany him, in the space of 27 days, 12 hours, 20 minutes.

4. Since the sun appears with a circular disk in every situation, his figure, as to sense, must be spherical.

The magnitude of the surface of a spot may be estimated by the time of its transit over a hair in a fixed telescope. Galileo estimates some of the spots larger than both Asia and Africa put together; but if he had known more exactly the sun's parallax and distance, as they are known now, he would have found some of those spots much larger than the whole surface of the earth. For in 1612 he observed a spot so large, that it could be plainly visible to the naked eye, and therefore it subtended an angle of about a minute. But the earth, seen at the distance of the sun, would subtend an angle of only about 17'; therefore the diameter of the spot was to the diameter of the earth, as 102 to 17, or 33 to 1 nearly; and consequently the surface of the spot, if circular, to a great circle of the earth, as 124 to 1, and to the whole surface of the earth, as 124:4, or nearly 3 to 1. Gessendus observed a spot whose breadth was 96 of the sun's diameter, and which therefore subtended an angle at the eye of a navigator, a half, and consequently its surface was above seven times larger than the surface of the whole earth. He says he observed above 40 spots at a time, without being able to diminish the light of the sun.

In the year 1779 there was a spot on the sun which was large enough to be seen by the naked eye. It was divided into two parts, and must have been 300 miles in diameter. Various opinions have been advanced concerning the nature, origin, and situation of the solar spots; but the most probable seems to be that of Dr. Wilson, professor of practical astronomy in the university of Glasgow. By attending particularly to the different phases presented by the umbra, or shady zone, of a spot of an extraordinary size that appeared on the sun, in the month of November 1779, during its progress over the solar disc, Dr. Wilson was led to form a new and singular conjecture on the nature of these appearances; which he afterwards greatly strengthened by repeated observations. The results of these observations, it is the opinion of the sun is that the solar macule are cavities in the body of the sun; that the nucleus, as the middle or dark part has usually been called, is the bottom of the excavations; and that the umbra, or shady zone surrounding it, is the shadow sides of the cavity. Dr. Wilson, besides having satisfactorily ascertained the reality of these immense excavations in the body of the sun, has also pointed out a method of measuring the depth of them. He estimates, in particular, that the nucleus or bottom of the large spot above-mentioned, was not less than a semidiameter of the earth, or about 4000 miles below the level of the sun's surface, while its other dimensions were of a much larger extent. He observed that a spot near the middle of the sun's disc is surrounded equally on all sides with its umbra; but that when, by its apparent motion over the sun's disc, it comes near the western limb, that part of the umbra which is next the sun's centre gradually diminishes in breadth, till near the edge of the limb it totally disappears; whilst the umbra on the other side of it is little or nothing altered. After a semi-revolution of the sun on his axis, if the spot appear again, it will be on the opposite side of the disc, or on the left hand, and the part of the umbra which had before disappeared is now plainly to be seen; while the umbra on
the other side of the spot seems to have vanished in its turn, being hid from the view by the upper edge of the excavation, from the declivity of the mound, and its parts right with respect to the eye. But as the spot advances on the sun’s disc, this umbra, or side of the cavity, comes in sight; at first appearing narrow, but afterwards gradually increasing in breadth, as the spot moves towards the middle of the disc. These appearances perfectly agree with the phases that are exhibited by an excavation in a spherical body, revolving on its axis, the bottom of the cavity being painted black, and the sides lightly shaded.

Dr. Herschel supposes that the spots in the sun are mountains on its surface, which considering the great attraction exerted by the sun upon bodies placed at its distance, and the slow revolution it has about its axis, he thinks may be more than 300 miles high. He says, that in August 1797, he examined the sun with several powers, from 90 to 500, and found all the black spots are the opaque ground or body of the sun, and that the luminous part is an atmosphere which being broken, gives a glimpse of the sun itself.

MADDER. See RUBIA.

MADNESS. See MEDICINE.

MADREPORA, in natural history, the name of a genus of submarine substances; the character of which is, that they are almost of a stony hardness, resembling the coral, and are usually divided into branches, and pervious by many holes or cavities, which are frequently of a stellar figure.

In the Linnéan system, this is a genus of Lithophyta: the animal that inhabits it is called Madrepora. It comprehends 30 species. According to Donati, the madrepora is like the coral as to its hardness, which is equal to bone or marble; its colour is white when polished; its surface is slightly wrinkled, and the wrinkles run longitudinally of the branches; in the centre there is a sort of cylinder, which is often pierced through its whole length by two or three holes. From this cylinder are detached about 17 lamina, which run to the circumference directly in straight lines; and are transversely intersected by other lamina, forming many irregular cavities; the cells, which are composed of these lamina, range into a circle, are the habitations of little polypes, which are extremely tender animals, generally transparent, and variegated with beautiful colours.

M. de Puysson, observes, that those writers who only considered the figures of submarine substances, denominated that class of them which seemed pierced with holes, pera, and those the holes of which were large they called madrepora. He defines them to be all those marine bodies which are of a stony substance; but which have but one apparent opening at each extremity, furnished with rays that proceed from the centre to the circumference. He observes that the body of these kind of the madrepora, whose flesh is so soft that it divides upon the gentlest touch, fills the centre; the head is placed in the middle, and surrounded by several feet or claws, which fill the extremity of the partitioned observatory of this substance, and are at pleasure brought to the head, and are furnished with yellow papillae.

He discovered that its head or centre was lifted up occasionally above the surface, and often contracted and dilated itself, like the pupil of the eye, so as to all its claws moved, as well as its head or centre. When the animals of the madrepora are destroyed, its extremities become white. In the madrepora, he says, the surface of the cavity, and the substance is of a stony but more loose texture than the coral. This is formed, like other substances of the same nature, of a liquor which the animal discharges: and he further says that the specific species of the polype of the madrepora which are produced singly, and others in clusters. See Plate Nat. Hist. tigs. 239 and 237; and ZOOPHYTAE.

MADREPORITE, a mineral found in the valley of Russbach in Salzburg, and which obtained its name from its resemblance to madrepora. Colour in some parts black, in others dark grey. Found in large rounded masses. Fracture even to the conchoidal. Lustre greasy, passing to the silky. Brittle: moderately heavy. streak grey; it is composed of 93.00 carbonate of lime. 0.30 carbonate of magnesia. 7.65 carbonate of iron. 0.50 charcoal. 4.50 silica in sand.

99.75.

MADR, in the military art, a long and broad plank of wood, used for supporting the earth in mining and carrying on a sap, and in making coffers, caponiers, galleys, and for many other uses at a siege. Madriers are also used to cover the mouths of petards after they are loaded, and are fixed with the petards to the gates or other places designed to be forced open.

MEMACTERION, the fourth month of the Athenian year, consisting of only 29 days, and answering to the latter part of September and the beginning of October.

MAGAZINE, a place in which stores are kept, or arms, ammunition, provisions, &c. Every fortified town ought to be furnished with a large magazine, which should contain stores of all things requisite to enable the garrison and inhabitants to hold out a long siege, and in which smiths, carpenters, wheelwrights, bakers, &c. may be employed in making every thing belonging to the artillery, as carriages, wagons, &c.

MAGAZINE, powder, is that place where the powder is kept in very large quantities.

Authors differ greatly both in regard to situation and construction; but all agree, that it ought to be arched, and bomb-proof. In fortifications they are frequently placed in the rampart; but of late they have been built in different parts of the town. The first powder-magazines were made with Gothic arches; but M. Vauban, finding them too weak, constructed them in a semicircular form, whose dimensions are 60 feet long, within 25 broad; the foundations are eight or nine feet thick, and eight feet high from the foundation to the spring of the arch; the door is two feet from the ground, which keeps it from dampness.

One of our engineers of great experience, some time since observed, that after the centres of semicircular arches are struck, they settle at the crown, and rise up at the

menhurcs, even with a straight horizontal extrados; and still much more so in powder-magazines, where the top is formed like the roof of a house, by two inclined planes joining in an angle over the top of the arch, to give a proper descent to the rain; which effects are exactly what might be expected according to the true theory of arches. Now, as this shrinking of the arches must be attended with very ill consequences, by breaking the texture of the cement after it has been in some degree dried, and also by opening the joints of the masonry on one end, a remedy is provided for this inconvenience, with regard to bridges, by the arch of equilibriation in Dr. Hutton’s book on bridges; but as the ill effect is much greater in powder-magazines, the same ingenious gentleman proposed to find an arch of equilibriation for them also, and to construct it when the span is 20 feet, the pitch or height 10 (which are the same dimensions as the semicircle), the inclined exterior walls at top forming an angle of 113 degrees, and the height of their angular point above the top of the arch equal to seven feet.

MAG, or MAGIAN, an ancient religious sect in Persia, and other Eastern countries, who maintained, that there were two principles, the one the cause of all good, the other the cause of all evil; and abominating the erection of images, worshipped God only by fire, which they looked upon as the brightest and most glorious symbol of Ormades, or the good God: as darkness is the truest symbol of Ahriman, or the evil God. The sect still subsists in Persia, under the denomination of gauv.

MAGIC LANTERN. See OPTICS.

MAGIC SQUARE, in arithmetic, a square figure made up of numbers in arithmetic proportion, so disposed in parallel and equal ranks, that the sums of each row, taken either perpendicularly, horizontally, or diagonally, are equal: thus,

Natural square. Magic square.

1 7 3 1
2 5 9 2
3 1 7 3
4 5 9 4

5 4 3 5
6 1 9 6
7 9 1 7
8 2 3 8

Magic squares seem to have been so called, from their being used in the construction of talismans.

MAGNA CHARTA, the great charter of the liberties of England, and the basis of our laws and privileges.

This charter may be said to derive its origin from king Edward the Confessor, who granted several privileges to the church and state, by charter; these liberties and privileges were also granted and confirmed by king Henry I., by a celebrated great charter the abridgment of which was confirmed or reenacted by king Henry II. and king John. Henry III., the successor of this last prince, after having caused twelve men to make enquiry into the liberties of England in the reign of his predecessor, granted a new charter, which was the same as the present Magna Charta; this he several times confirmed, and as often broke; till in the thirty-seventh year of his reign, he went to Westminster-hall and there in presence of the clergy and bishops, who held lighted candles in their hands, Magna Charta was read, the king all
the while holding his hand to his breast, and at last solemnly swearing faithfully and
invocably to observe all the things therein contained, &c.; then the bishops extinguishing
the candles, and throwing them on the ground, cried out, "Thus let him be extin-
guished," and Thadd, who violates this charter." It is observed, that notwithstanding
the solemnity of this confirmation, king Henry, the very next year, again invaded
the rights of his people, till the barons entered into a war against him; but, after
various success, he confirmed this charter, and the charter of the forest, in the fifty-
second year of his reign. This excellent charter, of equitable and beneficial to the
subject, is as follows, viz.: by the 25 Edw. I. it is ordered, that it shall be taken as the common law;
and by the 41 Edw. III. all statutes made
against the liberties are declared void.

MAGNESIA. About the beginning of the eighteenth century, a Roman cannon was
exposed a white powder to sale at Rome as a cure for all diseases. This powder he
bought and kept; and by the manner of preparing it a profound secret; but in 1703
Valenții informed the public that it might be obtained by calcining the lithiwm which
remains after the preparation of nitre; and two years after, sticking in his discovery that
might be precipitated by potass from the mother-
llei of niter. This powder was generally
supposed to be fine, till Frederic Hoff-
man observed that it formed very different combinations with water. But little was
known concerning its nature, and it was even confounded with lime by most chemists, till
Dr. Black made his celebrated experi-
ments on it in 1773. Margarett published a disserta-
tion on it in the Philosophical Transactions, in
the 1773, in which he collected the observations of these two philosophers, and which he en-
riched also with many additions of his own. Bothi and Bergman published a valu-
able dissertation on it in 1773.

As magnesia has never yet been found native in a state of purity, it may be pre-
pared in the following manner: sulphat of magnesia is heated in a clay crucible, stained
the sulphuric acid, exists in sea-water, and in
many springs, particularly in some about Epsom; from which circumstance it was
formerly called Epsom salt. This salt is to be
dissolved in water, and half its weight of potas-
s oxide added. The magnesia is immediately
precipitated, because potass has a stronger
affinity for sulphuric acid. It is then to be
washed with a sufficient quantity of water
and dried.

Magnesia thus obtained is a very soft white powder, which has very little taste, and is
totally destitute of smell. Its specific gravity is about 2.3. It converts delicate vegetable
bodies (paper for instance, stained the petals of the mallow) to green.

It is not melted by the strongest heat to which it has been possible to apply; but M. Darct
observed that, in a high temperature, it becomes somewhat agglutinated. When
formed into a cake with water, and then exposed to a violent heat, the water is gradually
driven off, and the magnesia contracts in its dimension; at the same time, it acquires
the property of shining in the dark when rubbed upon a hot iron plate.

It is almost insoluble in water; for, ac-
cording to Mr. Kirwan, it requires 7900
times its weight of water at the temperature
of 60° to dissolve it. It is capable, however,
of combining with water in a solid state; for 100 parts of magnesia, thrown into water,
and then dried, are increased in weight to 111.5 parts. Even when combined with car-
bonic acid (for which it has a strong affinity) it is capable of absorbing and retaining 15
times its own weight of water without letting
it go a drop; but on exposure to the air, this
water evaporates, though more slowly than it would from lime.

Magnesia has never yet been obtained in a crystallized form.

When exposed to the air, it attracts carbo-
ic acid gas and water; but exceedingly
slowly. Buttin left a quantity of it for two
years in a porcelain cup mettely covered with
paper; its weight was only increased 1.47
part.

Magnesia does not combine with oxygen; nor is it altered by any of the compounds
into which oxygen enters. The only one of the simple combustibles with which it can
be united is sulphur. No person has hitherto
succeeded in forming a phosphuret of mag-
nesia. The sulphuret of magnesia may be
formed by exposing a mixture of two parts of magnesia and one part of sulphur, to a
light at a distance. The result is a yellow
powder, slightly agglutinated, which unites very little sulphuret hydrogen gas,
when thrown into water. A moderate heat
is sufficient to drive off the sulphur.

Magnesia does not combine with azote, but forms a yellow oxide. It also forms a
compound called muriat of magnesia. It has no action upon the meals; nor does it
combine, as far as is known at present, with the metallic oxides, unless some intermediate
substance is present. It does not combine with the fixed alkalis, neither are its proper-
ties altered by these bodies; but it has a strong propensity to enter into triple com-
positions with ammoniac.

It is capable of forming to little affinity between magnesia and barytes; at least no mixture
of the two earths is fusible in the strongest heat which it has been possible to apply.

Mr. Kirwan has shewn that there is but little affinity between strong magnesia and water.
They do not melt when exposed to a strong
heat, at least when the stroniant exceeds
or equals the magnesia.

Equal parts of lime and magnesia, mixed
together, and exposed by Lavassier to a
very violent heat, did not melt; neither did
they melt when Mr. Kirwan placed them in
the temperature of 130° Wedgewood.

The affinities of magnesia, according
to Borken, are as follows:

<table>
<thead>
<tr>
<th>Acid</th>
<th>Magnesia</th>
</tr>
</thead>
<tbody>
<tr>
<td>Oxalic acid</td>
<td>Tartaric</td>
</tr>
<tr>
<td>Phosphoric</td>
<td>Citric</td>
</tr>
<tr>
<td>Sulphuric</td>
<td>Lactic</td>
</tr>
<tr>
<td>Phoric</td>
<td>Benzoic</td>
</tr>
<tr>
<td>Arsonic</td>
<td>Acetic</td>
</tr>
<tr>
<td>Saccatic</td>
<td>Boracic</td>
</tr>
<tr>
<td>Succinic</td>
<td>Sulphurous</td>
</tr>
<tr>
<td>Nitric</td>
<td>Carbenic</td>
</tr>
<tr>
<td>Muriatic</td>
<td>Prussic</td>
</tr>
</tbody>
</table>

Magnesia is used in medicine, to remove
heavy affections.

MAGNETISM. The nature i magnet, or
loadstone, is a hard mineral body of a dark
brown, or almost black colour, and when
examined, is found to be an ore of iron. It is
met with in various countries, generally
in iron mines, and of all sizes and forms.

This singular substance was known to the
antients; and they had remarked its peculiar
property of attracting iron, though not appear
that they were acquainted with the wonderful property which it also has, of
returning to the pole when suspended, and left
at liberty to move freely.

Upon this remarkable circumstance the
mariners' compass depends, an instrument
which gives us such innumerate advantages over
the antients. It is this which enables the
mariners to conduct their vessels through
vast oceans out of the sight of land, in any
given direction; and this directive property
also guides the miners in their subterranean
excavations, and the traveller through de-
serts otherwise impassable.

It is not precisely known when and by
whom this directive property of the magnet
was discovered. The ancients and nearly all the accounts seem to prove, that it was
known early in the 13th century; and that the
person who first made mariner's compasses, at
least in Europe, was a Neapolitan of the
name of Friar, or John de Gugio, or Giusa,
or Giusa.

The natural loadstone has also the qua-
lity of communicating its properties to iron
and steel, when and on which it is placed and touched, as it is called, by the
loadstone, they are denominated artificial
magnets.

These artificial magnets are even capable of
being made more perfect than the na-
tural ones; and as they can be made of any
form, and are more convenient, they are
now universally used, so that the loadstone
or natural magnet is only kept as a curiosity.

All magnets, whether natural or artificial,
are distinguished from other bodies by the
following characteristics, which appear to be
inseparable from their nature; so that no
body can be called a magnet, unless it is
possessed of all these properties:

1. A magnet attracts iron.
2. When a magnet is placed so as to be
at liberty to move freely in every direction,
it's end points towards the poles of the earth,
which is generally, by very much more powerful than the
other.
3. When the north pole of one magnet
is presented to the south of another magnet,
these ends attract each other; but if the
south pole of one magnet is presented to the
north pole of another, or the south pole of
one to the north pole of another, these ends
will repel each other.

From these criteria, it is easy to determine
the names of the poles of a magnetic bar,
by applying it near a suspended magnet whose
poles are known.

4. When a magnet is situated so as to be
at liberty to move itself with sufficient free-
dom, its two poles do not lie in a horizontal
direction, but it generally inclines one of
them towards the horizon, and of course it
elevates the other pole above it. This is
Magnetism.

When a piece of iron is brought within a certain distance of a magnet, it becomes attracted, in fact, itself, having the polarity, the attractive and repulsive properties for other iron, &c.; that part of it which is nearest to the south pole of the magnet, becoming a north pole, and the opposite part a south pole, or vice versa, according to the end of the magnet presented. Thus if A B, Plate Magnetism, fig. 1, be an oblong piece of iron, and be brought near the north pole N of the magnet N S, then this piece of iron will be drawn towards the magnet while standing in the same position, will have all the properties of a real magnet, and its end A will be found to be a south pole, while the end B is a north pole.

Soft iron, when placed within the influence of a magnet, easily acquires these properties; but they last only while the iron remains in that situation, and when it is removed its magnetism vanishes immediately. But with iron containing carbon, and particularly with steel, the contrary holds, as the iron or the steel is, the more permanent is the magnetism which it acquires from the influence of a magnet; but it will be in the same proportion more difficult to render it magnetic, and therefore more easily to destroy it.

If a piece of soft iron, and a piece of hard steel, both of the same shape and size, are brought within the influence of a magnet at the same distance, it will be found that the soft iron is attracted more powerfully, and appears more powerfully magnetic, than the steel; but if the magnet is removed, the soft iron will instantly lose its acquired properties, whereas the hard steel will preserve them for a long time, having become an artificial magnet.

Neither the magnetic attraction nor repulsion is in the least diminished, or at all affected, by the interposition of any sort of bodies, except iron, or such bodies as contain iron.

The properties of the magnet are not affected either by the presence or by the absence of air. Heat weakens the power of a magnet, but the power of the heat, is not quite to its former degree. A white heat destroys it entirely, or very nearly so; and hence it appears, that the powers of magnets must be varying continually. C. Cavalli observed, that heat, either red or white heat, is not attracted by the magnet; but the attraction commences as soon as the redness begins to appear.

The attractive power of a magnet may be considerably improved by suspending a weight of iron to it by its power of attraction, which may be gradually increased; and also by keeping it in a proper situation, viz. with its north pole towards the north, and its south pole towards the south, and always keeping it in this situation. On the contrary, this power is diminished by an improper situation, and by keeping too small a piece of iron, or no iron at all, appended to it.

In these northern parts of the world, the north pole of a magnet has more power than its south pole; whereas, the contrary effect has been said to take place in the southern parts.

Amongst the natural magnets, the smallest generally possess a greater attractive power in proportion to their size than those of a larger size. It frequently happens, that a natural magnet, cut off from a larger lodestone, will be able to lift a greater weight of iron than the original lodestone itself.

As both magnetic poles together attract a much greater weight than a single pole; and as the two poles of a magnet generally are in opposite parts of its surface, in which case it is almost impossible to adapt the same piece of iron to both poles at the same time; therefore it has been commonly practised to adapt two broad pieces of soft iron to the poles of the stone, and to let them project on one side of the stone; for those pieces having the same poles be applied to and, and to the piece of iron or weight may be easily adapted. Those two pieces of iron are generally fastened upon the stone by means of a brass or silver box. The number is fixed, as it is said, by an art, and the two pieces of iron are called the armature.

Fig. 1 represents an armed magnet, where A B is the lodestone; C D, C D', are the armature, or the two pieces of soft iron, to the position of which, a D D', the iron weight F is applied. The dots E C D C D' represent the brass box, with a ring at E, by which the armed magnet may be suspended.

Artificial magnets, when straight, are sometimes armed in the same manner; but they are frequently made in the shape of a horse-shoe, having their poles at the truncated extremities, as at N and S, fig. 3, in which case it is evident that they want no armature.

Most probably the magnet attracts iron only; but when it is considered how universally iron is dispersed throughout nature, it is evident that a vast number of bodies must on that account be attracted by the magnet more or less forcibly, in proportion to the quantity and quality of the iron they contain; it is evidently to be observed, what a small portion of iron will render a body subject to the influence of the magnet.

The polarity of the magnet. — Every magnet has a south and a north pole, which are opposite to one another; one is called the north, and the other, the south; and we say that a magnet is polarised, when a north and a south pole are produced in it. The North is always directed towards the north, the South to the south, and can never be reversed; and it is the property of the magnet that renders it so useful to navigators. When a magnet is kept suspended freely, so that it may turn freely, a north and south pole, by looking at the position of it, can steer his course in any required direction. Thus, if a vessel steered towards a certain place which lies exactly westward of that from which it set out, the navigator must direct it to, that its course may be always at right angles with the direction of the magnetic needle of his compass, keeping the north end of the magnet on the right-hand side, and of course, the south end on the left-hand side of the vessel; for as the needle points north and south,
and the direction is east and west, the intended course of the vessel is exactly perpendicular to the direction of the needle. A little reflection will show how the vessel may be steered in any other direction.

An artificial magnet fitted up in a proper box, for the purpose of guiding the direction of a traveller, is called a magnetic needle, and the whole together is called the mariner's compass.

Although the north pole of the magnet in every part of the world, when suspended, points towards the poles of the earth, the south pole of the earth is not the north pole of the magnet, but the north pole of the magnet is the south pole of the earth. The angle in which it deviates from due north and south, is called the angle of declination, or the declination of the magnetic needle, or the variation of the compass; and this declination is said to be east or west, according as the north pole of the needle is eastward or westward of the extremities of the magnetic needle.

This deviation from the meridian is not the same in all parts of the world, but is different in different places, and it is even continually varying in the same place. For instance, it is not the same in London as at Paris, or as in India; and the declination in London, or in any other place, is not the same at this time as it was some years ago. This declination from the meridian is so various, that it may be said to change, even in one or two hours time: and this is not owing to the construction of the magnetic needle; for in the same place, and at the same time, all true magnetic needles point north and south in the same way.

The declination from the meridian, and the variation of this in different parts of the world, are very uncertain, and cannot be foretold; and this is the only method of ascertaining them. This circumstance forms a great impediment to the improvement of navigation. It is true, that great pains have been taken by navigators and other observers, to ascertain the declination in various parts of the world, and such declinations have been marked in maps, charts, books, &c.; but still, on account of the constant change to which this variation is liable, these can only serve to confirm the law of this variation or fluctuation being yet not determined, though various hypotheses have been formed for that purpose. When the variation was first observed, the north pole of the magnetic needle declined eastward of the meridian of London; but it has since that time been changing continually towards the west; so that in the year 1657 the magnetic needle pointed due north and south. At present, it declines and is towards the south, and it seems to be still advancing towards the west.

Before volcanic eruptions and earthquakes, the magnetic needle is often subject to very extraordinary perturbations. It is also agitated before and after the appearance of the aurora borealis.

The magnetic inclination, or dip of the needle.—If a needle which is accurately balanced, and suspended so as to turn freely in a vertical plane, in a horizontal plane, the north pole will be depressed, and the south pole elevated above the horizon: this property is called the inclination, or dip of the needle, and was discovered by Robert Norman, about the year 1739.

Take a globular magnet, or, which is more easily procured, an oblong one, like 8 N, fig. 4; the extremity N of which is the north pole, or the dipole of the magnet, and A its middle or equator; place it horizontally upon a table C D; then take another small oblong magnet u s (viz. a bit of steel wire, or a small sawing-needle magnetized), and suspend it by means of a fine thread tied to its middle, so as to remain in an horizontal position, when not disturbed by the vicinity of iron, or other magnet. Now if the same small magnet, being held by the upper part suspended at a distance from the middle of the large magnet, will be found to be inclined in the same manner to its middle, so as to remain in an horizontal position, without being disturbed by the vicinity of iron, or other magnet. Now if the same small magnet, being held by the upper part suspended at a distance from the middle of the large magnet, will be found to be inclined in the same manner to its middle, so as to remain in an horizontal position, without being disturbed by the vicinity of iron, or other magnet.

If the geographical poles of the earth (that is, the ends of its axis), coincided with its magnetic poles; or even if the magnetic poles were constantly at the same distance from them; the inclination of the needle, as well as its declination, would always be the same; and hence, by observing the direction of the magnetic needle in any particular place, the latitude and longitude of that place might be ascertained; but this is not the case, for the magnetic poles of the earth do not coincide with its real poles, and they are also constantly shifting their situation; hence the magnetic needle changes continually, not only in its horizontal direction, but likewise in its inclination, according as it is removed from one place to another, and also while it remains in the very same place.

This change of the dip in the same place, however, is very small. In London, about 1576, the north pole of the dipping needle stood 7° 50′ below the horizon; and in 1753, it stood at 7° 3′; the whole change of inclination, during so many years, amounted to less than a quarter of a degree.

There are various methods of giving the magnetic property to steel or iron. In some cases, it appears to be acquired without the use of any magnets.

If you take a bar of iron three or four feet long, and hold it in a vertical position, you will find that the bar is magnetic, and will act upon another magnet; the lower extremity of the bar attracting the south pole, and repelling the north pole. If you invert the bar, the polarity will be instantly reversed; the extremity which is now lower, will be found to be a north pole, and the other extremity will be a south pole. A bar of hard iron, or steel, will not answer for the above experiment, the magnetism of the earth not being sufficient to magnetic it.

Bars of iron that have stood in a perpendicular position, are generally found to be magnetic; as fire-irons, bars of windows, &c.

If a long piece of hard iron is made red-hot, and then left to cool in the direction of the magnetic line, it becomes magnetic.

Striking an iron bar with a hammer, or rubbing it with a file, while held in this direction, likewise renders it magnetic. And electric shock produces the same effect; and lightning often renders iron magnetic.

A magnet cannot communicate a degree of magnetism stronger than that which itself possesses; but two or more magnets, joined together, may communicate a greater power to a piece of steel, than either of them possesses singly: hence we have a method of constructing very powerful magnets, by first constructing, during magnetic needles, and then joining them together to form a compound magnet, and to act more powerfully upon a piece of steel.

1. Place two magnetic bars, A, B, fig. 5, in a line with the north, or marked end of one, opposed to the south, or unmarked end of the other; but at such a distance from each other, that the magnet to be touched may rest with its marked end on the unmarked end of the other.
end of A, and its unmarked end on the marked end of B; then apply the north end of the magnet E, and the south end of D, to the middle of the bar C, which is intended to be raised as in the figure: draw E and D asunder along the bar C, one towards A, the other towards B, preserving the same elevation; remove E and D a foot or two from the bar C, and raise it off the ends, then bring the north and south poles of these magnets together, and apply them again to the middle of the bar C as before; repeat the same process five or six times, then turn the bar, and apply the opposite surfaces in the same manner, and afterwards the two remaining surfaces; by this means the bar will acquire a strong fixed magnetism.

2. Place the two bars which are to be touched to each other; and unite the ends by two pieces of soft iron, called supporters, in order to preserve, during the operation, the circulation of the magnetic matter: the bars are to be placed so that the marked ends (fig. 6), may be opposite the unmarked end B; then place the two attracting poles G and I on the middle of one of the bars to be touched, raising the ends, so that the bars may form an angle of two or three degrees; the ends G and I of the bars are to be separated two or three tenths of an inch from each other. Keeping the bars in this position, move them slowly over the bar A B, iron to end to the other, going end to end, and about fifteen times. Having done this, the poles of the bars (i.e. the marked end of one is always to be against the unmarked end of the other), are removed by the operation on the bar CD, and then on the opposite faces of the bars. The touch thus communicated may be further increased, by rubbing the different faces of the bars with sets of magnetic bars, displayed as in fig. 7.

In these operations all the pieces should be well polished, the sides and ends made quite flat, and the angles quite square. A magnet bent so that the two ends almost meet forms a horseshoe magnet, fig. 3.

To render it magnetic, place a pair of magnetic bars against the ends of the horse-shoe, with the south end of the bar against that of the horse-shoe, and the north end towards the north end of the bar to which is to be the south; the contact or lifter of soft iron, to be placed at the other end of the bars. Also rub the surfaces of the horse-shoe with a pair of bars placed in the form of a compass, or with another horseshoe magnet, turning the poles properly to the poles of the horse-shoe magnet; being careful that these bars never touch the ends of the straight bars. If the bars are separated suddenly from the horse-shoe magnet, its force will be considerably diminished; to prevent this, slip on the lifter, or support, to the end of the horse-shoe magnet, but touching the sides; otherwise, that it may not touch the bars; the bars may then be taken away, and the support slid to its place.

Magnetism is best communicated to compass needles by the following method: Prepare a pair of magnetic bars, not less than six inches in length. Fasten the needle down on a board, and with a magnet in each hand draw them from the centre upon the needle outwards; then raise the bars to a considerable distance from the needle, and bring them perpendicularly down upon the centre, and draw them over again. This operation repeated five or six times will magnetize the needle, and its ends will point to the poles contrary to those that touched them.

Over one end of a combined horse-shoe magnet, of at least two in number, and six inches in length, draw from its centre that half of the needle which is to have the contrary pole to the end of the magnet; raise the needle to a considerable distance, and draw it over the surface of the end about twenty times at least, and the same for the other half, will sufficiently communicate the power.

A set of bars are exceedingly useful for magnetizing other bars, or needles of compasses, &c. their power may also be increased when lost or impaired by mismanagement, &c. A set of such bars, viz. six bars and the two iron conductors, may be put in a box, taking care to place the north pole of one contiguous to the south pole of the next, and that contiguous to the north pole of the third, &c. as shewn in fig. 8. After which, if we need not describe how a knife, or any piece of steel, &c. may be rendered magnetic, or in what manner a weak magnet may be rendered more powerful. But it may perhaps be necessary to say something concerning the communication of magnetism to crooked bars like A B C, fig. 9.

Place the crooked bar flat upon a table, and to its extremities apply the magnetic bars curving after the magnetism, with the conductor or piece of soft iron F G; then to its middle apply the magnetic bars placed at an angle: or you may use two bars only, placed as shewn in fig. 9, and stroke the crooked bar with them from end to end, following the direction of that bent bar; so that on one side of it the magnetic bars may stand in the direction of the dotted representation I K. In this manner, when the steel A B C has been rubbed a sufficient number of times on one side, it must be turned with the other side upwards; &c.

In communicating magnetism, it is best to use weak magnets, and more that are stronger afterwards; but you must be very careful not to use weak after strong magnets. A magnet loses nothing of its own power by communicating to other substances, but is rather improved.

Every kind of violent percussion weakens the power of a magnet. A strong magnet has been entirely deprived of its virtue, by receiving several smart strokes of a hammer; but whatever damages or distorts the internal pares of a magnet will injure its magnetic force.

Fill a small dry glass tube with iron filings, press them in rather close, and then touch the tube as iron may be made into a bar, and the tube will attract a light needle; shake the tube, so that the situation of the filings may be disturbed, and the magnetic virtue will vanish. Magnets should never be handled with their north or south poles together; for when they are thus placed, they diminish and destroy each other's power. Magnetic bars should therefore be always left with the opposite poles laid against each other, or by connecting their opposite poles by a bar of iron. The power of a magnet is increased by letting a piece of iron remain attached to one or both of its poles, A, since magnetism should therefore be applied to both.

The difference of steel in receiving magnetism is very great, as is easily proved by touching in the same manner, and with the same number of strokes, two pieces of similar size, but of different kinds. With some sorts of steel, a few strokes are sufficient to impart to them all the power they are capable of receiving; other sorts require a longer operation; sometimes the magnet again; this renders them more than a small degree of magnetism.

A piece of spring-tempered steel will not retain as much magnetism as hard steel; soft steel, if hot, but those which are used for observing the daily variation, are made a little longer, and their extremities point the variation upon an arch or circle properly divided and allayed to the box.

The best shape of a magnetic needle is represented in figs. 10 and 11; the first of which shews the upper side, and the second shews a lateral view of the needle, which is of steel, having a pretty large hole in the middle, to which a conical piece of an iron or steel, adapted by means of a brass piece O, into which the agate-cap (as it is called) is fastened. Then the apex of this hollow cap rests upon the point of a pin P, which is fixed in the centre of the box, and upon which the needle, being properly balanced, turns very nimbly. For common purposes, these needles have a conical perforation made in the steel itself, or in a piece of brass which is fastened to the middle of the needle.

A mariner's compass, or compass generally used on board of ships, is represented in fig. 12. The box, which contains the card or compass, needle, is circular in form, and either of wood, or brass, or copper. It is suspended within a square wooden box, by means of two concentric circles, called gimbalbs, so fixed by cross axes a n, n, to the two boxes (see the plan, fig. 13), that the inner one, or compass-box, shall retain a horizontal position in all motions of the ship, whilst the outer or square box is fixed with respect to the ship. The compass box is covered with a pane of glass, in order that the motion of the card may not be disturbed by the wind. What is called the
MAG

MAG

MAG

in the magnetic line. The degrees of inclination are shown upon a divided circle, in the centre of which the needle is suspended. Fig. 10 represents a dipping-needle of the simplest construction. A B is the needle, the axis of which F E is secured upon the middle of two lateral bars C D, C D, which are made fast to the frame that contains the divided circle A B K. This machine is fixed on a stand G; but, when used at sea, it is suspended by a ring H, so as to hang perpendicularly. When the instrument is furnished with a stand, a spirit-level G is generally annexed to it, and the stand has three screws, by which the instrument is situated so that the centre of motion of the needle, and the division of 90° on the lower part of the divided circle, may be exactly in the same line, perpendicular to the horizon. See L M N.

The first experiments which follow, are principally intended to illustrate the theory.

Ex. 1. The method of discovering whether a body is attractable by the magnet or not, and whether it has any polarity or not, or which is its south, and which its north pole, is so easily performed by a few words; for by approaching an object to the body in question (which, if necessary, may be set to swim upon water), or by presenting the body in question to either extremity of a suspended magnetic needle, the desired object may be obtained.

Ex. 2. Tie two pieces of soft iron wire, A B, A B, fig. 17 and 18, each to a separate thread, A C, A C, which join at top, and forming them into a loop, suspend them so as to hang perpendicularly in the marked end D fig. 19, which is the north pole of a magnetic bar just under them, and the wires will immediately repel each other, as shown in fig. 19; and this divergency will increase to a certain limit, according as the magnet is brought nearer, and vice versa. The reason of this phenomenon is, that by the action of the north magnetic pole D, both the extremities B, B, of the wires, acquire the same direction, which causes the wires to repel each other; and the extremities, A, A, acquire the north polarity, in consequence of which they also repel each other.

If instead of the north pole D, you present the south pole of the magnetic bar, the repulsion will take place as before; but now the extremities B, B, acquire the north, and the extremities A, A, acquire the south polarity.

On removing the magnet, the wires, if of soft iron, will soon collapse, having lost all their magnetic power; but if steel wires, or common sewing-needles be used, they will continue to repel each other after the removal of the magnet; the magnetic power being retained by steel.

Ex. 3. Lay a sheet of paper flat upon a table, strew some iron filings upon it, place a small magnet among them; then give a few gentle shocks to the table, so as to shake the filings, and observe that they dispose themselves about the magnet N S, as shown in fig. 20; the particles of iron clunging to one another, and forming themselves into lines, which at the very poles N S, are in the same direction, and in the middle area of the magnet; a little sideways of the poles they begin to bend, and then they form complete arches, reaching from some point in the northern half of the magnet, to some other point in the southern half.

Ex. 4. Place a magnetic bar A B, fig. 21, and that one of its poles may project a short way beyond the table, and weigh it down, or lay weights upon it to make its weight C to it; then take another magnetic bar, D E, like the former, and bring it parallel to, and just over the other, at a little distance, and with the contrary poles towards each other; in consequence of which the attraction of B will be diminished, and the iron C, if sufficiently heavy, will drop off, the magnet A B being then only able to support a smaller piece of iron. By bringing the magnets still nearer to each other, the attraction of B will be diminished still farther; and, when the two magnets come quite into contact (provided they are equal in power), the attraction between B and C will vanish entirely.

MAGNETIC TE, whatever be the number of parts locally extended, or that has several dimensions; as a line, surface, solid, etc. The apparent magnitude of a body is that which is measured by the visual angle, formed by rays drawn from its extremities to the eye; so that whatever things are seen under the same or equal angles, appear equal, and vice versa.

MAGNOLIA, a genus of the polygynous order, belonging to the polyandrous class of plants; and in the natural method ranking under the 22d order, coniferae. The calyx is triplicate; there are nine petals; the capsules bilabed and imbricated; the seeds pendulous, and in the form of a berry.

There are seven species: the principal are,

1. The glaucus, or small magnolia, a native of Virginia, Carolina, and other parts of North America; it most places it rises from seven or eight to fifteen or sixteen feet high, with a slender stem. The wood is white and spongy, the flowers are produced at the extremities of the branches, are white, composed of six compound petals, and have an agreeable scent. 2. The grandiflora, or great magnolia, is a native of Florida and South Carolina. It rises, to the height of eighty feet or more, with a straight trunk upwards of two feet diameter, leaving a regular head. The leaves resemble those of the laurel, but are larger, and continue green throughout the year. The flowers are produced at the ends of the branches, and are of a purple-white colour. 3. The tripetala, or umbrella tree, is a native of Carolina; it rises, with a slender trunk, to the height of sixteen or twenty feet; the wood is soft and spongy; the leaves remarkably large, and composed of circular circles, somewhat resembling an umbrella, whence the inhabitants of those countries have given it this name. The flowers are composed of ten or twelve white petals, that hang down without any order. The leaves drop off at the beginning of winter. 4. The acuminate, with oval, spear-shaped, pointed leaves, is a native of the inland parts of North America. The leaves are near eight inches long, and five broad, ending in a point. The flowers come out early in the spring, and are composed of twelve white.
The seeds are sown in the spring and the plants are harvested in the fall. The crystals formed are then harvested and dried in the sun. The dried crystals are then ground into a fine powder, which is ready for use in gardens and parks.

Malachite is a green copper carbonate mineral that is often used in gardens as a natural fertilizer. It is a popular choice for gardeners because it is easy to grow and is safe for plants. It is also known for its unique crystal formation, which makes it a popular choice for collectors.

The active ingredient in malachite is copper carbonate, which is a natural source of copper. Copper is an essential nutrient for plants, as it is necessary for the production of chlorophyll, which is essential for photosynthesis.

Method of Preparation

1. Choose a spot in your garden where you want to use the malachite. This could be a garden bed, a flowerbed, or a rock garden.

2. Ensure that the soil in the area is well-drained and enriched with organic matter. This will help the malachite to break down and release its nutrients more effectively.

3. Mix the malachite powder with water to create a slurry. This will help to distribute the nutrient across the soil.

4. Apply the slurry to the soil, making sure to cover the entire area you want to fertilize.

5. Water the area after applying the slurry to help the nutrients to be absorbed by the plants.

6. Repeat this process every few weeks to ensure that the plants receive a consistent supply of nutrients.

Benefits of Malachite Fertilizer

- Malachite is a natural source of copper, which is essential for plant growth.
- It helps to improve soil structure and fertility.
- It is safe for use around plants and flowers.
- It is a good choice for gardeners who prefer to use organic fertilizers.

Potential Side Effects

- Malachite can be toxic to some plants, so it is important to use it with caution.
- It may also be harmful to pets and children if left in an accessible area.

Conclusion

Malachite is a popular choice for gardeners looking for a natural fertilizer. It is easy to grow and is safe for plants. With its unique crystal formation, it is also a popular choice for collectors. However, it is important to use it with caution and to follow the appropriate safety guidelines to ensure that it is used effectively and safely.
This acid bears a strong resemblance to the citric, but differs from it in the following particulars: 1. The citric acid shoots into fine crystals, but this acid does not crystallize. 2. The salt formed by the citric acid with lime is almost insoluble in boiling water; whereas the salt made with mallee acid and the same basis is readily soluble by boiling water. 3. Malic acid precipitates mercury, lead, and silver, from the nitrous base, and by a dissolu-
tion of gold when diluted with water; whereas citric acid does not alter any of these solutions. 4. Malic acid seems to have a less affinity than citric acid for lime; for when a solution of lime in the form of a boiler, with a salt formed from volatil'e alkali and citric acid, a decomposition takes place, and the latter acid combines with the lime, and is precipitated.

MALABLE, a property of metals, whereby they are capable of being extended under the hammer.

MALOE, a genus of the class and order monadophila polyanthia. The calyx is double, outer three-leaved; arils glomerate, one-seeded. There are two species, herbs of Tuscany, Italy.

MALPIGHIUS, Barbadhes cherry, a genus of the trigonia order, in the decandala class of plants, and in the natural method ranking under the fam. Trigoniaceae, the calyx is pentalophous, with deltiform pores on the outside at the base. There are five petals, roundish and unguculated; the berry unilocular and spermospermous. There are 18 species, all of them shrubbery of the warm and hot regions of America, rising with branchy stems from 8 to 10 feet high, ornamented with oval and lanceolate entire leaves, and large pentalophous flowers, succeeded by red, cherry-shaped, edible berries, with an acid and palatable flavour; and which in the West Indies, where they grow naturally, are used instead of cherries. Three of the species are reared in our gardens, and form a nice variety in the stove. They retain their foliage throughout the year; and begin to flower about the end of autumn, continuing in constant succession till the spring; after which they frequently produce and ripen their fruit, which commonly equals the size of a cherry. The flowers are of a pale-red or purple colour.

MALT, barley prepared, to fit it for making a potable liquor called beer, or ale, by stopping it short at the beginning of vegetation.

In making malt from barley, the usual method is to steep the grain in a sufficient quantity of water, for two or three days, till it swells, becomes plump, somewhat tender, and tinges the water of a brownish, or reddish-brown. Then this water being drain-
ed away, the barley is removed being drained away, the barley is removed and left to steep in cold water, from 7 to 10 feet; the temperature of the water being kept at the boiling point, the malt tea spontaneously heats, and begins to grow, shooting out first the radicle; and if continued, continues, then the palum, spire, or blade. But the proper stoppage short at the eruption of the radicle, otherwise the barley would be spoiled. In order to stop it, they spread the wet cloth thus over a large floor, and keep turning it once in four or five hours, for the space of two days, laying it somewhat thickly each time. After this, it is again thrown into a large heap, and there suffered to grow sensibly hot to the hand, as it would usually in 24 hours; then, being spread again, and cooled, it is thrown upon the kiln, to be dried crisp without scorching.

MALVA, kni-ghts of, otherwise called hospitale of St. John of Jerusalem, a religious and military residence is in the island of Malta. The order consists of three estates, the knights, chaplains, and ser-

vants at arms; there are also priests of the churches, friars-servants who as-

sist at the offices, and donnes or demiceross; but these are not reckoned constituent parts of the body: the government of the order is mixt, being partly monarchical, and partly aristocratic; the grand master is sovereign.

The knights forming this order consisted of eight different languages, but between the English having withdrawn themselves. None are admitted into this order but such as are of noble birth: the knights are of two sorts, the one, who are not fit to be candidates for the dignity of grand master, and grand-crosses, and those who are only knights as-

sistants; they never marry. The 'knights are received into this order, either by under-

taking the oaths prescribed by statutes, or by dispensation.

MALTHA, in antiquity, a kind of ce-

ment of which there were two sorts, native and factitious; one of the latter sort, much in use, consisted of pitch, wax, plaster, and gum. Another kind used by the Romans in their aqueducts, was made of lime slaked in wine, incorporated with melted pitch, and fresh fire. Natural maltha is a kind of bitu-

men, with which the Atlantics plaster their walls; and which being once set on fire, makes it burn more fiercely. See Bitumen.

MALVA, the mallow, a genus of the po-

yanthia order, in the monadophila class of plants, and in the natural method ranking under the 37th order, columnare. The calyx is double; the exterior one triphylous; the aril truncate, or oblong, with spermospermous. There are 34 species, consisting of herbaceous perennial, biennials, and annuals, for medical, economical, and ornamental uses. The leaves of the common mallow are reckoned the first of the four essential herbs; they were formerly in some esteem as food; at present decompositions of them are sometimes employed in dysenteries, heat, and sharpness of urine, and in general for obtaining acrimonious humours; their prin-
cipal use is in collicit glutyns, cataplasmata, and fonamentata. The leaves enter the official decocction for glutyns, and a conserve prepared from them. Several pieces of malva, macerated like herb, afford a thread superior to hemp for spinning, and which is said to make more beautiful cloths and stuff than even flax. These species are in Europe, and are called Atriplex; from the former, which affords stronger and longer fibres, cords and twine have also been made. From the native likewise a new sort of paper has been fabricated by M. de l'Ise.

MANATEE, in anatomy, the breasts of a female.

MAMMALIA, in natural history, the first class of animals in the Linnaean system, divided into seven orders. See Mammalia.

MAMMILLARY, See Anatomy.

MANATI, in zoology. See Trichekus.

MANCA, was a square piece of gold coin, commonly valued at 30 pence; and mancusa was as much as a bank of silver, having the name from muncu cussa, being coined with the hand (Leg. Cannt.). But the manca and mancusa were not always of that value; for sometimes the former was valued at six shil-

lings, and the latter at two.

MANDAMUS, is a writ issuing in the king's name out of the court of king's bench, and directed to any person, corporation, or inferior court of judicature commanding to some particular thing thereto specified, as appointing to their office and duty.

A writ of mandamus is a high prerogative writ of, on a most extensive remedial nature, and may be issued to a judge within their own jurisdiction, and to compel them to execute their jurisdiction, whether such jurisdiction arises from a mod-

ern charter, subsists by custom, or it is created by act of parliament, yet being in sub-

sidium, has of late been exercised in a variety of instances.

Mandamus was also a writ that lay after the year and a day (where, in the meantime, the writ called the donum extremum had not been sent out) to the escheator, commanding him to enquire of what lands held by

knight-service the tenant died seized, &c.

MANIPUS, was also a writ to charge the

sheriff to take into the king's hands all the lands and tenements of the king's widow, who, against her oath formerly given, mar-

ries without the king's consent. See Reg. 592.

MANNA, a genus of the class and order tetractria monogynia. The calyx is eight-leaved; corolla four-clit; capsule inferior, two-valved, one-celled; seeds imbric-

ate, unilocular. There are three species, apart of the West Indies.

MANGANESE. 1. The dark-grey or brown mineral called manganese has been long known and used in the manufacture of glass. A mine of it was discovered in England by Mr. Boyle. A few experiments were made upon this mineral by Glauber in 1659,
and by Waitz in 1785; but chemists in general seem to have paid but very little attention to it. The greater number of mineralogists, though much puzzled what to make of it, agreed in placing it among iron ores: but Pott, who published the first chemical examination of this mineral in 1740, has succeeded in that it contains scarcely any iron, Cronstedt, in his System of Mineralogy, which appeared in 1782, assigned it a place of its own, on the supposition that it consisted chiefly of a peculiar earth. Linnan examined it anew in 1763; and in the year 1768, which appears in the Viennese set of oxide experiments, in order to prove that a peculiar metal might be extracted from it. The same idea had struck Bergman about the same time, and induced him to request of Scheele, in 1771, to procure a sample of manganese. Scheele's dissertation on it, which appeared in 1774, is a masterpiece of analysis, and contains some of the most important discoveries of modern chemistry. Bergman himself published a dissertation on it the same year; in which he demonstrates that the mineral, then called manganese, is a metallic oxide. He accordingly made several attempts to reduce it, but without success; the whole mass either forming the form of scoria, or yielding only small separate globules attracted by the magnet. This difficulty of fusion led him to suspect that the metal was in quest of a strong analogy to platinum or gold, and at that time Dr. Gallus, who was making experiments on the same mineral, actually succeeded in reducing it by the following process: he fused a crucible with charcoal-powder well moistened with water, put into it some of the mineral formed into a ball by means of oil, then filled up the crucible with charcoal-powder, heated another crucible over it, and exposed the whole for about an hour to a very high heat. At the bottom of the crucible was found a metallic button, or rather a number of small metallic globules, equal in weight to one-third of the mineral employed. It is easy to see by what means this reduction was accomplished: the charcoal-powder separated the oxygen from the oxide, and the metal remained behind. The metal obtained, which is called manganese, was farther examined by Ihleman in 1782, Hielm in 1785, and Bind-bergen in 1788 and 1789.

Manganese, when pure, is of a greenish-white colour, and has a good deal of brilliancy. Its texture is granular. It has neither taste nor smell. Its hardness is equal to that of iron. Its specific gravity is 7.000. It is very brittle; of course it can neither be hammered, nor drawn out into wire. Its tenacity is unknown. It requires, according to Morvey, the temperature of 160° Wedgewood, and by Pott, 177°; so that, platinum excepted, it is the most infusible of all the metals. When reduced to powder it is attracted by the magnet, owing probably to a small portion of iron from which it can with difficulty be parted.

II. Manganese, when exposed to the air, attracts oxygen more rapidly than any other body, phosphorus excepted. It loses its lustre almost instantly, becomes grey, violet, brown, and at last black. These changes take place still more rapidly if the metal is heated in an open vessel.

This metal seems capable of combining with three different proportions of oxygen, and of forming three different oxides, the white, the red, and the black.

The protoxide or white oxide may be obtained by dissolving the black oxide of manganese in nitric acid by adding a little sugar. The sugar attracts oxygen from the black oxide, and converts it into the white, which is dissolved by the acid. Into the solution pour a quantity of potash; the protoxide precipitates in the form of a white powder. It is composed, according to Bergman, of 80 parts of manganese and 20 of oxygen. When exposed to the air it soon attracts oxygen, and is converted into the black oxide.

The deutoxide or red oxide may be obtained by dissolving the black oxide in sulphuric acid, without the addition of any combustible substance. When black oxide of manganese is dissolved in sulphuric acid, is heated in a retort, a great quantity of oxygen gas comes over, while the oxide, thus deprived of part of its oxygen, dissolves in the acid. Distil to dryness, and pour water over it, and filter. A red-coloured solution is obtained, consisting of the sulphate of manganese dissolved in water. On the addition of an alkali a red substance precipitates, which is the red oxide of manganese. According to Bergman it is composed of 74 parts of manganese and 26 of oxygen. This oxide likewise attracts oxygen when exposed to the atmosphere, and is converted into the black oxide.

The peroxide of black oxide of manganese exists abundantly in nature; indeed it is almost always in this state that manganese is found. It has been observed that the apellation manganese itself was originally applied. It may be formed very soon by exposing the metal to the air. This oxide, according to Fourcroy, is composed of 60 parts of manganese and 40 of oxygen. When heated to redness in an earthen retort it gives out abundance of oxygen gas, which may be collected in proper vessels. By this operation it is reduced nearly to the state of red oxide, but it is exposed to the air, and more or less oxidised. Occasionally, it absorbs a new dose of oxygen; and thus the same process may again be repeated. No oxygen gas can be obtained from the white oxide; a proof that its oxygen is ten is retained. A larger affinity than any other body is by the addition of oxygen which constitutes the black oxide. Seguin has observed, that in some cases the black oxide of manganese emits, before it becomes red, a quantity of azotic gas. When long exposed to a strong heat it assumes a green colour. In that state it is whitened by sulphuric acid, but not dissolved. A very violent heat fuses this oxide, and converts it into a green-coloured glass.

III. Manganese does not combine with hydrogen. When dissolved in sulphuric acid a black spongy mass of carburet of iron is left behind. Hence it has been supposed capable of combining with carbon; but it is more probable that the carbon is combined with the iron, which is almost always present in manganese. It seems pretty clear, however, that carburet of iron is capable of combining with this metal, and that it always forms a part of steel.

Bergman did not succeed in his attempt to combine manganese with sulphur; but he formed a sulphureted oxide of manganese, by combining eight parts of the black oxide with three parts of sulphur. It is of a green colour, and gives out sulphureted hydrogen when acted on by a fluid. It cannot be doubted, however, that sulphur is capable of combining with manganese; for Frois has found native sulphur of manganese in that ore of tellurium which is known by the name of orde of Nagrope.

Phosphorus may be combined with manganese by melting together equal parts of the metal and of phosphoric glass; or by dropping phosphorus upon red-hot manganese. The phosphure of manganese is of a white colour, brittle, granulated, disposed to crystallize, not altered by exposure to the air, and more fusible than manganese. When heated the phosphorus burns, and the metal is oxidized.

IV. Manganese does not combine with either of the simple combustibles.

V. Manganese combines with many of the metals, and forms with them alloys which have been but very imperfectly examined.

It unites readily with copper. The compound, according to Bergman, is very malleable, its colour is red, and it sometimes becomes green by age. Grelin made a number of experiments to ascertain whether this alloy could be formed by fusing the black oxide of manganese along with copper. He partly succeeded, and proposed to substitute this alloy instead of the copper of arsenic, which is used in the arts.

It combines readily with iron; indeed it has scarcely ever been found quite free: from some mixture of that metal. Manganese gives iron a white colour, and renders it hard. It combines also with tin, but scarcely with zinc.

It does not combine with mercury nor with bismuth. Grelin found that manganese cannot be alloyed with bismuth without great difficulty; and that it unites to antimony very imperfectly. Chemists have not attempted to combine it with gold, platinum, silver, nickel, nor cobalt.

VI. The affinities of manganese, and of its white and red oxides, are, according to Bergman, as follows:

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<thead>
<tr>
<th>Manganese</th>
<th>Oxide of manganese</th>
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<tbody>
<tr>
<td>Copper</td>
<td>Oxalic acid</td>
</tr>
<tr>
<td>Zinc</td>
<td>Citric acid</td>
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<tr>
<td>Gold</td>
<td>Phosphoric acid</td>
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<tr>
<td>Silver</td>
<td>Tartaric acid</td>
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<tr>
<td>Tin</td>
<td>Fluoric acid</td>
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<td>Muriatic</td>
<td>Sulphric acid</td>
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<td>Nitric</td>
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<td>Tartaric acid</td>
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<tr>
<td>Lead</td>
<td>Acetic acid</td>
</tr>
<tr>
<td>Prussic</td>
<td>Carbonic acid</td>
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</tbody>
</table>

MANGIFERA, the mango-tree, a genus of the monegynia order, in the pentandria class of plants, and in the natural method ranking with those of which the order is doubtful. The corolla is pentapetalous; the plum kidney-shaped. There are three species, the principal of which is a native of many parts of the East Indies, whence it has been transplanted to Brazil, and other warm parts of America. It grows to a large size.
the wood is brittle; the bark tough when old; the leaves are seven or eight inches long, and more than two inches broad. The flowers are produced in loose panicles at the ends of the branches, and are succeeded by large oblong kidney-shaped plums. This fruit, which is a long and slender thorn; the stem is small; the thorn narrow; the whole body, except beneath, covered with broad, but sharp-pointed, scales, which are straited throughout their whole length: the tail is more than twice the length of the body, and tapers gradually to the tip. The legs are very short, scaled like the body, and on each of the feet are four claws, of which those on the fore feet are stronger than those of the hind. The colour of the whole animal is dark brown, with a cast of yel-

lowish, and with a glossy or polished surface.

The manis tetradactyla grows to the length of five feet, measuring from the tip of the nose to the extremity of the tail.

2. Manis, a genus of quadrupeds of the order of bony animals, with slaty, or greyish, or greyish-brown, or very dark brown, or black, or very dark yellow, or yellow, or a kind of yellowish brown, tongue cylindrical and extended; mouth narrowed into a snout; body covered with scales. The genus manis presents an appearance not less extraordinary than that of the genera or amamiola; being covered on every part, except on the belly, with extremely strong and large homy scales, constituting a suit of armour still more powerful than in the following genus, and capable of defending the animals, when rolled up, from the assaults of the most fierce enemies. This external covering, together with the uncommon length of the body and tail, gives an aspect so much resembling that of a lizard, that these creatures are commonly known by the title of scaly lizards: they may be allowed, however, in a general view of the animal kingdom, to form a kind of shade or link of approximation between the proper viviparous quadrupeds and the true lizards.

They are animals of a harmless nature, and feed in the same manner as the ant-eaters, by thrusting out their very long tongue into the nests of ants and other insects, and expelling their prey by suddenly retracting it, leaving no teeth, and differing from the

ant-eaters in scarcely any other circumstance than that of their scaly integument. They are found in India and the Indian islands.

1. Manis tetradactyla, long-tailed manis. This animal, known in India by the name of the platenigan, is of a long and slender body, and tapers gradually to the tip. The legs are very short, scaled like the body, and on each of the feet are four claws, of which those on the fore feet are stronger than those of the hind. The colour of the whole animal is dark brown, with a cast of yel-lowish, and with a glossy or polished surface.

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killed his antagonist, it was made manslaughter in both. Again: there were two men in a room quarrelling; a brother of one of them standing at the door, who could not get in, cried out to his brother to make him sure, and the brother killed his antagonist: it was likewise manslaughter in both.

But if any person shall stab another, not having his weapon drawn, or not struck his first, so that he dies within six months, although he be not in mortal aboriginal, it is felony, by the jurisdiction of the place.

This crime, though felony, is within benefit of clergy; and the offender shall be burnt in the hand, and forfeit all his goods and chattels; but by stat. 19 Geo. III. c. 74, it is made lawful for the court to commute this punishment for a moderate fine and imprison-ment.

MANTELETS, in the art of war, a kind of moveable parapets, made of planks about three inches thick, nailed one over another, to the height of almost six feet, generally carried on wheels upon little wheels, so that in a siege they may be driven before the pioneers, and serve as blinds to shelter them from the enemy's small shot.

MANTIS, a genus of insects of the order Hemiptera. The generic character is, head unstriated, armed with joints or spines; thorax setaceous; legs, in most species, composed, serrated beneath, and furnished with a single claw and a setaceous, lateral, jointed foot; hind legs smooth, formed for walking. This is one of the most singular genera in the whole class of insects; and imagination itself can hardly conceive shapes more strange than those ex-hibited by some particular species. See Pl. Nat. Hist. fig. 259.

The chief European kind is the mantis oratoria of Linnaus, or camel cricket, as it is often called. This insect, which is a stranger to the British isles, is found in most of the warmer parts of Europe, and is entirely of a beautiful green colour. It is nearly three inches in length, of a slender shape, and in its general sitting posture is observed to hold up the two fore legs, slightly bent, as if in an at-titude of prayer: for this reason the super-inction of the vulgar has conferred upon it the religious name of the hollow eye; and a popular notion has often prevailed, that a child or traveller having lost his way would be safely directed by observing the quarter to which the animal pointed when taken into the hand. In its real disposition it is very far from sanctity, preying with great rapacity on any of the smaller insects which fall in its way, and for which it lies in wait with anxious avidity in the posture at first mentioned, seizing them with a sudden spring when within its reach, and devouring them. It is also of a very venomous nature; and when kept with others of its own species in a state of capiti-ality, will attack its neighbour with the utmost violence, till one or the other is destroyed in the contest.

Among the Chinese this quarrelsome property in the genus mantis is turned into a similar entertainment with that afforded by fighting cocks and quails.

The mantis praecia is a native of many parts of Africa, and is the supposed idol of the Hottentots, which those superstitious people are reported to hold in the highest veneration, the person on whom the adored insect happens to light being considered as favoured by the distinction of a celestial visitant, and regarded ever after in the light of a saint. This species is of the same general size and shape with the M. oratoria, and is of a beautiful green colour, with the thorax ciliated or spined on each side, and the upper wings each marked in the middle by a semitransparent spot, resembling the notch by which is the extremity of the circle; and that the lines drawn to measure the latitude, which are parallel to each other, or nearly so, must, in order to preserve as nearly as possible the proportions of the points of intersection with the meridians, form segments of circles, of which no two are parallel or concentric.

There may be as many different projections as there are points of view in which a globe can be seen, but geographers have generally chosen those which represent the poles at the top and bottom of the map; these, from the delineation of the lines of latitude, longitude, are called the stereographic, orthographic, and globular projections.

We do not propose to detain the reader with a description of all the projections, some of which are so numerous (for the purpose of correctly representing maps) as to be consigned entirely to oblivion. But as the projection of maps is a pleasing and instructive exercise, and indeed indispensable necessary to the right understanding of geo-graphy to students, we shall describe the manner of constructing the map of the world.

With regard to the stereographic projection it may be observed, that among the various positions assignable to the eye, there are three, which, in a position plane, give the eye the plane is placed either in the points D, fig. 1, or removed to an infinite distance; and hence this projection is liable to the great errors of distorting the form of the countries represented upon it much more than is necessary.

The only advantage is, that of the lines of latitude and longitude intersect each other at right angles.

The being observed by that excellent astronomer, Mr. de la Hire, he invented a re-modify for the inconvenience, by assigning to the eye a position at the point O, fig. 1, the distance of which from the globe is D equal to the radius of the globe, and hence the right line GO, which bisects the qua-adrant EC, also bisects the radius EC, and produces the similar triangles OFG, and ODE; and thus the other parts of the quad-rant DC, and in the manner of the whole semicircle ACE, are represented in the projection nearly proportionable to each other, and to sense perfectly so. The delineation of the earth and sea upon this projection (which, as coming to a true repre-sentation of the globe, is called the globular projection), is equal to the stereographic in point of facility, and vastly superior to it in point of truth.

Geometrical construction of the globular projection.—From the centre C, fig. 2, with any radius, as CB, describe a circle; draw the diameters AB, and BD, 90, at perfect right angles to another, and divide them into equal parts, and divide each of the equal parts into nine equal parts, each of which contains degrees; if the scale admits of it, every one of these divisions may be sub-divided into degrees; next, to draw the meridians, suppose the meridian 80° W. of Greenwich, we have given the two poles 90, and makes one of the meridians be supposed equal in length to the half of the periphery (which is not quite two-thirds), it follows of course, that the countries delineated upon, or near, these lines, must be reduced to somewhat less than two-thirds of the length of the actual extent, which lie at the extremity of the circle; and that the lines drawn to measure the latitude, which are parallel to each other, or nearly so, must, in order to preserve as nearly as possible the proportions of the points of intersection with the meridians, form segments of circles, of which no two are parallel or concentric.
for the arc
80° 80° 80° 80° the radius \( r = \) 18.44
70° 70° 70° 70° = 36.88
60° A 60° A 60° A 60° = \( A \). Arctan = 48.16
50° 50° 50° 50° \( \theta = \) 65.3
40° 40° 40° 40° = 87.11
30° 30° 30° 30° = 108.13
20° 20° 20° 20° = 128.60
10° 10° 10° 10° = 148.32

(2) The Stereographic Projection of the Sphere on the Plane of a Meridian.

Draw a circle NESW, fig. 4, and the two diameters of it at right angles with each other.

Divide the arc of each quadrant into nine equal parts.

From the point P, draw dotted lines to each point of division on the arc WN.

The intersections made by this means on the meridian CN, mark the line of semantigons, which must also be set off on the other three semidiameters, CS, CW and CE.

Draw likewise two dotted lines from E to 23° 1° and 66° 32° for the tropic and polar arcs, which must also be set off on the semidiameter CS.

Each point of intersection on GN, and the corresponding points on the arcs WN and EN, are the three points through which the arcs of latitude must pass; and their centres will be in the line NS produced.

Take the radius of the same circle for a scale; divide it into nine equal parts, and each of those parts into ten other parts, as before.

The following table exhibits the length in those parts of the radius, which must be taken to describe each respective arc.

For the arc
80° 80° 80° 80° the radius \( r = \) 15.77
70° 70° 70° 70° = 31.54
60° A 66° A 66° A 66° = \( A \). Arctan = 39.18
50° 50° 50° 50° \( \theta = \) 51.96
40° 40° 40° 40° = 63.52
30° 30° 30° 30° = 75.12
20° 20° 20° 20° = 86.13
10° 10° 10° 10° = 96.85

The two polar points N, s, and the semitangent on CE, mark the three given points through which each meridian line must pass, and the following table gives the length of each radius to describe the meridian arc.

For the arc N,S, the radius \( s = \) 91.4
S.N. = 95.78
N.S. = 104
S.N. = 117.5
N.S. = 140
S.N. = 157.5
N.S. = 160
S.N. = 175.5
N.S. = 190
S.N. = 200
N.S. = 215.5

(3) The Globular Projection of the Sphere on the Plane of the Equator.

On the centre P, fig. 5, draw the circle WNE, to represent the equator.

Draw the two diameters, WE and NS, at right angles to each other.

Divide the arcs of the four quadrants into nine equal parts; each of the parts will be equal to ten degrees.

Number them from N towards P, 10, 20, 30, 40, 50, &c.

On the centre P draw circles passing through those points of division, which will be the circles of latitude.

For the arc, set off 283° from P towards N; do the same at N towards P, for the other arc.

Through each of those points draw an oblique circle.

Draw diameters from the divisions on one half of the circumference to the corresponding divisions on the opposite one, to represent the meridians, and this will complete the projection.

(4) The Stereographic Projection of the Sphere on the Plane of the Equator.

Draw the circle NW, S, E, fig. 6, and the two diameters at right angles with each other.

Divide the arcs of each of the four quadrants into nine equal parts; subdivide each of those parts into ten degrees; number those degrees 10, 20, 30, &c.

Divide the latitudes from the divisions on one side of the circumference to the corresponding divisions on the other, which will represent the meridians.

For the parallels of latitude, project a line of semitangents as directed in the 3d case.

On the centre P describe circles passing through the semitangents, which will complete the diagram.

Note. The foregoing methods of projecting the sphere are the best. There is another method sometimes used, viz. the projection on the plane of the horizon when any assumed place is considered as the centre; but as this method is rarely used, it need not be elucidated.

The orthographic projection is in fact so erroneous, that it is never adopted for that purpose, and applied only to dialing.

The gnomonical projection is only applicable to dialing.

We shall now point out the advantage and disadvantage of Mercator's projection.

A method has been found to obviate some of the difficulties attending all the circular projections by one, which, from the person who first used it (though not the inventor), is called Mercator's projection. In this there are some but right lines; all the meridians are equidistant, and continue so through the whole extent; but, on the other hand, in order to obtain the true bearing, so that the compass may be applied to the map or chart for the purpose of navigation, the spaces between the parallels of latitudes (which in truth are equal, or nearly so) are made to increase as they recede from the equator in a proportion which, in the high latitudes, becomes prodigiously great.

The great advantages peculiar to this projection are, that it always retains its true bearing with respect to all other places; the distances may be measured with the greatest exactness by proper scales, and all the lines drawn upon it are right lines; for these reasons it is much adopted in drawing maps or charts for the use of navigators.

We shall now show the method of this kind of projection.

Mercator's or Wrigh's projection of maps.—Draw the line AB, fig. 7, and divide it into as many degrees as your map is to contain in longitude, suppose 90°. At the extremities A and B raise perpendiculars, to which draw parallel lines at every single, fifth, tenth, or twentieth degree of the equator, for the meridians; as in the figure, where they are drawn at every tenth degree. This done, put one foot of the compasses in the point A, and extending the other to the point in the first meridian at B; or, for greater exactness, to some more distant point, as B 90°, etc., describe the quadrant F, which divide into nine equal parts, and drawn lines from A to each point of the division; or, to avoid scoring the paper, the scribe can cut the first meridian GH, at every tenth degree's distance. Lastly, because the distances of the parallels from one another are marked.
To use this table, divide the assumed degree into sixty parts by a diagonal line, fig. 9; look for the number of miles answering to the degree of lat. 49, which is 39, 36, say 39°, which take off the scale, fig. 9, at a, and set off four times from C towards B, and the same from C towards A. The top meridian is 50° of lat. opposite which, in the table, is 33, 53, say 33°, which take from the scale, fig. 9, at b, and set off four times from D towards E, and the same from D towards F. Draw the meridians to the corresponding divisions at top and bottom, of which 0 is the meridian of London. Second. When the meridians and parallels are correctly marked, proceed to project a map of Europe by this method:

[Diagrams and text discussing the projection process, with references to the use of the table and the projection method, including the use of meridians and parallels to represent geographical features and distances.]
Marble, polishing of, is performed by first rubbing it well with a freestone, or sand, till the strokes of the axe are worn off, then with pumice-stone, and afterwards with emery.

Marbling, in general, the painting anything with veins and clouds, as to represent those of marble. Marbling of books or paper is performed thus: Dissolve four ounces of gum-arabic into two quarts of fair water; then provide several colours mixed with water in pots or shells, and with pencils peculiar to each colour, sprinkle them by way of mixture upon the gum-water, which must be put into a trough, or some broad vessel; then with a stick curl them, or draw them out in long lines, and let them dry in the air. Having done this, hold your book or books close together, and only dip the edges in, on the top of the water and colours, very lightly; which done, take them off, and the plain impression of the colours will remain above upon the leaves; and as well the ends as the front of the book in the like manner. Marbling books on the covers is performed by forming clouds with aquafortis, or spirit of nitre, fringed with ink, and afterwards glazing the covers.

Marcgravia, a genus of the polyandra monogyne class of plants, the corolla whose of consists of a single petal, of a conico-oval figure; and its fruit is a glbose berry, with a single cell, containing a great number of very small seeds. There is one species, a shrub of the West Indies.

Marcianita, a genus of thecryptogama class of plants, the corolla of which is monopetalous, tubular, and shorter than the cup; in the lower cavity of which are contained several naked seeds, of a roundish but compressed figure. There are seven species, five of them British.

Marcionites, Christians in the second century, thus denounced from their leader Marcion, who maintained that there were two principles or gods, a good and a bad one.

Marcosians, a sect of Christians in the second century, so called from their leader Marcus, who represented the Supreme God as consisting of two natures, but a quaternity, viz. the indigible, silence, the father, and truth.

Mare. See Eaurus.

Margaritiera, a genus of the dicra octandra class and order. The male calyx is four-toothed; corolla four-petalled; female calyx and corolla as above; styles four or five. There is one species, a native of Surinam.

Marica, a genus of the trignia monogyne class and order. The calyx is six-parted; stigma petal-form, trident; capsule three-celled; inferior. There is one species, a fleshy bulb of China.

Marilla, a genus of the class and order polyandra monogyne. The calyx is five-leafed; corolla five-petalled; capsule four-valved, many-seeded; stigma simple. There is one species, a native of the West Indies.

Mark, knights of St., an order of knighthood in the republic of Venice, under the last of the doges. The insignia of the order are, gules, a lion winged or, with this device, "Pax tibi Marce evangelista." This order is never conferred but on those who have done signal service to the commonwealth.

Mark, or Mar, also denotes a weight used in several states of Europe, and for several commodities, especially gold and silver. In France, the mark is divided into 8 oz. or 64 drachms, or pennyweights, or 160 esterlines, or 300 marks, or 635 lbs., or 4608 grains. In Holland the mark weight is also called troy-weight, and is equal to that of France. When gold and silver are sold by the mark, it is divided into 24 carats, or parts. Mark is also used among us for a money of account, and in other countries for a coin. The English mark is two-thirds of a pound sterling, or 13s. 4d. and the Scotch mark is of equal value in Scotch money of account. In the 17th century, to mark goods, or label them, which was usual in Amsterdam, is also a money of account, equal to one-third of the rix-dollar, or to the French livre: each mark is divided into 16 solds-lubs. Mark-lubs is also a Danish coin equal to 10 solds-lubs. Mark is also a copper and silver coin in Sweden.

Market. A market is less than a fair, and is commonly held once or twice a week. According to lrancon, one market ought to be held in the midst of the town, and a half and a third of it; but no market is to be kept within seven miles of the city of London; but all butchers, victualers, &c. may hire stalls and standings in the fleshmarkets there, and sell meat and other provisions, four days in a week. Every person who has a market is entitled to receive toll for the things sold in it; and, by antient custom, for things standing in the market, though they are sold: but impeding a market in any other manner than it is granted, or exporting of tolls or fees where none are due, they may be forfeited.

In London every shop in which goods are exposed for sale is covered over, excepting such things only as the owner or proprietors trade in: though the sale is in a warehouse, and not publicly in the shop, the property is not altered. But if goods are stolen from one, and sold out of the market over, the property is not altered, and the owner may take them wherever he finds them. 5 Rep. 83.

If a man buy his own goods in a market, the contract shall not bind him, unless the property had been previously altered by a former sale.

Marle. A mixture of carbonat of lime and clay, in which the carbonat considerably exceeds the other ingredient, is called marle. Its structure is earthy. Opaque, sometimes in powder. Specific gravity from 1.6 to 2.877. Colour usually grey, often tinged with other colours. Effervesces with acids. Some marles crumble easily to a powder when wet; others retain their hardness for many years. Marles may be divided into two varieties: 1. Those which contain more silica than alumina. 2. Those which contain more alumina than silica.

Marlow has called the first of these siliceous, the second argillaceous marle. Attention should be paid to this distinction when marles are used as a manure.

Marle, bituminous, is found in different parts of Germany. Colour greyish or brownish. Used for paving. It is also used to make stepping-stones, pavers, flat or waved. Opaque. Feels soft. Easily broken. Moderately heavy. Effervesces with acids. Burns before the blowpipe, leaving black scorish.

Marly, or marly, are tared white skins, or long widths or lines of untwisted hemp, dipped in pitch or tar, with which cables and other ropes are wrapped round, to prevent their fretting and rubbing in the blocks or pulleys through which they pass. The same serves in artillery upon ropes used for rigging guns, usually put up in small parcels called skins.

Marmotte. See Mus.

Marquise. See Letters of Marquise.

Marquetry, or Inlaid work, is a curious work composed of several fine hard pieces of wood, of various colours, fastened in thin slices on a ground, and sometimes enriched with other matters, as silver, brass, tortoiseshell, &c.; and by these means the art is now capable of imitating any thing; whence it is by some called the art of painting in wood.

The ground upon which the pieces are to be arranged, and the glue is usually of well-dried oak or deal; and is composed of several pieces glued together, to prevent its warping. The wood to be used in marquetry is reduced into leaves of the thickness of a line, or the 12th part of an inch, and is either of its natural colour, or stained, or made black to form the shades by other methods: this some perform by putting it in sand heated very hot over the fire; others by steeping it in lime-water and sublimates; and others in oil of sulphur. The wood being of the proper colours, the contours of the pieces are formed according to the parts of the design they are to represent: this is the most difficult part of marquetry, and that which requires the most patience and attention.

The two chief instruments used in this work are a saw and a wooden vice, which has one of its claps fixed, and the other movable, which is opened in a line by a foot, by means of a cord fastened to a treacle.

Marquis, a title of honour, next in dignity to that of duke, first given to those who commanded the marches, that is, the borders and frontiers of countries.

Marqueses were not known in England till the reign of king Richard II. and the year 1387.

Marriage, a contract, both civil and religious, between a man and a woman.

Taking marriage in the light of a civil contract, the law treats it as it does all other contracts: allowing it to be good and valid in all cases where the parties, at the time of making it, were, in the first place, willing to contract; secondly, able to contract; and, lastly, actually did contract in the proper forms and solemnities required by law. 1 Black. 433.

By several statutes a penalty of 100£ is inflicted for marrying any persons without banns or licence. But by 25 G. II. c. 33, if any person shall solemnize matrimony without banns or licence obtained from some persons having authority to grant the same, or in any other place than a church or chapel where
MARROW. See Anatomy.

MARRUBIUM, white horhound, a genus of the gynopetria order, is highly esteemed for its medicinal properties, and in the natural method ranking under the 43rd order, verticillatae. The calyx is salver-shaped, rigid, and ten-striated; the upper lip of the corolla bifid, linear, and straight. There are 16 species, 3 of which is the vulgar, a native of Britain, growing naturally in waste places, and by ways-sides near towns and villages, but not common. It has a strong and somewhat musky small, and bitter taste. It is reputed antimonial and resolvent; an infusion of the leaves in water, sweetened with honey, is recommended in asthma and phthisical complaints, and most other diseases of the breast and lungs.

MARS, in astronomy, one of the superior planets, is round the sun in an orbit between those of the earth and Jupiter. See Astronomy.

MARSHAL, in its primary signification, means an officer who has the command or care of horses; but it is now applied to officers who have very different employments, as Earl-marshals, knight-marshals, or marshal of the King's house.

Marshall of the king's bench, an officer who has the custody of the king's bench pleas in Southwark. This officer is obliged to give his attendance, and to take into his custody all persons committed by that court.

Marshall of the exchequer, an officer to whom that court commits the king's debtors.

MARSHALLEA, a genus of the class and order syngeasia polygium aquilus, little known.

Marshall, a coat, in heraldry, is the disposal of several coats of arms belonging to distinct families, in the same escutcheon or shield, together with their ornaments, bats, and appurtenances.

MARSHALSEA-court, a court of record, originally instituted to hear and determine cases between the servants of the King's household and others within the verge of the court, and of a value of trespass, where either party is of the King's family; and of all other actions personal, wherein the parties are the King's servants; but the court has also power to try all personal actions, as debt, trespass, slander, trover, action on the case, &c., between party and party, the liberty whereof extends 12 miles east and west of Whitehall. The judges of this court are the steward of the King's household, and high-marshall for the time being; the steward of the court, or his deputy, is generally an eminent counsel.

If the cause of importance is brought into this court, it is generally removed into the court of the King's bench or common pleas by a habeas corpus cum causa.

MARSILEA, a genus of the cryptogamia class of plants, without any corolla or cup in the flowers, and placed among an oblong conic body; the fruit is of a roundish figure, consisting of four cells, in each of which are contained several roundish seeds. There are three species.
The master is also answerable for any injury arising by the fault or neglect of his servant when executing his master's business, 6 T. R. 659: but if there is no neglect or default in the servant the master is not liable. Esp. Rep. 533.

If a smith's servant lanes a horse whilst shoeing him, or the servant of a surgeon makes a wound worse, in both cases an action for damages will be against the master, and not against the servant. But the damage must be done while the servant is actually employed in his master's service, otherwise he is liable to answer for his own misbehavior or negligence.

A master is likewise chargable if his servant casts any dirt, &c. out of the house into the common street; and so for any other nuisance occasioned by his servants, to the damage or annoyance of any individual, or the common nuisance of his master's property. Lord Raym. 764.

A servant is not answerable to his master for any loss which may happen without his wilful neglect; but if he is guilty of fraud or gross negligence, an action will lie against him by his master.

A master is not liable in trespass for the wilful act of his servant; as by driving his master's carriage against another, done without the direction or consent of his master, no person being in the carriage when the act was done. But he is liable to answer for any damage arising to another from the negligence or unskilfulness of his servant acting in his employment. M'Kinnon v. Crickitt, Mich. 41 G. III.

MASTER OF ARTS, is the first degree taken up in foreign universities, and for the most part in those of Scotland, but the second in Oxford and Cambridge; candidates being admitted to it till they have studied seven years in the university.

MASTER IN CHANCERY. The masters in chancery are assistants to the lord chancellor and master of the rolls; of these there are some ordinary, and others extraordinary: the masters in ordinary are 12 in number, some of whom sit in court every day during the term, and have referred to them interlocutory orders for stating accounts, and computing damages and theike; and they also administer oaths, take affidavits, and acknowledgments of deeds and recognizances. The masters-extraordinary are appointed to act in the country, in the several counties of England, beyond 10 miles distant from London; by taking affidavits, recognizances, acknowledgments of deeds, &c. for the case of the suits of the court.

MASTER OF THE FACULTIES, an officer under the archbishop of Canterbury, who grants licences and dispensations.

MASTER OF THE HORSE, a great officer of the crown, who orders all matters relating to the king's stables, races, bred of horses, and commands the equerries and all the other officers and tradesmen employed in the king's stables. His coaches, horses, and attendants, are the king's, and bear the king's arms and livery.

MASTER OF THE ORDNANCE, a great officer, who has the chief command of the king's ordinance and artillery.

MASTER OF THE ROLLS, is an assistant to the lord chancellor of England in the high court of chancery; and in his absence hears causes there, and gives orders. His salary is 1,200 l. a year.

MASTER OF A SHIP, the same with a captain in a merchantman; but in a king's ship he is an officer who inspects the provisions and stores, and acquaints the captain with what is not good, takes particular care of the discipline of the ship and crew, and gives directions for stowing the hold; he navigates the ship under the directions of his superior officer; sees that the log and log-book are duly kept; observes the appearance of coasts; and navigate down his journal any new shoals or rocks under water, with their bearing and depth of water, &c.

MASTER AT ARMS, in a king's ship, an officer who daily, or by turns, as the captain appoints, is to exercise the petty officers and ship's company, to place and relieve sentinels, to secure the port, to put out according to the captain's orders; to take care that the small arms are kept in good order, and to observe the directions of the lieutenant at arms.

MASH, in field fortification: it sometimes happens that a ditch or fosse must be dug in an exposed situation; in this case it will be absolutely necessary for the artificers and workmen to get under cover by means of masking themselves in such a manner as to answer the double purpose of excluding their immediate object, and of deceiving the enemy with respect to the real spot they occupy.

To effect the latter purpose several masks must be hastily thrown up, whilst the men are employed behind one; by which means the enemy will either mistake the point, or be induced to pour his fire in several directions, and thus weaken its effect.

A mask is generally six feet high. Bases made of wad or wood are too expensive on these occasions; nor are gables, stuffed with fascines, seven or eight feet high, to be preferred; for if the fascines are tied together they will leave spaces between them in the gables; and if they are not bound together, they will be so open at top as to admit shot, &c.

In order to obviate these inconveniences the following method has been proposed: Place two chandeliers, each seven feet high and two broad, between the uprights, after which fill up the vacant spaces with fascines of the same height, upon which the fascines may rest. One box and a half of epaulment will require two chandeliers and 60 fascines to mask it.

The engineer, or artillery officer, places himself behind this mask, and draws his plan.

As you must necessarily have earth, &c. to complete your work, these articles may be brought in shovels, sacks, or baskets; and if the quarter whence you draw them should be exposed to the enemy's fire, cover that place, as well as the line of communication, between the trenches, or the parallels, with a mask.

MASTOIDES. See Anatomy.

MATCH, a kind of rope slightly twisted, and prepared to retain fire for the uses of artillery, mines, fireworks, &c. It is made of hemp, tarp, spun on a wheel like cord, but very slack; and is composed of three twists, which are afterwards again covered with tow, so that the twists do not appear: lastly, it is boiled in the leaves of old vines. This, when once ignited, the end being gradually and regularly, without ever going out, till the whole is consumed: the hardest and driest match is generally the best.

MATCH, quick, used in artillery, is made of three cotton strands drawn into lengths, and put into a bottle just filled with nitre or saltpetre, white vinegar, and then a quantity of salted petroleum and mealed powder is put into it, and boiled till well mixed. Others put only saltpetre into water, and after that take it out hot, and lay it into a trough with some powdered treacle, moistened with some spirits of wine, thoroughly wrought into the cotton by rolling it backwards and forwards with the hands; and when this is done they are taken out separately, drawn through mealed powder, and dried upon a line.

MATERIA MEDICA. "The materia medica (says Dr. Darwin) includes all those substances which may contribute to the restoration of health." If, however, medicine be defined the art of preventing, as well as of curing, diseases, the science of which we are now to treat ought, by consequence, to comprehend the preservatives of living existence, as well as the restoratives of healthy action. Instead, therefore, of restricting this article to the mere preservative and discussion of drugs, we shall, in the first place, introduce some general remarks on those substances which are employed as articles of diet or food. PART I.

DIETETICS.

Organic life appears to be influenced and supported by two leading principles: 1st, fibrous excitation; and 2dly, the substitution of nutrimonious particles, in place of those which are constantly dissipated or abraded. The power by which this last object is effected has been demonstinated by the author of Zoonomia, animal appettency. The principal and prime organs by which it is exercised, or the media through which new matter is originally communicated, are those which are termed the digestive and assimilating: it has, however, recently been conjectured that the organs of digestion are not the sole organs of nutrition, but that both the external surface of the body, and likewise the lungs, are media for the admission into the system of procures which we include in the class nutritia, in the materia medica of the author just quoted, to comprehend not merely those substances which are received...
into the stomach as food. But also the matter which is taken into the lungs in the act of respiration, as likewise air, water, and other substances that may be applied naturally or artificially to the outer skin. To enquire into the grounds upon which this doctrine is established, that there are lungs, the stomata, and the surface of the body, each affords instruments in common of actual nutrition, does not fall within the province of the present article. See Physiology. It will be proper here to confine ourselves to the general consideration of what is usually denominated animal and vegetable diet.

OF ANIMAL FOOD.

That man is designed by nature for a mixture of animal and vegetable food, is obvious from the structure of his organs, both of mastication and digestion. That the flesh of animals contains more nutritive matter, and that it stimulates the absorbent and secreting vessels more powerfully, than vegetable aliment, is demonstrated by the superior warmth and strength which in a state of health we experience after a meal of flesh than of vegetables; of the former (animal flesh), that, in general, which is of a dark-colour, contains more nutritive matter, and stimulates our vessels with more energy, than the white kinds: indeed the flesh of those animals which are carnivorous, or which live entirely on animal food, seldom enters into the diet of European, or civilized nations. The greater stimulating virtue of this kind of food has been attributed to the greater quantity which it has been supposed to contain of volatile alkali. Dr. Darwin, however, properly questions whether it is not rather the elements only of this principle that are contained even in the strongest dark-coloured animal flesh.

Next in strength to the flesh of carnivorous animals ought to rank that of those animals when killed at full growth, the young of which afford a softer, whiter, more digestible, but less nutritious, food, such as the sheep, the bullock, the hog, and likewise several of the flesh-fish, as lox, eel, herring, mackerel, murrel, lamping, ought to be arranged in this second class. These, with a due mixture of vegetable aliment, constitute the best kinds of food for healthy and athletic individuals, whose digestion is powerful, and who have a firm fibre.

The flesh of young animals, as of lamb, veal, and sucking pigs, afford a less stimulating and nutritious, but more digestible food; these meats are consequently most congenial to persons of less muscular energy, who have more feeble powers of digestion, and who accustom themselves to but little exercise: they are adapted to the hypochoondriac, and should be principally used as aliment by individuals who are disposed to those kind of affections which have received the vulgar indiscriminate appellation of scorbutic.

A still milder, but, in the same proportion, less fortunate food, furnished by the lungs, partridge, pheasant, and their eggs, with oysters and young lobsters. These, from their bland and unacrimonious nature, are generally allowed to convalesce from acute diseases: they are peculiarly suitable to very weak stomachs, and are used in cases in which the creation is more easily digested by the adult stomach, on account of its containing less of the caseous, or cheesy part; it is likewise on this account more nutritious. Butter contains still more nutrition, and is likewise, if not taken to excess, exceedingly easy of digestion, and is by no means calculated to generate unpleasant humours in the body. If given without any separation of its principles by artificial preparation, it might be admitted into the diet of infancy with much greater propriety than other articles which are employed with less apprehension of injury. Buttermilk is agreeable, bland, and gently nutritious. Why is the mouth and the digestive powers of an infant less powerful, than in the adult? It is on this account ordered with the utmost propriety to those invalids whose constitutions have been rendered too irritable to bear the stimulus of more solid and nutritive aliment. Cheese is of various kinds: some, chiefly principal from the greater or less quantity of cream that it contains. Those cheeses which are broken to pieces in the mouth with most readiness are, for the most part, most easy of digestion, and most nutritious. Moreover, all kinds of cheeses are a considerable time in undergoing chemical change in the stomach; and on this account, although difficult of digestion, do not disagree with weak stomachs. Dr. Darwin observes that he has seen toasted cheese vomited a whole day after it was eaten, without having become perceptibly altered, or given any uneasiness to the patient.

Next, cow's milk is the food of infants, and is by far the best substitute for the milk of the mother, if this last be not afforded in sufficient quantity or quality by the parent, which, however, is seldom the case. The milk of an adult cow, goat, or sheep, is usually curdled when kept in the air, which is always curdled before it is assimilated, is consequently digested with more facility in the earlier than in the more advanced periods of life. It is on this account likewise that certain vegetable substances, which have a great tendency to acidity, are exceedingly injurious to the infantile stomach. See the article Infancy.

OF VEGETABLE FOOD.

The seeds, roots, leaves, and fruits, of plants, particularly the two former, constitute a very material part of the food of mankind. According to the opinion of Dr. Cullen, and other physiologists, the quantity of actual nourishment that these contain, is in proportion to the quantity of sugar that they can be made to produce; it is imagined that the mucilage which the farinaceous seeds contain, is chemically combined with that sugar, and that this starch, in the processes to which the seeds are afterwards subjected, or by digestion in the stomach, is at length converted into saccharine principle. See Physiology.

The farinaceous seeds are wheat, barley, oats, rye, millet, maize or Indian corn, &c. The roots of this class of plants are potatoes, the common carrot, beet, and polydory. Those with less of the saccharine principle, and which afford a tender farina, are the turnip, cabbage, the purslane, parsley root, asparagus, and many others, of which, if less nutritious, are better suited to weakly organs of digestion than those in which the sugar is more abundant.

Other vegetables contain oil, sugar, mucilage, or acid; in various proportions, diluted with much water; these are but slightly nutritious; and are, for the most part, injurious to delicate stomachs especially, unless taken with moderation; these are the apple, pear, plum, apricot, pear-tree, peach, strawberry, grape, orange, melon, cucumber, dried figs, raisins, and a great variety of other roots, seeds, leaves, and fruits. Of these it may be observed generally, that those which are cold, watery, and sweet, are most calculated to prove indigestible, and consequently injurious.

DIFFERENT METHODS OF DRESSING VITALS.

Various modes of preparing and dressing both animal and vegetable articles of food have been contrived, in order to render them more palatable, and better adapted to the stomach. By boiling, animal flesh is, in a measure, deprived of its nourishing juice, which is with more or less facility given out to, and incorporated with, the broth: this last then contains the most nutritious part of the meat, but in general stronger than it ordinarily is used, it is too diluted to admit of an easy digestion. Broths likewise have a remarkable tendency to acidity, particularly when made from the flesh of young animals, as of lamb and veal; and on this account also are much less congenial to weak stomachs than is generally imagined. The various jellies, which contain the gelatins and nutritious, to the exclusion of the fibrous part of the flesh, are in general much more suitable to the invalid and the convalescent than either broths or soups. Perhaps the most eligible mode of preparing animal food is by the process called stewing; for by this means all the nutritive parts of the flesh are concentrated and preserved. It is scarcely necessary to observe that the gravy of boiled meat contains its nutritive parts in a state of concentration; it is digested with facility; and gravy is therefore the best mode of giving animal food to very young infants.

Roasting preserves the nutritious part of flesh from dissipation in a greater degree than boiling: and it has been asserted by an observant author (Dr. Willich) that 'one pound of roast meat is, in real nourishment, equal to two or three pounds of boiled meat.' It ought however to be noticed, that the fat of meat treated in this way has undergone some degree of chemical decomposition from its exposure to heat, and is in consequence more oppressive to delicate stomachs, and generally less salutary, than that of boiled flesh. Both baking and frying are upon similar principles; and in the methods of preparing animal food. Smoked meats, as prepared hams, are hard of digestion. They should only be taken in small quantities, and rather as condiment than food.
MATERIA MEDICA.

Water is the natural and proper drink of man. It is the basis of all other fluids; and the larger proportion of water that enters their composition, the more easily, in a state of health, and provided proper food has been taken, are the solution and digestion of such food effected.

This fluid, however, is never or seldom taken in a state of entire purity. Even in nature's laboratory it is invariably impregnated with foreign substances; and it is this admixture of extraneous matter which constitutes its varieties. Thus we have snow water, rain water, spring water, river water, and water from lakes, wells, and swamps, each possessing their individual characteristics.

Spring water is, in general, most free from impurities; it is, however, less suited for drink than the water of rivers, as it almost constantly contains calcareous, or saline ingredients. The calcareous earth dissolved in the water of many springs, has been supposed indeed by Dr. Darwin to contribute to our nourishment in the manner that lime proves useful in agriculture. This principle, however, is not perhaps fully established; and we believe that too much is contributed by general theories in the specific qualities of water, as modifying both the bodily and intellectual character of individuals and nations. The cestrin and fatuity of the Alpine valleys were formerly attributed to the waters of these countries, but are now more commonly, and we believe more justly, referred to constitutional propensity, innutritious food, and a humid unhealthy atmosphere.

That water however possesses great varieties, according to the nature of the soil and situation of the place in which it is produced or contained, is undeniable; and we shall here extract part of what is observed on these varieties by an attentive and judicious observer.

"Spring water," says Dr. Willich, "originates partly from that of the sea, which has been thrown out by subterranean heat, and partly from the atmosphere. As it is dissolved and purified in a variety of ways before it becomes visible to us, it is lighter and purer than other waters."

"River water," opened in a sandy soil are the purest. The water faintly a well is used, the better; for the longer water stands unmoved, the sooner it turns putrid.

"Lake water much resembles river water, but being agitated it is more impure. The water which, in cases of necessity, is obtained from swamps and ditches, is the worst of all; because a great variety of impurities are there collected, which, in a stagnant and soft soil, readily purify.

"Rain water is also impure, as it contains many saline and oily particles, soon putrefy, and principally consists of the joint exhalations of animals, vegetables, and minerals, of all seeds of plants, and the like. Rain water is particularly impure in places filled with many noxious vapours; such as marshy countries, and large manufacturing towns, where the fumes of metallic and other substances are mixed with rain. In high and elevated situations, at a distance from impure exhalations, if no strong winds blow, and after a gentle shower, rain water is then purest. In summer, however, on account of the copious exhalations, rain water is most objectionable.

"Snow water possesses the same properties as rain water, but is purer; both are soot, that is, without so many mineral and earthy particles as spring, well, and river waters. Hall water, being produced in the higher regions of the atmosphere, is still purer from its cong lations. Lastly, deco, as it arises from the evaporation of various bodies of the vegetable and animal kingdoms, is more or less impure, according to the different regions and seasons.

On the different kinds and qualities of fermented and spirituous liquors, it does not fall within the compass of the present article to treat. They all consist of water as their base or vehicle, of more or less spirit according to their different degrees of strength, of sugar, and of the particular ingredient by which their nature is determined; such as the grape in wine, the apple and pear in cider and cider-pear, and the like. (See the respective articles in their alphabetical order.) It is only necessary here to observe, that with few exceptions, fermented liquors, when immediately taken, are more detrimental than elementary fluids, in proportion to the quantity that they contain of alcohol, or ardent spirit.

With respect to the China tea and the coffee-berry, which have lately come into such general use in this country, we believe them to be much less injurious to the animal economy than some theorists have been disposed to conjecture. In excess, however, and when indulged in as substitutes for, and, in some times the case, almost to the exclusion of, nourishing diet, they are highly deliciouse, as they tend to the induction of a morbidly irritable condition of the nervous system. It deserves to be remarked, that these stimulants do not, like alcohol, produce those formidable, and often irreducible, disorders, affections of the liver, drop, and apoplexy.

An enumeration of spices (which, like spirituous liquors, are used as articles of diet with too great freedom) will be found under the head Aromatic, in a subsequent section of this article.

PART II.

MEDICINALS.

We now proceed to the second division of our subject, or to the consideration of the materia medica in its more ordinary and limited signification.

Various divisions and modes of classification of those articles which are used in medicine, have been proposed and adopted by different authors. Some systematic writers arrange the articles of the materia medica according to their alphabetic order; but others have taken for the basis of their arrangement the more sensible properties of drugs, as detected by the taste; thus reducing medicines to the arid kinds of bitterness, sweetness, astringency, acidity, &c. These have been regulated in their classification of medicinal articles, by their characters as objects in natural history. "As, however, the study
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of the materia medica is merely the study of the medicinal properties of certain substances, it is evident that the method of arranging them as they agree in producing effects on the living system is the one best calculated to fulfil all its objects." Murray.

Among the different plans of arrangement which have been framed on this principle, that adopted by Mr. Murray, in his late work on the materia medica, appears liable to the fewest objections. It is founded on the principles of Dr. Brown, "that medicines operate by stimulating the living fibre, or exciting it into motion." See the article BRUNONIAN SYSTEM. This proposition, however, was received and applied by its author in too unlimited a sense. In the first place, stimulation differs not merely in degree, but also in kind; or, in other words, one given medicine cannot by any regulation of its quantity be made to produce the same effects which result from the agency of another; some are more diffusible and transient, others more slow and permanent in their action; some affect the universal system in almost an equal degree, while the operation of others is more especially, and in some instances almost exclusively, deviated to a certain part. They have all likewise properties peculiar to themselves.

But besides this general and very important modification of the Brunonian materia medica, it is necessary further to take notice, that medicines sometimes appear to display their agency, even on the living body almost entirely upon chemical or mechanical principles; these last modes of operation, although less common and extensive than were supposed in the antient systems of medicine, must still be admitted as interferring with the universality, and opposing the unqualified assumption, of Dr. Brown, to which we have just alluded.

Guided by these views, Mr. Murray has adopted the general division of medicines under the four heads of universal stimulants, local stimulants, chemical remedies, and mechanical remedies, which are subdivided in the following manner:

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<th>TABLE OF CLASSIFICATION.</th>
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<tr>
<td><strong>A. General stimulants.</strong></td>
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<td>a. Antispasmodics.</td>
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<td>b. Permanent.</td>
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<td>b. Local stimulants.</td>
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<td>c. Local remedies.</td>
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<td>c. Diuretics.</td>
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<td>c. Astringents.</td>
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<td>c. Epispatics.</td>
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<td>c. Antacids.</td>
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<td>c. Lethoentrics.</td>
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<td>c. Demulcents.</td>
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<td>c. Emollients.</td>
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<td><em>D. Mechanical remedies.</em></td>
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The objections which still lie against this, which we have chosen as the most perspicuous and comprehensive arrangement of medicines, will be urged, as we proceed to make some observations on their indications, in the order of the above table.

The following, then, may be regarded, with some few exceptions, as an abridgment, or condensation, of the materia medica departimt, the out of which the articles of the present collection have been adopted from the last edition, recently published, of the Parmaco- peian collegii regin Medicorum Edinburgensis. In this edition the simples are principally in- cluded by the Linnaean names. We have added, however, the more eusynomy titles, in order to obviate confusion.

**OF NARCOTICS.**

Medicines of this class had, previous to the time of Dr. Brown, been almost universally regarded as sedative, or depressing, even in their primary operation. By a bold, and, in some measure, legitimate generalization, our author has proved that this kind of agency, in the greater number of cases, merely of a secondary nature; and that the symptoms of depressed, or, more properly speaking, exhausted power, resulting from their administration, are consequent upon the irritability that is attendant on the universal system, and very extraordinary manner, the actions of the system. Thus opium, which is one of the most powerful of the narcotics, Dr. Brown maintained is, in the first instance, invariably stimulant; and the same virtue he attributes to the whole range of narcotic, or, as they were formerly characterized, sedative powers.

Although this conclusion is deduced from principles in the main correct, and in its application has been of abundant service in developing the laws of organic existence, it cannot, as we have above remark- ed, be admitted as universal, as the fact must be obvious to all who are not biased by system, that the sedative effects of narcotics are often disproportioned to their previous existing operation, allowing even in such cases for its rapidity and little permanence.

Thus Dr. Murray, in some instances, interferes with the correctness of our author's (Mr. Murray's) classification.

Narcotics are employed medicinally with different and opposite intentions. As stimulants, they are given in various disorders of debility; in intermittent and continued fever, in gout, hysteria, epilepsy, dropsy, &c. As sedatives they are administered to allay pain and irritation, and are consequently largely administered in spasmatic and painful affections. Alcohol, ardent spirit; spirit of wine. For the origin and preparation of this consult the article ALCOHOL. The stimulant effect of alcohol is generally known to be very powerful and diffusible; its exciting power is perhaps, in proportion to its sedative quality, greater than any of the other narcotics. Moderate excitement, with proportionate subsequent languor, results from a moderate dose of spirits. In larger quantities it occasions inflammation, delirium, stupor, coma, death.

Alcohol is used externally as a stimulant in muscular pains; it has lately been discovered to be an useful application in the cure of burns. Internally it is seldom employed; in without dilution; and then is rather administered as an auxiliary, or solvent of other ingredients.

Ether. Ethers bear some resemblance in their medicinal powers to alcohol: they are more diffusible, and less permanent in their operation. They are employed principally in asthma, hysteria, and other spasmodic affections. Their dose is one drachm to one or two drachims. Externally applied, sub- limed alcohol has been used to relieve spasmodic contraction of the muscles, and is often supposed as a substitute for the temples in headache.

Camphora, aulos camporum (Linn.): benzoin, Japan, India. Camphor is a permanent principle of vegetables; it is principally obtained from the aulos camphorum of Japan. In a moderate dose camphor is stimulant; in a larger quantity it invariably diminishes the perspiration of the circulation, and induces sleep.

Camphor has been used as a stimulant in typhus, cyananche maligna, and other affections attended with debility and irritation; as a sedative in pneumonia, rheumatism, &c. In asthma it has been given as an anodyne. As an antispasmodic it is employed in asthma, St. Vitus's dance, and epilepsy. Its dose is from live to twenty grains. Externally, in combination with oil or lanolin, camphor has been advantageously used in rheumatism, bruises, and other inflammatory affections.

Papaver somniferum, poppy, Europe. Asia. The concrete juice of the capsule of this plant is opium, which is chiefly imported from Egypt, Turkey, and the East Indies.

The effects of opium, as above stated, are stimulating: it often occasions, when given in somewhat large doses, intoxication, and even actual delirium. If a larger dose be given, the symptoms of diminished action appear without any previous excitement, and are succeeded by delirium, stupor, stertorous breathing, convulsions, and death.

Where opium is given as a stimulant it ought to be administered in small and frequently repeated doses. Where the intention is to alleviate pain, or to bring on, on the contrary, to be given in a large dose, and at distant intervals. It is of importance to observe, that where evacuations have been previously procured, or when a state of diaphoresis is present, opium is much more gen- eral and salutary than while the skin is dry, or the bowels torpid.

In continued, as well as intermittent, fevers, opium is given as a stimulant. In the profuse of Dr. Cullen, opium is employed to diminish the discharge. In gout it is highly serviceable. In convulsive and spasmatic affections it is often administered to a very great extent, as in the terrors of warm climates. In lues venerea it is thought to accelerate the action of medicine, and is often given to promote suppuration, and is extremely efficacious in arresting gangrene. In the form of enema opium is often administered in violent affections of the bowels.

Its usual dose is one grain to an adult.

Hypocypreus niger, indigenous, herbs, se- men, black hemlock. This plant, in its action on the system, bears a considerable resemblance to opium; for it is often employed as a substitute. The latter is seldom employed as a substitute for its inferiority, occasioning unpleasant sympotms. It is free from the constipating effects of opium.

Atropa belladonna, indigenous, deadly
nightshade. Both the leaves and berries of this plant, and also its root, are narcotic. It is seldom used in medicine.

Aconitum napellus, aconite, monk’s-hood, herb. Europe, America. Aconite has been employed in obstinate chronic rheumatism, in sciatica, &c. Its dose is from one to two grains of the powdered ed leaves; of the inspissated juice half a grain.

Conium maculatum, císta, hemlock, folia, senhen, indigenous. This is a powerful narcotic. Like the aconite, it has been used in sciatica and scrophulous affection, as well as in rheumatism. Dose two or three grains of the powdered leaves; one or two of the inspissated juice.

Digitalis purpurea, foxglove, folia, indigenous. Of all the narcotics, digitalis most speedily and certainly diminishes the actions of the system, especially of the arteries. It acts at the same time as a stimulant on the absorbent system; hence its usual duty in dropsy. Lately it has been extensively employed in phthisis, and in the early stages of this disorder with remarkable success. Dose one grain of the powdered leaves, and ten drops of the tincture of the Edinburgh pharmacopoeia, gradually increased.

Nicotiana tabacum, tobacco, folia, America. This is a powerful narcotic. Its extreme activity prevents it from being much used in medicine.

Lactuca vera, strong-scented lettuce, folia, indigenous. From five to ten grains of the inspissated juice, gradually increased, have been given as a narcotic, diuretic, and antispasmodic.

Datura stramonium, thorn-apple, herba, indigenous. This has been used in mania, epilepsy, and convulsive diseases. Dose from one to three grains of the inspissated juice. Arnica montana, leopard’s-bane, flores, radix, &c. Its root has been employed as a substitute for Peruvian bark.

Rhus toxicodendron, yellow-flowered rhododendron, folia, Sib. ria. This has been given in chronic rheumatism and gout.

Rhus toxicodendron, poison-oak, folia, N. America. The dried leaves have been used in palsy. Dose half a grain twice or thrice a day.

Strychnos nux vomica, vomica nut. East Indies. It has been employed in mania, hysteria, &c. Dose five grains twice a day.

Prunus strobus-cerasus, cherry-tree laurel, folia, Europe. This has scarcely been employed in medicine.

OF ANTISPASMODICS. Antispasmodics form a kind of intermediate class between narcotics and tonics. Spasm sometimes arises from local irritation in states of general irritability, and is sometimes occasioned by pure debility. Both narcotics therefore employed and tonics are used as antispasmodics; but there are certain substances which in some measure appear to possess a specific antispasmodic power; these we are now to enumerate.

Muscum, musk, monotis muschifera, South of Asia. Musk is a peculiar substance found in a small sac, situated in the umbilicus in the male of the above animal. Its antispasmodic powers are considerable. Dose from six to twenty grains in the form of the crude; in a solution: it is useful in much smaller quantities in the convulsions of infants from debility. Castor oil, castor, fiber oil. This is a deposition collected in cells near the extremity of the rectum in the beaver. It is much used in hysteria. Dose from ten to twenty grains.

Oxymalle empyreumaticum, empyreumatic animal oil. This is nearly discarded from practice.

Petroleum, a bitumen of a red colour. This was formerly, but is not now, much employed.

Ammonia. This, when employed alone as an antispasmodic, is given in the form of carbonate.

Ferula assafizida, assafetida, Persia. This is a concrete juice, obtained by incision from the roots of certain plants. Its dose, as an antispasmodic, is from five to twenty grains.

Segrega leucodendron, Persia; virtues the same as assafetida, but inferior in power.

Bubon galbanum, gummi-resina, Africa. Dose ten grains.

Valerian officinalis, wild valerian, radix, &c. Its root is one of the principal antispasmodics. Dose from one scruple to one drachm, three or four times a day.

Coccus arctis, saffron, indigenous. This substance is derived from the stigmas which crown the pistil of the flower. It has scarcely any virtue.

Melancholia levendendron, cajuput oil, India. This is scarcely in use, except as a local application in tooth-ache.

OF TONICS. This term ought not perhaps to be retained. The agency of tonics is not that of increasing tension or tone, but they are permanent stimuli to the system, and are properly regarded as slow and durable, in opposition to the more diffusive and transient stimuli. They are chosen from the mineral and vegetable kingdom; the former are less speedy and sensible in their action than the latter.

From the mineral kingdom.

Hydrargyrum, argentum vivum, mercury. Ferrum, iron. Zincum, zinc. Cuprum, copper. Arsenicum, arsenic. For the various preparations and medicinal virtues of the above important minerals, consult the articles Pharmacy and Medicine.

Boraces, terra ponderosa, heavy earth. This has only been used as a saline combined with muriatic acid. Dr. Crawford introduced the saturated solution into practice as a remedy for scrofula. Dose from five to twenty or more drops.

Calis, lime. This earth exists in nature as a carbonate: when dried, it has been used as a tonic in combination with muriatic acid.

Acidum nitricum, nitric acid. This acid has been used as a tonic to support the system under a mercurial course. It has likewise been used with digitalis and indomitable success, as a specific in the cure of hectic fevers.

Oxymuriatic potassae, oxymuriate of potash. This may be classed as a remedy with the former article. Its dose when grains increased to twenty or twenty-five.

Tonics from the vegetable kingdom.

The tonic faculty in vegetables is intimately united with certain sensible qualities, with astrignency, and with aromatic. The aromatic principle is more active, but less permanent in its stimulating operation. The purest bitters independently possess a tonic power. Astrignency, when it exists exclusively, or as the most predominant principle in vegetables, constitutes a distinct class; the remaining tonics may be arranged according as bitterness or aroma is predominant.

Cichorium intybus, chicory, Peruvian. Cortis, America, Peru. Three kinds of this bark are in use, the pale, red, and yellow. The last is now principally employed, as it gives out more bitterness and astrignency to water, alcohol, and other media. Peruvian bark was first employed in intermittent fever. It has been given in the dose of a scruple or half a drachm every third hour, during the interval of the paroxysm. In continued fever it is principally employed during the latter stages, when debility is severe. In chronic Cases of scrofula, leucodendron, bronchitis, and almost all asthmetic disorders, it has been administered as a tonic.

Cinchona Carthaya, Caribean bark, Caribee islands. Augustae, Spanish West Indies. This herb bark has both been used as substitutes for the Peruvian bark.

Aristolochia serpenaria, Virginia snake-root. This is a stimulating aromatic tonic. It is generally given in the form of tincture. Dose: ten graminea, conserva, cortex, Peru, West Indies. This is scarcely possessed of any virtue.

Croton elethérius, cascarilla cortex, N. America. This is another substitute for Peruvian bark. Dose a scruple or half a drachm.

Colombia, radix, Ceylon, a very useful tonic bitter. Dose half a drachm.

Zinzanex excelsa, lignum, West Indies. This is one of the most excellent aromatic tonics. Dose in substance, from two to thirty grains, thrice a day.

Zinzanex sinuovum, simartobus, cortex, South America. This has been extolled as a remedy in dysentery, and chronic diarrhoea. Dose: ten graminea, conserva, cortex, East Indies. Swietienia mahagoni, mahogany. Two other proposed substitutes for the Peruvian bark.

Gentiana tinctoria, gentian, Switzerland, Germany. This is a common and useful remedy in dyspepsia; its virtues are extracted both by water and spirit. Dose in substance half a drachm.

Antheia nobilis, chamomile, flores, indigenous; a powerful and well-known bitter. N. B. The following plants are now not used in medicine: Artemisia absiníthium, wormwood; Chrysanthemum cynanthus, marigold; Vernáculo vulgaris, borage; Menthae verticillata, mint; Centaurae, blessed thistle.

AROMATIC.

Citrus aurantium, orange, cortex flavus. The rind of the orange is principally employed in tinctures, in combination with different substances used in dyspepsia. It is given in the form of tincture, conserve, and syrup.

Citrus medicus, lemon, cortex fructus,
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Asia; similar in flavour and virtue, but rather less bitter than the orange.

Laurus cinnamomum, cinnamon, cortex, Ceylon. This is the most grateful of the aromatics.

Laurus cassia, cassia, cortex, East Indies. This nearly resembles the cinnamon in appearance, taste, and virtue. It is therefore used with the same intention as this last. Its flavour, however, is less grateful.

Canthi alba, cortex, West Indies. This is a moderately strong aromatic: it is not much used except in combination with other substances in the form of tincture.

decoctus cumulatus, sweet-scented flag, radix, indigenous. This is scarcely at all employed in medicine.

Annona squamosa, ginger, radix, East Indies. The dose of ginger is about ten grains.

Kempferia rotunda, zedoary, radix, East Indies. This is seldom employed in medicine.

Santalum album, yellow sanders, lignum, E. Indies. This wood is now nearly banished from practice.

Santalum santalilium, santalum rubrum, red sanders, lignum, India. This, although slightly aromatic, is at present merely used in pharmacy as a colouring ingredient.

Myristica macranta, India. Under the old name myristica, both nutmeg and mace are included: the former is the seed, or kernel of the fruit; the latter its capsule. Nutmeg is given as an aromatic in doses of from five to fifteen grains. In larger doses it is narcotic. Mace is employed for the same purposes as nutmeg.

Carophyllus aromaticus, clove, flores, India. Cloves are the unexpanded flowers of the plant. Dose from five to ten grains.

Capsicum annuum, capsicum, Guinean pepper, fructus, and W. Indies. This fruit is a very powerful stimulant. It is not in much use as a medicine. Dose from five to ten grains.

Piper nigrum, black pepper, fruit, India. Black pepper is the ripe berry of the same vegetable, freed from its outer covering. It is milder than the black. Dose ten or fifteen grains.

Piper longum, long pepper. This is the berry of the plant, gathered before it is fully ripened. It is similar to the black pepper in its qualities.

Piper Cedea, cedibis, the dried fruit of the tree. It has similar virtues to the other peppers.

Myrista pimenta, Jamaica pepper, bacca, W. Indies. This is usually called pimento; it is employed in medicine principally on account of its flavour.

Annona repens, lesser cardamon, semen. Cardamoms form an ingredient in many of the bitter tinctures.

Curcuma caran, caraway, semen, indigenous. These are in common use, in culinary as well as medicinal preparations.

Coriandrum sativum, coriander, semen. These are used with the same intention as caraway.

Pimpinella anisum, anise, semen. Anise is used chiefly in the flatulence of children. The four following seeds have similar virtues to the anise and caraway: Anethum falciporum, falciporum, Anethum graveolens, dill, semen.

Anchusa urticae r우, bear's whortle-berry, folia, Europe. This has been principally given in disorders of the urinary organs. Recently it has been proposed in pleuritis pulmonalis.

Mimosa echinata, catechu, or Japan earth, East Indies. This is a useful and useful astringent in diarrhoea. Its dose is from fifteen to thirty grains. Kino is employed with the same intention as catechu. Its dose is from twenty to thirty grains.

Pterocarpus dioica, dragon's blood, resin, South America. This is scarcely employed in medicine.

Loco, lac, ficus indica, resin, East Indies. Lac is very little employed as a medicinal.

Pistacia lentiscus, mastich, resin, South of Europe. This is likewise discarded from practice.

Astringents.

Astringents are those substances that restrain morbid evacuations. Their mode of operation has been erroneously supposed similar to that by which dead animal matter is constricted and congealed. Increased evacuation do not depend merely upon mechanical laxity of the solids; the process, therefore, by which they are arrested, cannot entirely be ascribed to chemical principles; although in some cases medicines which are employed for this purpose discharge, necessarily possess a power of constringing dead animal fibre. This faculty in vegetables is denominated astringency, and results from the union of gallic acid and tannin principle combined; the former, when separated, is distinguished by its property of striking a deep-black colour with the salts of iron; the other by its great attraction to animal gelatin. Vegetable astringents then may be considered as mere permanent stimuli, modified in their action, even on living matter, by the principle above alluded to. Inordinate evacuations are, however, often restrained by mineral as well as vegetable substances, and in this case the former deserve to be arranged in the class of astringents, according to the definition above given of these powers.

Of Astringents.

Astringents are employed in the treatment of ulcers, hemorrhages, and diarrhoea.

Succus eucomi, cortex, indigenuous. This has been employed in haemorrhage, diarrhoea, and intermittent fever. Its dose in powder is from fifteen to thirty grains.

Succus cerris, galla, south of Europe. These are theerences found on the branch of the tree which produces them. They are employed in medicine for the same purposes, and are used under the same forms, as oak bark.

Tormilla cretica, tormentil, radix, indigenuous. This has been used in diarrhoea in decoction. Its dose, in substance, is from half a drachm to a drachm.

Pilagnum bistorta, bistorta, radix, indigenuous. This is a strong astringent. Dose a scruple to a drachm.

Anchusa tinctoria, alkanet, radix, South of Europe. This is at present merely employed as a colouring matter.

Hematoxylon Campechianum, woodgum. It is used as an astringent under the form of decoction, or watery extract.

Rose gallica, red rose, South of Europe.

The principle use of this astringent is in the form of gargle.
Neither this nor the acetate of copper is in much use; they are violent in their operation, and in no respect preferable to milder emetics.

**OF CATHARTICS.**

A discharge of the intestinal contents appears to be occasioned by medicines upon a twofold principle. Cathartics either immediately act upon the intestines, thus accelerating their peristaltic motion, and consequent fecal evacuations, or they produce this effect more indirectly by stimulating the exhalant and secreting vessels, whose fluids, pancreatic juice, and intestinal mucus act as solvents to, and promote the discharge of, the faces. These latter are milder in their operation than the former: they are classed by Dr. Darwin among the secernentia. There are, however, many drugs which act at the same time in each of the above modes.

Cathartics, still more than emetics, are extensively employed in medicine, as capable of modifying impulses throughout the system. Their use has recently been brought more systematically into notice. Upon the grounds just stated, cathartics may with some propriety be divided into purgatives and laxatives.

**Purgatives.**

**Cassia acutia.** Seed, folia, Egypt, Arabia. This is frequently employed: it is given in the form of infusion. Dose a drachm or more.

**Rheum officinale.** Rhubarb, Tartary. The best rhubarb is imported from Turkey. The China rhubarb has less of the aromatic flavour. British rhubarb is much inferior to either. The dose of rhubarb, as a cathartic, is from fifteen grains to two scruples. It is given with advantage in diarrhoea and dysentery, as it contains an astringent principle. In small doses it is atoxic and tonic.

**Convolvulus Jalapa.** Jalap, radix, Mexico. This is often administered both alone and more especially with calomel (submuriac hydargyri). Its dose is from fifteen grains to two scruples.

**Helicteres niger.** Black heliobole, radix, Austria, Italy. This, in a dose from ten to twenty grains, is a violent cathartic. It is seldom employed in modern practice. Dr. Mead attributed a powerful emmenagogue property to it, which however has scarcely been realized by others. The ancient physicians gave it freely in maniacal disorders.

**Bryonia alba.** Buxton, radix, indigenous. This root is not much used. Dose from twenty to thirty grains. It is slightly diuretic.

**Caucasus colocynthis.** Colocynthis, fructus, Syria. This is a much used cathartic in all purgatives. Its dose is half a grain to two grains.

**Rhamnus catharticus.** Buckthorn, beccanum success, indigenous. This is seldom used.

**Also perfoliatum.** Senna, Barbadoes, or hepatic and calamine doses; succus spinatus, Africa, Asia, America.

The cathartic doses is the purest. The Barbadoes and hepatic rank next. The calamine is the most impure, and is the weakest. Dose from fifteen grains to a scruple. Its action is principally upon the later intestines, and on account of the viscid, or water-like, nature of the discharge of these vessels, the uterus, it is often useful in amenorrhoea.

**Cassia fistula.** Cassia, purging cassia, or cassia in the pod; pulpa fructis, Egypt, East and West Indies.

Dose from five to eight or ten grains.

**Laxatives.**

**Mecon.** Manna, fraxinus omus, succus concretus, South of Europe. This is a mild and pleasant laxative. It is frequently given to children in conjunction with senna. Dose to an adult from one to two ounces.

**Cassia fistula.** Cassia fistula, common cassia. Dose from four to six drachms.

**Tamarix indica.** Tamarind, fructus confusus, E. and W. Indies, America, Arabia. The tamarind of the shops is the pulp of the tree mixed with seeds and small fibres, with a quantity of coarse sugar. It may be taken to the extent of two ounces, or more.

**Rhus verniciflua.** Palma Christi, oleum, senna, W. Indies. The oil from the nuts of palma Christi is the castor oil of the shops. This is a mild and very useful purgative.

**Sulphur.** A simple inoffensive substance, and magnesia, either pure orcarbonated, are all the laxatives that are afforded by the mineral kingdom. The operation of either is exceedingly mild.

For the different neutral salts that are employed as purgatives in medicine, see Pharmacy.

The purgatives that are administered only in the form of enema, are the

**Terebuthinae crestum.** Turpentine, pinnaria larica, gymnium-resina. This is sometimes employed as an enema triturated with the yolk of an egg. Dr. Cullen recommends this as a very certain cathartic. It is indicated in obstinate constipation.

**Nicotiana.** The introduction per-ann of tobacco smoke has sometimes been effectual in procuring alvine evacuation, after other cathartics have failed. The infusion of one or two drachms in a pint of water is a more convenient mode of administering this medicine. Much caution is requisite in either case to obviate its injurious effects.

**OF EMENAGOGUES.**

These are medicines which promote the menstrual discharge. Obstruction or reten-
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 tion of the menses, unless consequent upon defective conformation, or uterine impregna-
tion, is usually owing to weakness or want of due excitation in the vesicles of the uterus. This
deficiency is best overcome by gen-
eric remedies, or by taking a decoction of the leaves of some
myrrha, three drachms being given, to which
these virtues, which action is principally directed to the in-
ferior portion of the intestinal canal. In this
of the function of some
ferum, the carbonate of iron, rubigo
ferri praeparata; is given in a dose of ten or
fifteen grains in ammoniacum, the sulphate of
iron in three or four grains. This is the
ferrum vitriolatum of the London pharma-
copoeia.

Hydargyrus, the mild mutirite of mer-
cury, as already noticed.

Sanguis organicum. This is "frequently given" in
ammoniacum, in conjunction with some of the preparations of
iron.

From the class of antispasmodics. Castorium. This is a medicine of very
trilling efficacy when used as an emmen-
gogue. Dose from ten to twenty grains.

Ferula assyriatica, and the other fett
grains, (galbanum, sagapenum, and ammoni-
acum) are employed sometimes as emmen-
gogues. Dose from ten grains to fifteen.

From the class of cathartics. Aloe. This is a substance generally con-
nected with others when given to promote
the menses, as in the pilula aloe cum
myrrha, &c.

Helieborus niger. This is not at present
in much repute. Dose of the extract from
three to ten grains.

Sinapis alba, semen, mustard-seed in the
dose of about half an ounce is sometimes
taken as an emmenagogue.

Chelidonium officinale, rosemary, sum-
mittales florentis. This is now nearly banish-
ed from practice.

Rubia tinctorum, madder, rhizis, south of
Europe. A dose from a scruple to half a
drachm. Its virtue is not much confined in
by modern physicians.

Ruta graveolens, ruta, rue, herba, south
of Europe. The herb in the form of infu-
sion, and likewise its essential oil, are the
preparations of rue that are given. It is per-
haps of inferior efficacy.

Juniperus sabina, savin, folia, south of
Europe. Savin is not much used internally,
although supposed by some to be a powerful
emmenagogue.

OF DIURETICS.

Diuretics are those medicines which aug-
ment the urinary discharge. This effect is
either produced by a direct stimuli on com-
municated to the kidneys, by a sympathetic
excitation of these organs from a product of
deton action excited in the stomach, or, lastly,
by the promotion of absorption, by which more
than their usual quantity is directed to the
secretory vesicles of the urine. The saline
drugs are principally so exert their agency in the first of these ways. Squill
and others appear to produce a primary ac-
ction of the stomach, and digitalis from its
extraordinary power over the absorbent sys-
tem is an example of the last-mentioned
mode of procuring diuresis.

Saline diuretics.

Superius pain, cream of tartar.
Dose four or six drachms twice a day in
considerable quantities of water. This has
been much employed in dropsy.

Nitros potassus, nitre. Dose from five to
twenty grains. Nitre was formerly much
used in gonorheea, in order to abate the
ardor urinæ.

Muriros ammoniaci, crude salt ammoniac.
This is not much employed. Dose from
eight grains to a scruple.

Aceti potassii, sal diuretis. This has
now likewise fallen into disuse.

Potassa, kali. The dose of carbonated
kali is from twenty to thirty grains.

Vegetable diuretics.

Scilla maritima. Dose as a diuretic from
one to three or four grains.

Digi dias purpurea. Dose from one grain
to two or more, of the powdered lea:
from ten to thirty drops of the saturated
tincture. The dose requires to be regulated
and increased with the degree of

Nicotiana tabacum. An ounce of the
dried leaves infused in a pint of water, has
been given as a diuretic in the dose of from
sixty to a hundred drops.

Solanum dulcamara, poisonous, nightshade,
bitter, sweet, indigenous. This is scarcely
ever prescribed.

Lactua verona. Dose from ten grains to
three drachms. It is not much used.

Cochlearia officinalis, medicow saltnum, indi-
genous. This has not been in much use
in this country. It was first prescribed in
dropsy by Storck of Vienna.

Gratiola officinalis, hedge hyssop, south of
Europe. The leaves of this plant have
likewise been given in dropsy, but they have
not come into general use.

Spartium scoparium, broom, summittales,
indigenous.

The broom tops infused in water have
proved advantageous in dropsy.

Juniperus communis, juniper, bacca indi-
genous. Juniper berries given in infusion
have a pretty considerable diuretic power.

Copaeiia officinalis, copaera balbus,
South America. Dose from twenty to thir-
ty drops twice a day. It is principally em-
ployed in gleet.

Pinnas ovalis, Venice turpentine, holms
Dose from five to twelve drops of the essen-
tial oil. This has likewise been given in
gleet, and in sciata.

Pisctia teres, English turpentine, the
common turpentine (pinus sylvestris balbus)
is on the other hand the most offen-

Diuretics from the animal Kingdom.

Melis vestitiiria, cantharides, Spanish
fly. This is an insect collected from the
leaves of plants growing in the South of
Europe. It has principally been given in
to the secretion of the bladder, and in the
retention of urine. Dose one grain gradually
increased.

OF DIAPHORETICS.

If the natural and constant exhalation
from the skin be condensed on the surface
from its augmented discharge, it constitutes
sweat. This effect when produced only to a
certain extent, is called diaphoresis. Di-
aphoretic and sudorific powers differ then
only in degree. Diaphoresis is chiefly by
Darwin under the head of secretinaria. They
are necessarily operate by directly or indirectly
exciting the cutaneous exhalations. The sa-
line and cooling diaphoresis appear to act
better, the hot and dry medicines which
are given to procure sweat in the former
manner. Diaphoresis with respect to their
influence on the system, are often abun-
dantly powerful and salutary.

Antimony. All saline preparations are
more or less diaphoretic under proper regu-
lation. The ammonial salts have been
imagined to be so in a greater degree than
others. See Pharmacy.

Hydragyrum. The mild muricate (calo-
iac) in conjunction with opium is very
small doses, is sometimes usefully employed
as a diaphoretic.

Antimonius. All the preparations of
antimony may be made to prove sudorific.

Pergamini. In a dose of two or three
drops or without caution, is considered as
intended as a diaphoretic.

Guacon officinalis, guaiac ligurnum, et
guani-resina, South America, and the West
Indies. Guaiac wood is given in the form
of infusion, and the gum which is given in
the course of the day. The gum-resin is
commonly administered in spirit of amberine,
in which it derives a considerable part
or its virtues. Dose from one draught to two
of the tincture.

Daphne mezereum, vevren, cortex ra-
dicis indigena. This is a stimulating di-
aphoretic; it is generally given in views of
inflammation of the liver, and of gout, forming the Liveridge's

Sinae sarcoverpa, radix, South America.
This has scarcely any power exclusively
employed.

Anis, sassafras, sassafras, ligurnum, Ameri-
ca. This is slightly stimulating and dia-
phoretic. It is probably less efficacious than
this has generally been imagined.

Cucullaria armoracia, horse-radish, radish,
indigenous. This is a stimulant capable of
promoting perspiration. About a draught
of the root cut in small pieces and swallowed
whole, has been recommended in paralysis,
reumatism, asthma, and dropsy.

Salvia officinalis, sage, folis, South of
Europe. Its aqueous infusion drunk warm
is slightly stimulating and diaphoretic.

EXPECTORANTS.

Are those medicines which facilitate the
rejection of mucus or other fluids from the lungs. This object is accomplished by
inspiring the pulmonary viscidia, where the
sufficiency, or diminishing it when too copious.

In the one instance expectorants are sec-
vent, in the other absorbent powers; their
operation, like that of emetics, is in both
cases the same. See Pharmacy.

Antimonius. The most common prepa-
rations of antimony for an expectorant is the
cutaneous tartar of the shops. This is given in
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The juice of the lemon is composed of citric acid, and saccharine and mucilaginous matter. It is the most powerful and agreeable of the refrigerants. With carbonate of potash, it forms the draught, the virtues of which are perhaps owing to the carbonic acid that is evolved by the mixture of the acid and alkali.

**Antacids.**

These are perhaps more strictly chemical in their primary operation than the last class of medicines. They immediately neutralize the prevailing morbid acidity of the stomach.

**Alkalies.**

Pure potash in solution is employed to correct acidity, in doses of fifteen drops in water. The carbonates of potash and soda are, however, in more general use for this purpose.

**Aqua ammonio.**

This is given likewise with this intention. Dose from twenty to forty drops.

**Aqua calis.**

Lime-water is also used to correct acidity; six or eight ounces being taken occasionally.

**Carbonas calcis.**

Of these there are two varieties, creta alba, (prepared chalk) and chelae cancerum (crab's claws). These, especially the former, are principally used in the diarrhoea of infants.

**Magnesia (carbonas magnesia).**

This in some cases preferable to chalk as an acid, as the neutral compound formed by its union with the acid of the stomach proves slightly purgative.

**OF LITHOTRIPSES.**

Medicines supposed to have a power of dissolving stone in the bladder. Calculus is principally formed by a peculiar acid, called the lithic acid, which alkalies unite out of the body, and thus become part of the stone. These medicines, however, cannot in any way be conveyed to the urinary organs in sufficient quantity to effect this purpose without material injury to the parts and the general system. It has, indeed, been ascertained, from experiment, that by the exhibition of alkaline substances, for a length of time, the constitutional disposition to secrete fresh calculi is in a great measure obviated. These substances are rather preventive than curatives of calculary disorders. That they do not, when taken into the stomach, operate as solvents, is sufficiently evident, from the circumstance of their being more useful when administered saturated with carbonic acid; for these alkaline carbonates do not exert any action on the urinary calculus out of the body, as the lithic acid of the calculus is not of sufficient attractive power to disengage the carbonic acid from its union with the salt. The only power then that is possessed by the medicines termed lithotriptes, is that of neutralizing acidity in the first passages, and thus preventing the deposition of lithic acid in the urinary organs.

**Potassae, potass.** The dose of the solution...
of pure potash is 15 or 20 drops gradually increased. The form in which it is generally employed is as a labyrinth, is in the supersaturated solution. Does, one or two pounds daily.

Soda. This is likewise used in the form of saturated solution, under the name of soda water. Does, one or two ounces in the course of the day.

Galls. Lime-water is sometimes employed as a lithotriptic.

DEULCENTS

Are substances employed in medicine to shield from astringency; they can only act on the parts to which they are directly applied. From some circumstances, however, attending their internal administration, it is supposed that they are capable of being absorbed and again separated by particular secrerary organs. This supposition does not appear to be satisfactory.

Astragalus officinalis, gum arabic, Africa. This is used to allay the irritation of the fauces in catarrh. It is likewise given in tenesmus, strangury, &c.

Antirrhinum tragacantha, tragacanth, South of Europe, Asia. This has virtues similar to gum arabic. It is more viscous.

Linum usitatissimum, flax, semen, indigenuous. This is sometimes used in gomorrina, and catarrh.

Veratrum album, marsh mallow, radix, indigenuous.

Malva sylvestris, common mallow, folia, indigenuous. This is used in virtue to sago.

Arctium lappa, South America. Arrow-root is demulcent, and slightly nutritive.

Trifolium hybernum, wheat, amylin. Starch is useful as an enema with opium in dysentery, &c.

Copa vitrea, blosson, indigenuous. Similar in virtue to sago.

Maeruia aromatica, South America. Arrow-root is demulcent, and slightly nutritive.

MATRICE, or Matrix, in dyeing, is ap-
Matric, or Matrics, See Coining.

Matric, or Mother Earth, the stone in which metallic ores are found enveloped.

Matrosse, or Matrosse (or), which some lexicographers have derived from mater, a mother; denotes, in its primitive sense, that unexplained something from which all those things which are objects of our sense derive their being.

The term body is sometimes confounded with that of matter; but they are essentially different. Body is of Saxon origin. It is explained by the Latin words statura, pectus, truncus, and hostia, or the Latin name of a man, or other creature; whence it is plain that it ought to be confined to express a substance possessing form or figure.

Substance, both in its etymology and application, is the inherent essence to the meaning of the former of these terms. It is well known to be compounded from the Latin proposition sub (under) and the verb stare (to stand). It consequently implies that which supports or stands under the different forms and appearances which are presented to our senses. It is still, however, used in a distinct and more limited sense than matter. It is generally indeed used with the article, to signify a distinct or definite portion of matter; whereas matter in the abstract implies a more confused and general idea of solidity and extension, with little or no regard to figure, proportion, or quantity.

That the same matter of which this universe of things is composed, is essentially the same, and that the apparent differences which subsist in different bodies depend altogether on the particular distribution or disposition of the component particles, is an opinion which has been entertained by some philosophers of the highest reputation. The wonderful apparent transmutations which take place in the different processes and operations of nature can be confessed, at first sight countenance this hypothesis. A plant will vegetate, and become a solid substance, in the purest water. The generation of stones in earth, the various phenomena of petrifications, and a multitude of other facts, contribute greatly, on a fair consideration, to diminish the absurdity of the alchemists (who seem chiefly to have rested on this hypothesis) that all matter was essentially the same and the basis of its conversion the same materials by the efforts of art into the most splendid and valuable of substances.

Mr. Boyle dissented the same water about two hundred times, and at the end of each distillation found a fresh deposit of earth. Magriff repeated the experiment with still greater caution. By means of two glass globes, which communicated with each other, he preserved the water while in the state of vapour from all contact with the air; and on repeated distillation, a quantity of earth of the calcareous kind was deposited at the conclusion of each operation.

The extreme rarity and minuteness of the particles into which different substances may be resolved, imparts a still greater degree of probability to this hypothesis; and in general the more any body can be divided, the simpler it appears in its component parts.

We must, however, be cautious of admitting opinions which are not sanctioned by the direct test of experiment; and however plausible the opinion, the accurate observations of modern philosophy have suggested some objections to the homogeneity of matter, which, without further discoveries, it will not be easy to silence.

Whatever phenomenon may appear to indicate a transmutation of bodies, or a change of one substance into another, we have the utmost reason, by the latest and best experiments, to believe them merely the effect of confusion, and of the conversion of air and water into a solid substance, such as the body of a plant, is merely an apparent conversion; for that solid substance may, by an artificial process, be resolved again into its original particles or elements. In the evolution of the principles or elementary particles of which those fluids are composed; and the formation of stones, and the phenomena of petrifications, are accounted for upon much easier principles, and with greater precision.

On the other hand, the utmost efforts of chemistry have never been able to proceed farther in the analysis of bodies than to reduce them to a few principles, which appear essentially different from each other, and which have never yet been brought to a more simple form. Thus the matter of fire, or light, appears totally different from that of all other bodies; thus the acid and alkaline principles cannot be brought under the same properties; nor can even the different species of earth be converted into the substance of each other.

If hypothetical reasoning was to be admitted on this occasion, it would appear more agreeable to the analogy of nature, to suppose that different substances are formed from the different combinations of a few simple principles in different proportions, than that the very opposite qualities of some of the rarest and most subtle fluids should depend wholly on the different form or modification of the extremely minute particles which enter into their composition.

Whatever distinction it may be proper to observe, that on this subject there has hitherto appeared no decisive experimental proof on either side. The imperfection of all human efforts, and perhaps of the human faculties themselves, has hitherto confined our investigations to the properties of a few substances, the simplest which chemical analysis has been able to obtain, and which for that reason are denominated fundamental. See Elements.

Mazzuchelli, Filippo, author of the tetrads monographia class and order. The calyx is four-parted; corolla one-petalled; germ superior, four-lobed. There is one species, a herb of Guiana.

Mauritia, the grilgo, or mainau-hair, a genus of plants belonging to the natural order of palm. The calyx of the male is monopetallous; the corolla monanepetalous, with six adnate. It is a native of Japan, where it is also known by the names of man and fasia. It rises with a long, erect, thick, and serrated stem, to a palm-tree. The bark is ash-coloured, the wood brittle or smooth, the pith soft and spongy. The leaves are large, expanded from a narrow bottom into the figure of a mainau-leaf, unequally parted, streaked, without veins or nerves. From the uppermost shoots hang the flowers in long catkins that are filled with the fertilizing power; and to which succeeds the fruit, adhering to a thick fleshy pedicle, which proceeds from the bottom one or two, this fruit is either exactly or nearly round, and of the appearance and size of a camphor plum. The substance surrounding the fruit is fleshy, white, very hard, and adheres so firmly to the enclosed nut, as not to be separated from it except by putrefaction. The nut, properly termed gineau, resembles the pista-chio nut, especially a Persian species named bergies pistio; but is almost double in size, and of a rounder figure or oval. The shell is somewhat white, woody, and brittle, and incloses a white bone kernel, having the sweetness of an almond, along with a degree of hardness. These kernels taken after dinner are said to give to the inclosed nut, as not to be separated from it except by putrefaction. The nut, properly termed gineau, resembles the pista-chio nut, especially a Persian species named bergies pistio; but is almost double in size, and of a rounder figure or oval. The shell is somewhat white, woody, and brittle, and incoses a white bone kernel, having the sweetness of an almond, along with a degree of hardness. These kernels taken after dinner are said to give to the inclosed nut, as not to be separated from it except by putrefaction.

Maxilla. See Anatomy.

Maximum, in mathematics, denotes the greatest or most considerable in any given case. If a quantity conceived to be generated by motion, increases, or decreases, till it arrives at a certain magnitude or position, and then, after passing it, decreases, or becomes greater, and it be required to determine the said magnitude or position, the question is called a problem de maximum et minimis.

Thus, let a point move uniformly in a right line from one extremity and let another point move after it, with a velocity either increasing or decreasing, but so that it may, at a certain position D, become equal to that of the former point, moving uniformly.

D

B a

This being premised, let the motion of n be first considered as an increasing one; in which case the distance of n behind m will continually increase, till the two points arrive at the contemporary positions C and D; but afterwards it will again decrease; for the motion of n till then being slower than at D, it is also slower than that of the preceding point m (by the postulate), but afterwards, whatever after the point m (as has been already said) will again decrease; and therefore is a maximum, or the greatest of all, when the velocities of the two points are equal to each other.
that of $n$, its fluxion at that instant is evidently equal to nothing. Therefore, as the motion of the points $m$ and $n$ may be conceived such that their distance $mn$ may express the measure of any variable quantity whatever, it follows, that the fluxion of any variable quantity whatever, when a maximum or a minimum is, equal to nothing.

The rule therefore to determine any flowing quantity in an equation proposed, to an extreme value, is: having put the equation when it is found, let the fluxion of that quantity whose extreme value is sought be supposed equal to nothing; by which means all the members of the equation in which it is found will vanish, and the remaining ones will give the determination of the maximum or minimum required.

Prob. I. To divide a given right line into two equal parts, that their product, or rectangle, may be the greatest possible. This is the case when the line is bisected or divided into equal parts. See Fluxions.

In any mechanical engine the proportion of the power to the weight, when they balance each other, is found by supposing the engine to move, and regarding their velocity as proportional to the respective directions in which they act; for the inverse ratio of those velocities is that of the power to the weight according to the general principle of mechanics. But it is of use to determine likewise the proportion they ought to bear to each other, that when the power prevails, and the engine is in motion, it may produce the greatest effect in a given time. Therefore, the weight moves at first with an accelerated motion; and when the velocity of the power is variable, its action upon the weight decreases, while the velocity of the weight increases. Thus the action of a stream of water or air upon a wheel, is to be estimated from the excess of the velocity of the fluid above the velocity of the part of the wheel which it strikes, or from their relative velocity only. The uniform motion of the engine ceases to be accelerated when this relative velocity is so far diminished, that the action of the power becomes equal to the resistance of the engine arising from the gravity of the matter that is elevated, or from friction; for while the velocity balances each other, the engine proceeds with its uniform motion it has acquired.

Prob. II. Let $a$ denote the velocity of the stream, $s$ the velocity of the part of the engine which it strikes when the motion of the machine is uniform, and $a - s$ will represent their relative velocity. Let $A$ represent the weight which would balance the force of the stream when its velocity is $a$, and $a - s$ the weight which would balance the force of the stream if its velocity was only $a - s$; then $\rho = A \times \frac{a - s}{a}$, and $\rho$ shall represent the action of the stream upon the wheel. If we subtract the friction, and have regard to the quantity of the weight only, let it be equal to $\Delta w$; (for we have $\Delta w = \rho \times \Delta y$), and because the motion of the machine is supposed uniform, $\rho = \frac{a}{\Delta y}$.

\[ x \times a^{n} = \text{vanishes}, \text{that is, when } x \times a^{n} = \text{vanishes} \]

\[ \frac{\Delta w}{a} = \frac{a}{\Delta y} \times \frac{a}{a} \]

The momentum of this weight is $\frac{\Delta w}{a}$, which is a maximum when the fluxion of $x \times a^{n}$ vanishes.
The MEAN PROPORTIONAL, between two given lines, is the line which at the same time is to the lesser as the greater is to the sum of the lesser and the greater.

Thus, if the squares on a and b be equal, a and b are in mean proportion; and the mean proportional between a and b is \( \sqrt{ab} \).

This proportion is especially useful in the solution of quadratic equations.

Example: To find the mean proportional between 4 and 9.

\[ \sqrt{4 \times 9} = \sqrt{36} = 6 \]

Therefore, the mean proportional between 4 and 9 is 6.

The mean proportional is also used in the calculation of the sides of a rectangle when the area and one side are known.

Example: If the area of a rectangle is 25 square units and one side is 5 units, the other side can be found as follows:

\[ \sqrt{25} = 5 \]

Thus, the other side is also 5 units, making the rectangle a square.

The mean proportional is also used in the calculation of the altitude of a triangle when the base and area are known.

Example: If the area of a triangle is 12 square units and the base is 6 units, the altitude can be found as follows:

\[ \sqrt{\frac{2 \times 12}{6}} = \sqrt{4} = 2 \]

Thus, the altitude of the triangle is 2 units.

The mean proportional is also used in the calculation of the diameter of a circle when the circumference is known.

Example: If the circumference of a circle is 10 units, the diameter can be found as follows:

\[ \sqrt{\frac{10^2}{\pi}} = \sqrt{\frac{100}{\pi}} \]

Thus, the diameter of the circle is approximately 3.18 units.

The mean proportional is also used in the calculation of the volume of a sphere when the surface area is known.

Example: If the surface area of a sphere is 40 square units, the diameter can be found as follows:

\[ \sqrt{\frac{40}{4\pi}} = \sqrt{10} \]

Thus, the diameter of the sphere is approximately 3.16 units.

The mean proportional is also used in the calculation of the speed of a moving object when the distance and time are known.

Example: If an object travels 100 units in 5 units of time, the average speed can be found as follows:

\[ \sqrt{\frac{100}{5}} = \sqrt{20} \]

Thus, the average speed of the object is approximately 4.47 units per unit of time.
3. The Englishavoirdupois pound weighs 7004 troy grains; whence theavoirdupois ounce, whereof to make a pound, is found equal to 437.75 troy grains. And it follows, that the troy pound is to theavoirdupois pound as 88 to 107 nearly; for as 88 to 107, so is 5760 to 7004.536; that the troy ounce is to theavoirdupois ounce, as 80 to 73 nearly; for as 80 to 73, so is 480 to 437.5: and, lastly, that theavoirdupois pound and ounce are to the Paris two-inch weight and ounce, as 65 to 68 nearly; for as 65 to 68, so is 7004 to 7300.767. See Weight 4. The Paris foot expressed in decimals is equal to 1.0054 of the English foot, or contains 12.783 English inches.

3. The standard in Holland, Flanders, Sweden, a good part of Germany, many of the Hanse towns, as Danzick and Hanbourg, and at Geneva, Franchfort, &c. is likewise the ell; but the ell in all these places differs from the Paris ell. In Holland it contains one Paris foot 11 lines, or 4-sevenths of the Paris ell. At Bologna, Modena, and Mantua, the ell is the same as at Venice. At Lucca it contains 1 Paris foot, 9 inches, 10 lines, or 8-fifteenths of the Paris ell. At Milan, the ell is the same as at Venice. At Lucca it contains 1 Paris foot, 9 inches, 10 lines, or 11 sixteenths of the Paris ell. At Florence it contains 1 foot, 9 inches, 10 lines, or 4-hundredths of the Paris ell. At Milan, the ell for measuring of silks is 1 Paris foot, 7 inches, 4 lines, or 4 ninths of a Paris ell; that for wooden cloths is the same as the ell of Holland. Lastly, at Geneva, the ell is 1 foot 7 inches, 6 lines, or 3-ninths of a Paris ell. The usual measure in Naples, however, is the canna, containing 6 feet, 10 inches, and 2 lines, or one Paris ell and 15-seventeenths.

5. The Spanish measure is the vara or yard, in some places called the vara; containing 17 twenty-fourths of the Paris ell. But the measure in Castile and Valencia is the span, or palm; which is used, together with the canna, at Genoa. In Arragon, the vara, is equal to a Paris ell and a half, or 5 feet, 5 inches, 6 lines.

6. ThePortuguese measure is the cavo,

The Piedmontese measure is the ras,

The Muscovite measures are the cubit,

The Turkish and Levant measures are the piey,

The Chinese measure is the cubit, ten whereof are equal to three Paris ells.

For wood:

10,000,000th part of the dist. from the pole to the equator

A decimetre cube.

1 pint and \( \frac{1}{3} \)5, or 1 litre and \( \frac{1}{3} \) nearly.

18 grains and 841,000 parts.

Two square perches
des eaux et forêt.

1 demi-voile, or \( \frac{1}{4} \) of a cord des eaux et forêt.

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18 grains and 841,000 parts.

Two square perches
des eaux et forêt.

1 demi-voile, or \( \frac{1}{4} \) of a cord des eaux et forêt.
### Scripture Measures of Length, reduced to English.

<table>
<thead>
<tr>
<th>English</th>
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</thead>
<tbody>
<tr>
<td>Digit</td>
<td>0.0312</td>
</tr>
<tr>
<td>4 Palm</td>
<td>0.0346</td>
</tr>
<tr>
<td>12 3 Span</td>
<td>0.1041</td>
</tr>
<tr>
<td>24 6 ° 2 Cubit</td>
<td>0.9888</td>
</tr>
<tr>
<td>96 32 8 4 Fathom</td>
<td>0.6952</td>
</tr>
<tr>
<td>144 36 ° 6 1° Ezekiel's reed</td>
<td>10.1128</td>
</tr>
<tr>
<td>192 48 18 ° 6 2° Arabiun pole</td>
<td>14.7104</td>
</tr>
<tr>
<td>96000 19200 80 20 10° 30 Schemus, or measuring line</td>
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The Longer Scripture-Measures.

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<tbody>
<tr>
<td>Cubit</td>
<td>0 1.824</td>
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<tr>
<td>400 Stadium</td>
<td>145 4.6</td>
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<tr>
<td>2000 5 Sah day's journey</td>
<td>729 3.000</td>
</tr>
<tr>
<td>4000 10 2 Eastern mile</td>
<td>1 403 1.000</td>
</tr>
<tr>
<td>10000 20 6 Pransang</td>
<td>4 153 3.000</td>
</tr>
<tr>
<td>96000 19200 8 24 8 A day's journey</td>
<td>33 172 4.000</td>
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### Greek Measures of Length, reduced to English.

<table>
<thead>
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<tbody>
<tr>
<td>Dactylus, digit</td>
<td>0 0</td>
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<tr>
<td>4 Doron, docheum</td>
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</tr>
<tr>
<td>10 Lichas</td>
<td>0 0.0010</td>
</tr>
<tr>
<td>11 Chori</td>
<td>0 0.0015</td>
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<tr>
<td>12 Chori</td>
<td>0 0.0025</td>
</tr>
<tr>
<td>16 Cephis</td>
<td>0 0.0030</td>
</tr>
<tr>
<td>18 Chorine</td>
<td>0 0.0035</td>
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<tr>
<td>20 Cloa</td>
<td>0 0.0040</td>
</tr>
<tr>
<td>24 Stade</td>
<td>0 0.0080</td>
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<tr>
<td>36 Stade</td>
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<td>7055 0</td>
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### Roman Measures of Length, reduced to English.

<table>
<thead>
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<tbody>
<tr>
<td>Digitus transversus</td>
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</tr>
<tr>
<td>4 Palmus minor</td>
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</tr>
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<td>16 12 Pen</td>
<td>0 0.1404</td>
</tr>
<tr>
<td>20 15 5 Palmae</td>
<td>0 0.0125</td>
</tr>
<tr>
<td>24 18 6 Cubitus</td>
<td>0 0.0120</td>
</tr>
<tr>
<td>30 20 10 Gradus</td>
<td>0 0.0130</td>
</tr>
<tr>
<td>90 60 30 2 Passus</td>
<td>0 0.0290</td>
</tr>
<tr>
<td>10000 7200 2250 625 500 416 830 125 Stadium</td>
<td>120 4 4.4</td>
</tr>
<tr>
<td>60000 600000 20000 5000 3334 20000 10000 8 Milliare</td>
<td>967 0 0</td>
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### A Table

<table>
<thead>
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</thead>
<tbody>
<tr>
<td>100 Aunes of Breslau</td>
<td>60</td>
</tr>
<tr>
<td>100 of Dantzig</td>
<td>60</td>
</tr>
<tr>
<td>100 of Bergen and Drontheim</td>
<td>65</td>
</tr>
<tr>
<td>100 of Sweden or Stockholm</td>
<td>65</td>
</tr>
<tr>
<td>100 of St. Gall, for linen</td>
<td>87</td>
</tr>
<tr>
<td>100 of ditto, cloth</td>
<td>97</td>
</tr>
<tr>
<td>100 of Geneva</td>
<td>124</td>
</tr>
<tr>
<td>100 of Marselles and Montpelier</td>
<td>214</td>
</tr>
<tr>
<td>100 of Toulouse &amp; High Languedoc000</td>
<td>100</td>
</tr>
<tr>
<td>100 of Genoa, of 9 palms</td>
<td>242</td>
</tr>
</tbody>
</table>

### English Square-Measures.

<table>
<thead>
<tr>
<th>Square feet</th>
<th>English</th>
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<tbody>
<tr>
<td>144 Foot</td>
<td>1260 9</td>
</tr>
<tr>
<td>39204 272 304</td>
<td>10.89 Pole</td>
</tr>
<tr>
<td>1565160 10890 1010</td>
<td>435.6 40 Roof</td>
</tr>
<tr>
<td>6727640 43660 4480 1743.6 160 3.4 Acre</td>
<td></td>
</tr>
</tbody>
</table>

### Roman Square-Measure reduced to English.

The integer was the jugerum or acre, which the Romans divided like the libra or as: such, the jugerum contained

### Cubical Measures, or Measures of capacity for liquids.

The English measures were originally raised from Troy-weight; it being enacted by several statutes that eight pounds Troy of wheat, gathered from the middle of the ear, and well dried, should weigh a gallon of wine-measure, the divisions and multiples whereof were to form the other measures; at the same time it was also ordered, that there should but one liquid measure in the kingdom; yet custom has prevailed, and there having been introduced a new weight, viz. the avoirdupois, we have now a second standard gallon adjusted thereto, and therefore exceeding the former in the proportion of the avoirdupois weight to Troy weight.
From this latter standard are raised two several measures, the one for ale, the other for beer.

The sealed gallon at Guildhall, which is the standard for wines, spirits, oils, &c. is supposed to contain 231 cubic inches, and on this supposition the other measures raised therefrom, will contain as in the table underneath; yet, by actual experiment, made in 1688, before the lord-mayor and the commissioners of excise, this gallon was found to contain only 230 cubic inches: it was however agreed to continue the common supposed contents of 231 cubic inches; so that all computations stand on their old footing. Hence, as 12 is to 231, so is 14$\frac{3}{5}$ to 282$\frac{3}{5}$ the cubic inches in the ale gallon: but in effect the ale quart contains 70$\frac{1}{2}$ cubic inches, on which principle the ale and beer gallon will be 282 cubic inches. The several divisions and multiples of these measures, and their proportions, are exhibited in the following tables:

### English Measure of Capacity for Liquids, Wine-Measure.

<table>
<thead>
<tr>
<th></th>
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<tbody>
<tr>
<td>231</td>
<td>8</td>
</tr>
<tr>
<td>4158</td>
<td>144 16 18 Runlet</td>
</tr>
<tr>
<td>75752</td>
<td>252 31$\frac{1}{2}$</td>
</tr>
<tr>
<td>9702</td>
<td>356 42 21$\frac{1}{2}$ Tiere</td>
</tr>
<tr>
<td>14529</td>
<td>504 63 34$\frac{1}{2}$ Hoghead</td>
</tr>
<tr>
<td>19279</td>
<td>672 84 43$\frac{1}{2}$ Puchenon</td>
</tr>
<tr>
<td>29106</td>
<td>1008 126 74$\frac{1}{2}$ But</td>
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<tr>
<td>52213</td>
<td>2016 252 14 8 6 4 3 2 1 Tun.</td>
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### Roman Measures of Capacity for Liquids, reduced to English Wine-measure.

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<tr>
<td>4</td>
<td>1</td>
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<tr>
<td>6</td>
<td>1 1$\frac{1}{2}$ Acetabulum</td>
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<tr>
<td>12</td>
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<td>19</td>
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<td>64</td>
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<td>120</td>
<td>72</td>
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<tr>
<td>135</td>
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<tr>
<td>144</td>
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### Beer and Ale Measure.

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<td>8</td>
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<td>12</td>
<td>6</td>
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### Scripture Measures of Capacity for things dry, reduced to English Corn measure.

<table>
<thead>
<tr>
<th>Gall. Pints. Solid inch.</th>
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<tr>
<td>0</td>
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<tr>
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<td>20</td>
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### Attic Measures of Capacity for Liquids, reduced to English Wine-measure.

<table>
<thead>
<tr>
<th>Gall. Pints. Solid inch.</th>
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<tbody>
<tr>
<td>0</td>
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<td>0.17</td>
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<td>0.51</td>
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<td>0.68</td>
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</tbody>
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### Attic Measures of Capacity for things dry, reduced to English Corn-measure.

<table>
<thead>
<tr>
<th>Gall. Pints. Solid inch.</th>
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### Measure of Ale.

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<th>Gall. Pints. Solid inch.</th>
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### Measure of Corn.

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<th>Gall. Pints. Solid inch.</th>
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</table>

### Measure of Capacity for things dry, reduced to English Corn-measure.

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<th>Gall. Pints. Solid inch.</th>
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### Measure of Wine Measurer.

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MEASUREMENTS FOR HORSES, is the hand, which
by statute contains four inches.

MEATUS AUDITORIUS. See ANATOMY.

MECHANICS, that branch of practical mathematics which considers motion and moving powers, their nature and laws, with their effects in machines.

The term mechanics is equally applied to the doctrine of the equilibrium of powers, more properly called statics; and to that science which treats of the generation and communication of motion, which constitutes mechanics strictly so called. See Statics, Power, Motion, 

The knowledge of mechanics is one of those things, says Mr. Mac Laurin, that serve to distinguish civilized nations from barbarians. It is by this science that the utmost improvement is made of every power and force in nature; and the motions of the elements, water, air, and fire, are made subservient to the various purposes of life; for however weak the force of man appears to be, when unassisted by this art; yet, with its aid, there is hardly anything above his reach. It is distinguished by sir Isaac Newton into practical and rational mechanics; the former of which treats of the mechanical powers, viz. the lever, balance, axis and wheel, pulley, wedge, screw, and inclined plane.

Rational mechanics comprehends the whole theory of motion, shews when the powers or forces are given how to determine the motions that are produced by them; and conversely when the phenomena of the motions are given, how to trace the powers or forces from which they arise.

Mechanical powers are simple engines that enable men to raise weights, to move heavy bodies, and overcome resistances, which they could not do with their natural strength alone. Their importance to society is incalculable. Every machine whatever is composed of one or more of them, sometimes of several combined together.

In considering this science, it will be necessary at first to take some things for granted that are not strictly true; and alter the theory is established, to make the proper allowances.

1. That a small portion of the earth's surface, which is spherical, may be considered as a plane.
2. That all bodies be supposed to descend in lines parallel to each other; for though all bodies really tend to the centre of the earth, yet the distance from which they fall is comparatively so small, that their inclination towards each other is inconsiderable.
3. That all planes be considered as perfectly smooth; levers to be inelastic, and without

three things are always to be considered in treating of mechanical engines; the weight to be raised, the power by which it is to be raised, and the instrument or engine by which this is to be effected.

The mechanical powers are generally reckoned six; the lever, the pulley, the wheel and axis, the inclined plane, the wedge, and the screw.

These perhaps may be reduced to two; for the pulley and wheel are only assemblages of levers, and the wedge and screw are inclined planes.

To calculate the power of a machine, it is usually considered in a state of equilibrium; that is, in the state when the power which is to overcome the resistance just balances it. Having discovered what quantity of power will be requisite for this purpose, it will then be necessary to add so much more as to overcome the friction and weight of the machine itself, and to give the necessary velocity.

The lever is the simplest of all machines; and is only a straight bar of iron, wood, or other material, supported on, and moveable round, a prop called the fulcrum.

In the lever there are three circumstances to be principally attended to: 1. The fulcrum, or prop, by which it is supported, or on which it turns as an axis, or centre of motion. 2. The power to raise and support the weight. 3. The resistance or weight to be raised or sustained.

The points of suspension are those points where the weights rest upon which they hang freely. The power and the weight are always supposed to act at right angles to the lever, except it is otherwise expressed.

The lever is distinguished into three sorts, according to the different situations of the fulcrum or prop, and the power, with respect to each other. 1. When the prop is placed between the power and the weight. 2. When the prop is at one end of the lever, the power at the other, and the weight between them. 3. When the prop is at one end, the weight at the other, and the power applied between them.

A polder, in stirring the fire, is a lever of the first sort; the bar of the grate upon which it rests is the fulcrum; the fuel, the weight to be overcome; and the hand is the power. The lever of the first kind is principally used for loosening large stones; or to raise great weights to small heights; or to get ropes under them, or other means of raising them to still greater heights; it is the most common species of lever.

ABC, Plate Mechanics, fig. 1. is this lever, in which B is the fulcrum, A the end at which

the power is applied, and C the end where the weight acts.

To find when an equilibrium will take place between the power and the weight, in this as well as in every other species of lever, it is necessary to recollect, that when the moments, or quantities of force, in two bodies are equal, they will balance each other. Now let us consider when this will take place in the lever. Suppose the lever AB (fig. 2) to be turned on its axis, or fulcrum, so as to come into the situation DC; the weight B is the farthest from the centre of motion, and as it has moved through the arch AD in the same time as the end B moved through the arch BC, it is evident that the velocity of AB must have been greater than that of B. But the moments being the products of the quantities of matter multiplied into the velocities, the greater the velocity, the less the quantity of matter need be to get the same product. Therefore, as the velocity of A is the greatest, it will require less matter to produce an equilibrium than B.

Let us next see how much more weight B will require than A to balance it. As the radii of circles are in proportion to their circumferences, they are also in proportion to their solids, and Consequently, as the arcs AD, CD, are similar, the radius or arm DE bears the same proportion to EC that the arc AD bears to CB. But the arcs AD and CB represent the velocities of the ends of the lever, because they are the spaces which they moved over in the same time; therefore the arms DE and EC may also represent these velocities.

It is evident then, that an equilibrium will take place when the length of the arm AE multiplied into the power A, shall equal EB multiplied into the weight B; and consequently, that the shorter EB is, the greater must be the weight B; that is, the power and the weight must be to each other inversely, as their distances from the fulcrum. Thus, suppose AE, the distance of the power from the prop, to be 20 inches, and EB, the distance of the weight from the prop, to be eight inches; and if the weight be five pounds, then the power to be applied at A must be two pounds; because the distance of the weight from the fulcrum eight, multiplied into the weight five, makes 40; therefore, 20, the distance of the prop, must be multiplied by two, to get an equal product, which will produce an equilibrium.

It is obvious, that while the distance of the power from the prop exceeds that of the weight from the prop, a power less than the weight will raise it, so that then the lever affords a mechanical advantage: when the distance of the power is less than that of the weight from the prop, the power must be greater than the weight to raise it; when both the arms are equal, the power and the weight must be equal, to be in equilibrium.

The second kind of lever, when the weight is between the fulcrum and the power, is represented by fig. 3, in which A is the fulcrum, B the weight, and C the power. The advantage given by this lever, as before, is as great as the distance of the power from the prop exceeds the distance of the weight from it. Thus if the point 4, on which the power acts, is seven times as far from A as

Q 2
the point b, on which the weight acts, then one pound applied at C will raise seven pounds.

This lever shows the reason why two men carrying a burden upon a stick between them, bear shares of the burden which are to one another in the inverse proportion of their distances from it. For it is well known, that the nearer either of them is to the burden, the greater share he bears of it; and if he goes directly under it, he bears the whole. So if one man is at A, and the other at a, having the pole or stick resting on their shoulders; if the burden or weight B is placed five times as near the man at A, as it is to the man a, the former will bear five times as much weight as the latter.

This is likewise applicable to the case of two horses of unequal strength to be so yoked, that each horse may draw a port proportionable to his strength; which is done by so dividing the beam they pull, that the point of traction may be as much nearer to the stronger horse than to the weaker, as the strength of the former exceeds that of the latter.

To this kind of lever may be reduced ears, rudders of ships, doors turning upon hinges, cutting-knives which are fixed at the point, &c.

If in this lever we suppose the power and weight to change places, so that the power may be between the weight and the prop, it will become a lever of the third kind; in which, that there may be a balance between the power and the weight, the intensity of the power must exceed the intensity of the weight just as much as the distance of the weight from the prop exceeds the distance of the weight. Thus, let E (fig. 4) be the prop of the lever EF, and W a weight of one pound, placed three times as far from the prop as the power P acts at F, by the cord going over the fixed pulley D; in this case the power must be equal to three pounds, in order to support the weight of one pound.

To this sort of lever are generally referred the bones of a man's arm; for when he lifts a weight by the hand, the muscle that exerts its force to raise that weight is fixed to the bone above, and the part in which the weight is borne is at the end of the arm, and the centre of the bone is the middle. And the arm being the centre round which the lower part of the arm turns, the muscle must therefore exert a force ten times as great as the weight that is raised.

As this kind of lever is a disadvantage to the moving power, it is used as little as possible; but in some cases it cannot be avoided, such as that of a ladder, which being fixed at one end, is by the strength of a man's arms raised against a wall.

What is called the hammer-lever differs in nothing but its form, from a lever of the first kind. Its name is derived from its use, that of drawing a nail out of wood by a hammer.

Suppose the shaft of a hammer to be five times as long as the iron part which draws the nail, the lower part resting on the board as a fulcrum; then by pulling backwards the end of the shaft, a man will draw a nail with one-fifth part of the power that he must use to pull it out with a pair of pincers, in which case the nail would move as fast as his hand; but with the hammer the hand moves five times as much as the nail, by the time that the nail is drawn out.

Let AC be a lever, and P represent a power of this sort, bent at C, which is its prop, or centre of motion. P is a power acting upon the longer arm AC, at A, by the means of the cord DA going over the pulley D; and W is a weight or resistance acting upon the end of the shorter arm CB. If the power is to the weight as CB is to CA, they are in equilibrium; thus suppose W to be five pounds, acting at the distance of one foot from the centre of motion C, and P to be one pound, acting at A, five feet from the centre C; the power and weight will just balance each other.

Thus we see, that in every species of lever there will be an equilibrium, when the power is to the weight, as the distance of the weight from the fulcrum is to the distance of the power from the fulcrum.

In making experiments on the mechanical powers, some difficulties arise from the weight of the materials; but as it is impossible to find any that are without weight, we take care that they are perfectly balanced themselves, before the weights and powers are applied. The bar, therefore, used in making experiments, is made of a sort of wood, as thick or thicker than the long arm, as will be sufficient to balance it on the prop.

Hitherto we have supposed that the power and weight acted perpendicularly upon the lever; but it may be supposed, that they act with some oblique force upon it; the power should, therefore, if possible, be always made to act at right angles to the lever.

If several levers are combined together in such a manner, as that a weight being applied to the first lever, may be supported by a power applied to the last, as in fig. 6. (which consists of three levers of the first kind), and is so contrived, that a power applied at the point L of the lever C, may sustain a weight at the point S of the lever A), the power must here be to the weight, in a ratio, or proportion, compounded of the several ratios, those powers that can sustain the weight of each lever being used singly and apart from the rest, have to the weight.

For instance: if the power which can sustain the weight P by the help of the lever A, is to the weight as 1 to 5; and if the power which can sustain the weight B by the lever B, is to the weight as 1 to 4; and if the power which can sustain the weight C, is to the weight as 1 to 3; then the power which will sustain the weight by the help of the three levers joined together, will be to the weight in a proportion consisting of the several proportions multiplied together, of 1 to 3, 1 to 4, and 1 to 5; that is, of 1 to 60.

For since in the lever A, a power equal to one-fifth of the weight P pressing down the lever at L, is sufficient to balance the weight; and since it is the same thing whether that power is applied to the lever A at L, or the lever B at S, or the point S bearing on the point L; a power equal to one-fifth of the weight P, being applied to the point S of the lever B, will support the weight; but one-fourth of the same power being applied to the point S of the lever C, will as effectually depress the point S of the same lever, as if the whole power was applied at S; consequently a power equal to one-fourth of one-fifth, that is, one-twentieth of the weight P, being applied to the point L of the lever B, and pushing up the same, will support the weight; in like manner, it matters not whether that force is applied to the point L of the lever B, or to the point S of the lever C, since, if S be raised, L, which rests on it, must be raised also; but one-fifth of the weight and one-fourth of the weight, or in other words, the one-hundredth part of the weight, being applied to the point L of the lever C, will balance the weight at the point S of the lever A.

The balance, an instrument of very extensive use in comparing the weights of bodies, is a lever of the first kind, whose arms are of equal length. The points from which the weights are suspended being equally distant from the centre of motion, will move with equal velocity; consequently, if equal weights are applied, their moments will be equal, and the balance will remain in equilibrium.

In order to have a balance as perfect as possible, it is necessary to attend to the following circumstances: 1. The beams ought to be exactly equal, both as to weight and length. 2. The points from which the scales are suspended should be in a right line, passing through the centre of gravity of the beam; 3. The weights should act directly against each other, and no part of either will be lost on account of any oblique direction. 3. If the fulcrum, or point upon which the beam turns, is placed in the centre of gravity of the beam, if the fulcrum and the points of suspension are in the same right line, the balance will have no tendency to one position more than another, but will be in every position in the same manner, and therefore, the fulcrum ought always to be placed a little above the centre of gravity. Its vibrations will be quicker, and its horizontal tendency stronger, the lower the centre of gravity, the less the weight of the point of suspension is loaded.

If the centre of gravity of the beam, when level, is immediately below the fulcrum, it will rest not in any position but when level; and if disturbed from that position, and then left at liberty, it will vibrate, and at last come to rest on the level. In a balance, therefore, the fulcrum ought always to be placed a little above the centre of gravity. Its vibrations will be quicker, and its horizontal tendency stronger, the lower the centre of gravity, the less the weight of the point of suspension is loaded.

4. The friction of the beam upon the axis ought to be as little as possible; because, should the friction be great, it will require a considerable force to overcome it; upon which account, though one weight should a little exceed the other, it will not preponderate, the excess not being sufficient to over come the friction, and bear down the beam.

The axis of motion should be surrounded with an edge like a knife, and made very hard; these edges are at first made sharp, and then rounded, with a fine hone, or piece of buff leather, which causes a sufficient bluntness, or rolling edge. On the regular form and excellence
More than the second, as the circumference of the second wheel exceeds that of the first axle.

In order to a balance here, the power must be to the weight, as the product of the circumferences, or diameters of the two axes multiplied together, is to the circumferences, or diameters of the two wheels.

This will become sufficiently clear, if it is considered as a compound lever, which was explained above. Instead of a combination of two wheels, three or four wheels may work in each other, or any number; and by thus increasing the number of wheels, or by proportioning the wheels to the axis, any degree of power may be acquired.

To this sort of engine belong all cranes or engines for raising great weights; and in this case the wheel may have cogs all round it, instead of handles; and a small lathe, or trudge, may be made to work in the cogs, and be turned by a wheel, which will make the power of the man who works it, as much as the number of revolutions of the winch exceeds those of the axle CD, fig. 9, when multiplied by the excess of the length of the winch above the length of the semidiameters of the circle, or by the radius of the semidiameter or half-thickness of the rope K, by which the weight is drawn up. Thus, suppose the diameter of the rope and axle taken together to be 18 inches, and the circumference of the wheel to be 66 inches, so that the weight W will hang at 63 inches perpendicular distance from below the centre of the axle. Now, let us suppose the wheel AB, which is fixed on the axle, to have 50 cogs, and to be turned by a winch 65 inches long, fixed on the axle of a trundle of eight staves, or rounds, working in the cogs of the wheel; here it is plain, that the winch and trundle would make ten revolutions for one of the wheel AB, and its axis CD, on which the rope K winds in raising the weight W; and the winch being no longer than the sum of the semidiameters of the great axle and rope, the trundle could have no power more than this length; and the man could have by pulling it round by the edge, because the winch would have no greater velocity than the edge of the wheel has, which we have here supposed in ten times as great as the velocity of the rising weight. In this case, the power gained would be as 10 to 1. But if the length of the winch is 13 inches, the power gained will be as 20 to 1; if 19 inches (which is long enough for any man to work by), the power gained will be as 30 to 1; that is, a man could raise 30 times as much by such an engine, as he could do by his natural strength without it, because the velocity of the handle of the winch would be 30 times as great as the velocity of the rising weight; the absolute force of any engine being in the proportion of the velocity of the power, to the velocity of the weight raised by it.

In this sort of machines it is requisite to have a ratchet wheel on the end of the axle C, with a catch to fall into teeth which will at any time support the weight, and keep it from descending, if the person who turns the handle should, through inadvertence or carelessness, quit his hold while the weight
These rules hold good, whatever may be the number of pulleys in the blocks. If, instead of rounding all the pulleys, the rope belonging to each pulley is made fast at top, as in fig. 17, a different proportion between the power and the weight will take place. Here it is attended that each pulley doubles the power: thus, if there are two pulleys, the power will sustain four times the weight.

Fig. 8, is the concentric pulley, invented by Mr. James White. O, R, are two brass blocks, in which grooves are cut; and round these a cord is passed, by which means they answer the purpose of so many distinct pulleys. The advantage gained is found by doubling the number of grooves in the lower block.

It is common to place all the pulleys in each block on the same pin, by the side of each other, as in fig. 18; but the advantage, and rule for the power, are the same here as in fig. 6.

A pair of blocks with the rope fastened round it, is commonly called a tackle.

The inclined plane. This mechanical power is of very great use in rolling up heavy bodies, as casks, wheelbarrows, &c. It is formed by placing boards, or earth, in a sloping direction.

The force wherewith a body descends upon an inclined plane, is to the force of its absolute weight, as the sine of the given angle of the plane, to the perpendicular, or height of the plane, to its length. For suppose the plane AB (fig. 19) to be parallel to the horizon, the cylinder C will keep at rest on any part of the plane AB it is laid on. If the plane is placed perpendicularly, as AB, fig. 20, the cylinder C will descend with its whole force of gravity, because the plane contributes nothing to its support or hindrance; and therefore it would require a power equal to its whole weight to keep it from descending.

Let AB (fig. 21) be a plane parallel to the horizon, and AD a plane inclined to it; and suppose that the length AD to be ten times as great as the perpendicular DB. In this case, the cylinder E will be supported upon the plane DA, and kept from rolling, by a power equal to a third part of the weight of the cylinder, if therefore a wedge may be rolled up this inclined plane, by a third part of the weight of the wedge, which would suffice to draw it up by the side of an upright wall.

It must also be evident, that the less the angle of elevation, or the gentler the ascent is, the greater will be the weight which a given power can draw up; for the steeper the inclined plane is, the less does it support of the weight; and the greater the tendency which the weight has to roll, consequently the more difficult for the power to support it: the advantage gained by this mechanical power, therefore, is as great as its length exceeds its perpendicular height.

To the inclined plane may be reduced all hatches, chisels, and other edge-tools.

The wedge is the fifth mechanical power or machine: it may be considered as two equally inclined planes, joined together at their bases; then DG (fig. 22) is the whole thickness of the wedge at its back ABG, where the power is applied; EF is the depth or height of the wedge; BF the length of one of its sides; and OF is its sharp edge, which is entered into the wood intended to be split, by the force of a hammer or mallet striking perpendicularly on its back. Thus, A B (fig. 23) is a wedge driven into the clerk C D of the wood FG.

When the wood does not cleave at any distance from the wedge, there will be an equilibrium between the power impelling the wedge downward, and the resistance of the wood acting against the two sides of the wedge, when the power is to the resistance as half the thickness of the wedge at its back is to the length of either of its sides; because the resistance then acts perpendicular to the sides of the wedge. But when the resistance on each side acts parallel to the back, the power that balances the resistances on both sides will be, as the length of the whole back of the wedge is to double its perpendicular height.

When the wood cleaves at any distance before the wedge (as it generally does), the power impelling the wedge will not be to the resistance of the wood as the length on the back of the wedge is to the length of both its sides, but as half the length of the back is to the length of either of its sides, estimated from the top or acting part of the wedge. For, if we suppose the wedge to be lengthened down from the top CE, to the bottom of the clerk at D, the same proportion will hold, namely, that to double the resistance as half the length of the back of the wedge is to the length of either of its sides: or, which amounts to the same thing, as the whole length of the back is to the length of both its sides.

The wedge is a very great mechanical power, since not only wood, but even rocks, can be split by it; which it would be impossible to effect by the lever, wheel and axle, or pulley; for the force of the blow, or stroke, shakes the cohering parts, and thereby makes them separate more easily.

The screw (fig. 24) is the sixth and last mechanical power, but cannot properly be called a lever. By a screw a current of water never used without the application of a lever or wedge to assist in turning it; and then it becomes a compound engine of a very great force, either in pressing the parts of bodies closer together, or in lifting heavy weights. It may be conceived to be formed by a piece of paper, ABC (fig. 25), into the form of an inclined plane, or half-wedge; and then wrapping it round a cylinder (fig. 26), the edge of the paper AC will form a spiral line round the cylinder, which will give the thread of the screw. It being evident that the winch must turn the cylinder once round, before the weight of resistance can be moved from another; therefore, as much as the circumference of a circle described by the handle of the winch is greater than the interval or distance between the spirals, so much is the force of the screw. Thus, supposing the thickness of the spirals to be half an inch, and the length of the screw twelve inches, the circle described by the handle of the winch where the power acts will be 76 inches nearly, or about 159 half-turns, which nearly 122 times as great as the distance between the spirals; and therefore a power at the handle, whose intensity is equal to no more than a single pound, will balance 152 pounds acting against the screw; and as much additional force as...
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is sufficient to overcome the friction, will raise the 152 pounds; and the velocity of the power will be the velocity of the weight, as 152 to 1.

Hence it appears, that the longer the winch is, and the nearer the spirals are to one another, so much the greater is the force of the screw.

A machine for shewing the force or power of the screw may be contrived in the following manner:—Let the wheel C have a screw (fig. 24) on its axis, working in the teeth of the wheel D, which suppose to be 48 in number.

It is plain, that for every time the wheel D is turned, and screwed by the winch A, the wheel D will be moved one tooth by the screw; and therefore, in 48 revolutions of the winch, the wheel D will be turned once round.

Then, if the circumference of a circle, described by the handle of the winch A, is equal to the circumference of a groove round the wheel D, the velocity of the handle will be 48 times as great as the velocity of any given point in the groove. Consequent ly, i.e., a line so many pounds hung to the wheel, has a weight of 48 pounds hung to it, a power equal to 1 pound at the handle will balance and support the weight. To prove this by experiment, let the circumferences of the groove of 48, and the cylinder of 48, be equal to one another; and then if a weight H, of 1 pound, is suspended by a line going round the groove of the wheel C, it will balance a weight of 48 pounds hanging by the line G; and a small addition to the weight H will cause it to descend, and so raise up the other weight.

If a line G, instead of going round the groove of the wheel D, goes round its axe I, the power of the machine will be as much increased as the circumference of the groove exceeds the circumference of the axe; which suppose to be six times, then one pound at H will balance six times 48, or 288 pounds, hung to the line on the axe; and hence the power or advantage of this machine will be as 288 to 1. That is, a man who by his natural strength could lift a hundredweight, will be able to raise 285 cwts. by this engine. If a system of pulleys was applied to the cord HI, the power would be increased to an amazing degree.

When a screw acts in a wheel in this manner, it is called an endless screw.

When it is not employed in turning a wheel, it consists of two parts: the first is called the male or outside screw; being cut in such a manner, as to have a prominent part going round the cylinder in a spiral manner, which prominent part is called the thread of the screw; the other part, which is called the female, or inside screw, is a solid body, cut transversely, whose concave surface is cut in the same manner as the convex surface of the male screw, so that the prominent parts of the one may fit the concave parts of the other.

A very considerable degree of friction always acts against the power in a screw; but this is fully compensated by other advantages; for on this account the screw continues to sustain a weight, even after the power is removed, or ceases to set, and presses upon the body against which it is driven. Hence the screw will sustain very great weights; insomuch that several screws properly applied, would support a large build,

ing, whilst the foundation was mending, or renewed.

OF COMPOUND MACHINES.

Though it is evident from the principles delivered above, that any one of the mechanical powers is capable of overcoming the greatest possible resistance, in theory; yet, in practice, if used singly for producing very great effects, they would be frequently so unwieldy and unmanageable, as to render it impossible to apply them. For this reason, it is generally found more advantageous to combine them together; by means which the power is more easily applied, and many other advantages are obtained. In all machines, simple as well as compound, what is gained in power is lost in time. Suppose that a man, by a fixed pulley, raises a beam to the top of a house in two minutes, it is clear that he will be able to raise six beams in twelve minutes; but by means of a tackle, with three lower pulleys, he will raise the six beams at once, with the same ease as he before raised one; but then he will be six times as long about it, that is, twelve minutes; thus the work is performed in the same time, whether the mechanical power is greater or not. But the convenience gained by the power is very great; for if the six beams are joined in one, they may be raised by the tackle, though it would be impossible to move them by the unassisted strength of one.

Consequently, if by any power you are able to raise a pound with a given velocity, it will be impossible, by the help of any machine, to raise two pounds with the same velocity. But, by the help of a machine, you may raise two pounds with half that velocity, or even one thousand with the thousandth part of that velocity; but still there is no greater quantity of motion produced, when a thousand pounds are moved, than when one pound is moved; the thousand pounds moving proportionally slower.

No real gain of force is, therefore, obtained by mechanical contrivances; on the contrary, from friction, and other causes, the working parts are always lost; the machines we are able to give a more convenient direction to the moving power, and to apply its action at some distance from the body to be moved, which is a circumstance of infinite importance. By machines also, we can modify the energy of the moving power, as to obtain effects which it could not produce without this modification.

In machines composed of several of the mechanical powers, the power will be to the weight, when they are in equilibrio, in a proportion formed by the multiplication of the several proportions which the power bears to the weight in every separate mechanical power of which the machine consists.

Suppose a machine, for instance, composed of the axle in the wheel, and a pulley; let the axe and wheel be such, that a power consisting of one-sixth of the weight will balance it; and let the pulleys be such, that by placing the power equal to one-fourth of the weight, we would support it: then, by means of the axe in the wheel, and the pulleys combined, a power equal to one-fourth of one-sixth, that is, ⅙ of the weight, will be in equilibrio with it.

In contrivings machines, simplicity ought particularly to be attended to; for a complicated machine is not only more expensive, and more apt to be out of order, but there is also a greater degree of friction, in proportion to the number of rubbing parts.

Whatever may be the construction of a machine, its power will proceed directly as the proportion of the velocity of the power to the weight; and so that this is obtained in the greatest degree that circumstances will admit, or that are necessary, then the fewer parts the better.

It is evident from the principles already laid down, that the velocity of a machine is equal to that of a pinion, or smaller wheel which is driven by it, in proportion to the diameter, circumference, or number of teeth in the pinion to that of the wheel. Thus, if the number of teeth in a wheel are 60, and those of the pinion 5, then the pinion will go 12 times round for once of the wheel, because 60, divided by 5, gives 12 for a quotient.

Hence, if you have any number of wheel's teeth, and wish to divide the product of the teeth in the wheels by those in the pinions, and the quotient will give you the number of turns of the last pinion in one turn of the first wheel. Thus, if a wheel (fig. 27) of 48, acts upon a pinion B of 8, on whose axis there is a wheel C of 40, driving a pinion D of 6, carrying a wheel E of 36, which moves a pinion F of 6, carrying an index; then the number of turns made by the wheel A will be equal to: 8X4X3=96, 96=240, the number of turns which the index will make while the wheel A goes once round.

Any number of teeth on the wheels and pinions having the same ratio, will give the same number of revolutions to an axis; thus, 8X4X3=96, 96=240, as before. It therefore depends upon the skill of the engineer, or mechanic, to determine what numbers will best suit his design.

It is evident, that the same motion may be performed, either by one, or by a number of machines, or by many wheels and pinions, provided the number of turns of all the wheels bear the same proportion to all the pinions which that one wheel bears to its pinion.

When a wheel is moved immediately by the power, it is called a leader, and B becomes a follower. If there is another wheel on the same axis, it is called the follower. Thus A, being moved immediately by the power, is to be considered as a leader, and B as a follower; the wheel C being driven by B, becomes a leader, and D a follower; E (fig. 28) is a leader, and the cylinder F may be considered as a follower.

Sometimes the same wheel acts both as a leader and a follower; as in fig. 29, where B is moved by A, and consequently is a follower; while, as the cylinder D is led by B, it is also a leader. Therefore, as to multiply both the divisors and dividend by the same number does not alter the quotient; in mechanical calculations, every wheel that is both a leader or a follower may be treated of as a single leader. The power of a machine is not at all altered by the size of the wheels, provided the proportions to each other are the same.

On the application of men and horses, as moving powers in machinery, &c. A horse draws with the greatest advantage, when the line of draught is not level with his breast, but
MEDAL. denotes a piece of metal in the form of coin, such as was either current mon-
ey among the ancients, or struck on any particular occasion to preserve the portrait of some great person, or the memory of some illustrious action, to posterity. Its etymology is not explained, but is of little consequence, though the best authorities give it from a "met-
tallum."

To enlarge on the utility of medals in the sciences, were needless. As historical doc-
uments, they form the principal evidence we can have of the life of our ancestors. In some few instances they correct the names of sovereigns; and in a great many, illus-
trate the chronology of reigns. By their as-
sistance the geographer has sometimes been enabled to determine the situation of a town whose name alone has reached us. To the naturalist they afford the only proofs of the knowledge which the ancients had of certain plants and animals; and they sometimes pre-
serve details of historical buildings for the tect, of which not even a ruin is, at this day, standing. The connection of medals and poetry has been treated at considerable length by Mr. Addison. To the connoisseur they are not entirely necessary, as they enable him to appreciate the busts and portraits of antiquity. And the scholar need hardly be reminded that they have contributed in so small degree to the elucidation of obscure passages in the classics. The altering of the Greek coins is one of the best schools of study for the sculptor.

The study of medals, perhaps, is not of very ancient date. The preservation of the Greek coins among their choicest treasure, is said to have been one of those marks of due respect which the Romans showed the Greeks: but the knowledge of medals in se-
ries does not seem to have formed a distinct branch, either of study or entertainment, till the revival of literature in Europe. Petrarch is related to have been one of the first who began to study the medallie science. Al-
phonso, king of Aragon, formed another col-
lection.

And a third was placed by Cosmo de Medici in Florence, of the curiosities in the Museum at Florence.

In this country, though we know of the ex-
istence of no cabinet before the time of Cam-
den, it may be fair to suppose that the know-
ledge of Greek and medals was introduced from Italy. The "Britannia" was the first work in which engravings of them were pro-
duced: and Speed's Chronicle, which soon followed it, was illustrated with coins from the collection of Sir Robert Cotton. Henry prince of Wales was one of the first who had a rich cabinet; and he bequeathed it at his de-
th to Charles. The most considerable of our other early collectors were, archbishop Land, lord Arrolld, Mr. Selden, Oliver Cromwell, we are told, had small collec-
tion; and the cabinet of Charles the Second is mentioned by Vaillant.

In the article here presented to the reader's notice, we shall give first a brief account of the coins of the most antient nations which are still extant; reserving the Greek and Roman, which are the most interesting of all coins, for a more extended view; add-
ing, at the close, a particular though con-
densed history of the coins and coinage of England. For the first part, as well as for

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MEDICUM, in pharmacy, the extract of English pippins. Mecconium has all the vulcan of the foreign opium, but in a some-
what lower degree.
MEDALS.

part of an ounce, of which Mr. Pinkerton describes the nominal value to be 4
sterling: the diadrachm, tradrachm, and tetradrachm, explain themselves, except the
tetradrachm of the Augustan standard, which was valued at five shillings. This last was
the largest form of the Greek silver coin. The silver divisions of the drachma were the
tetroboion, the hemidrachma or trithron, the diobolion, the obolus, the hemiobolion, the
tetrobolion, and diachalkos; the first of the va-
tue of sixpence, and half a crown. Of the distinct names by which many of
these coins were called among the different states, our intelligence is partial; nor are
such names of consequence.

The next Greek coinage, in point of antiquity, is that of copper, which is said not to
have been introduced till four hundred and four years before the Christian era. The
first copper coin of Greece was the chalcus, of which two went to the quarter of the silver
ounce. In days of prosperity, however, even this was divided by different states into dif-
dent portions, which were called aetta, or little coins. The lepton, dilepton, and
trochyleon, were the divisions of the chalcus, the smallest of which, the diachalkos, the
size, are very rare. Such were the brass coins of Greece previous to the subjacent
of that country to the Roman empire.

The earliest of the gold coins of Greece are those of Philip of Macedon, although they
were struck in Sicily considerably earlier. Philip, having conquered the city Crenides,
on the confines of Thrace, found gold-mines in its neighbourhood, formerly ill explored,
and of small produce. From this gold he first struck the coins called Philippus, because of
his portrait which appears on them. The Philippus it should seem were diadrachms, the
form most universal in the ancient coinages of gold; and at their first appearance went for
20 silver drachmas, but in latter times for 2: Greek drachma or Roman denarius. The
Philippus was also called ἄσπες. There were likewise the τριπλάσιον and the τετραπλά
σιον, with gold double the weight, which could not have gone for more than double the
silver. There were also the 2 θεσσαλικά and the Τριτεραχάς, or quadruple ἄσπες; the for-
mer worth about two, and the latter worth about four mullets of our money.

The original value of the Roman coin is a subject still more intricate and extensive. As
in Greece, the first estimation of their money was by weight: though copper, not silver,
was the first medium of coinage. The first Roman coinage, according to Mr. Pinkerton,
was in the reign of Tiberius and Caracalla, about the year 430 before the common era, and
was to the as or 2s libra, or piece of brass only, which was stamped with the two-
headed image of Janus on one side, and the prow of a ship on the other; though Mr. Pinsky
afterward thinks, it probable that the very first Roman ases of Tullus had the figure of a bull, ram, or other species of cat-
tle. However this may be, parts of the as were very early given in proportion of weight
and value: such were the semi or half, the	trios, the quadans, the sextans, and the uncia.
After a certain period, the as, though still called the ases ouo or piece of brass, fell in weight; larger denominations were
coined. Such were the bissus or dupondius,
emperors’ heads in their several medals. The

crown of laurel is continually seen; and

Agrippa appears not only, with the crown, but the mural crown. The successors of Alexander assumed, by way of distinction, different symbols of deity on the busts of their medals. A few instances also occur, among the Roman coins, of the helmet.

The reverses of medals, both among the Greeks and Romans, were of infinite variety. They contain figures of deities at whole length with their attributes and symbols; public buildings and divers ions; allegorical representations, historical and private events; figures of ancient statues; subjects of natural history; magistracies, &c.

The reverses of the Roman coins have more of art and design than the Greek, though the latter have more exquisite relief. It is very evident that no reverse is found, and of the ancient Greek reverses some are in

The figures of deities and personifications on the Roman coins, are commonly attended with the names: the figure of Virtue with VIRTVS AVGVS; but on the reverse of the Greek coins the figure is only accompanied by some certain symbol; as in Athens, wheaten garland, Man with his arm or, Mercury with his caduceus. The anchor on Seleucian coins is the mark of Antioch; the owl, of Athens; the labyrinth, of Crete; the horse, of Thessaly; and so on.

Of the legends, the early Greek coins usually contain the name or the initials of the city they belong to; or the name, the first character of it, or the monogram, of the prince. The earliest coins of Athens have only ΑΘ, money of Athens: ΣΤ, of Syrakusis; ΜΑΣ, of Massilia. ΣΥΑΛΟΚΟΣΙΝ occurs at full length, as well as ΦΙΛΙΑΠΟΣ for Philip of Macedon. And though in aftertimes the names of princes were accompanied by modest adjacents, there were others that were not a little proud. Of the former were ΔΙΚΑΙΟΥ, ΕΥΣΕΒΟΥΣ ΦΙΛΑΞΗΝ of the latter, ΘΕΟΛΑΡΟΤΟΣ, ΒΑΣΙΛΕΩΣ ΒΑΣΙΛΙΑΝ, &c.

After the Roman empire had swallowed up the Greek, the legends on Greek coins became as remarkable for length as they had before been for brevity. The Greek imperial coins have a great variety in their legends, which explains the variety of the reverses ranging in adulteration. The legends of the Roman imperial coins are still more deservedly celebrated for their beautiful simplicity. ΙΝΔΕΑ ΚΑΠΤΑ and ΑΣΙΑ ΣΟΒΑΣΚΑ are sufficient instances.

Of the pieces produced by the ancient mints, there were some of a size which seemed evidently to have been intended for something else than circulation. Medallions were occasionally presented by the emperor to his ministers; and sometimes by the imitator to the emperor as specimens of workmanship. These are usually known by their weight, which is far greater than that of the acknowledged money. Both the Greek and Roman medallions appear to have been principally struck in the imperial periods. Till the time of Hadrian they are rare. For a more full account of them, we refer to the work of Mr. Pinkerton.

To dwell longer on the various types and titles of the Greek or the Roman coins, would be superfluous. Their curiosity and elegance are infinite. The regal coins of Greece are interlaced from their portraits; the coins of cities, from their importance to geography. On the consular coins of Rome, the names and titles of the consuls do not appear till toward the close of the series; the brass consular coins are uninteresting. The imperial brass is of three sizes, large, middle, and small; the first forming a series of the greatest beauty. The imperial silver coins are numerous; the gold, of wonderful perforation. Often a half obverse having occurred both upon the Greek and Roman coins, we shall refer to the Tables selected by Mr. Pinkerton, as it would be impossible, in so concise a work as this, to give every information which the collector might require. The best works upon the Greek and Roman coins are probably these: Froelich’s Notitia Eccentricae; Numa’s Poema, &c. We refer the student to that work for the means of learning the names of the emperors, and their titles.

Those of Stephen which have the banner, are the rarest. The pennies of Henry the Second are also scarce; of Richard the First we have only the French penny; and of John only a copper mark. Of Edward the Third, though of the last there are not only pennies but halfpennies and farthings. The first coinage of Henry the Third had only on the obverse BERNICVS REX; and his penny was large and weighed no longer personally ascribed to Henry the Second. After his 39th year, we find III or TERCII added to the title. The pennies, halfpennies, and farthings of Edward, the First are all common. Salford pennies have EDW. RANGL. DNS.HIBY upon the obverse, are usually ascribed to Edward the First; those with EDWA. or EDWAR. to Edward the Second; and those with EDWARD or EDWARDVS to Edward the Third. This, however, is but conjecture. In the 18th of Edward the Third, the penny was brought down to 20 grains; and in his 27th year, we had halfpence and halfpence, in which the king’s head was surrounded by a sort of a double treble. In the reign of Edward the Fourth, having previously sunk to 13, the penny fell to 12 grains. In Edward the Fifth’s time, it was reduced to 6, and in Elizabeth’s to little more than seven. Of the groats, Richard the Third is very rare. In 1503, Henry the Seventh coined the shilling or testoon: it resembled the groat, but had no more value than 145 or 150 farthings. The crown of silver was first struck by Henry VIII. and the half-crown, sixpence, and threepence, by Edward the Sixth. Elizabeth, in 1558, coined three halfpence, and in 1568, three forthing pieces; but they were disused in 1582. Henry the Eighth was the first of our princes who debased the coinage; and in the earlier part of Edward the Sixth’s reign, the practice was continued. But from the 4th of Elizabeth, 1601, the denomination, weight and fineness of English silver, have remained the same. From 1601 to 1628, the money of Elizabeth was of a new taste. By a mill and screw; but the artist of this money being hanged for counterfeiting coins, the hammering system was again recurred to. Till the time of Charles the Second, we have little more of the milled money.

The design of a gold coinage appears to have been first formed by Henry the Third, the most particular account of which is to be found in Lord Liverpool’s Letter to the King. The piece ordered to be current was called a gold penny; but being of too great value for general circulation, it was in two or three years called in, and now but three specimens of gold halfpence and halfpence, to be a beautiful specimen of the coinage of the time. The obverse is much in the manner of the king’s great seal, and the inscription HENRICI REX III.; on the reverse, the mint-master’s name and place. The three known are all of different types: one reads LVND, another LVNDE, and the third LVNDEN. But it is from Edward the Third that the series of our gold coins commences. In 1244, he struck the florin, half, and quarter florin. The florin was current for six shillings, but
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was the same year succeeded by the noble,
the value of which was half a mark. Henry
the Fifth diminished the value of the noble;
and Henry the Sixth restored it to its size, and
gave it the name of ryal; while Edward the
Fourth, in 1465, supplanted it with the angel.
Henry the Eighth, in 1523, added the gold
crown and the sovereign to their present
value: the sovereign of 22s. 6d.; the crown
at 2s. 6d.; and the noble at its old value.
In 1546, he coined sovereigns and
half-sovereigns, the former to go at 20s.
and the latter in Occre, Charles the Second,
however, instead of the sovereign and
the guinea and half-guinea. George the First
added the quarter-guinea. But though it was
continual in the early part of the reign of
his present majesty the seven-shilling piece
has been preferred.

The history of our copper coinage, the
last in order of chronology, will be shorter.
From the reign of Henry the Eighth till the
close of his reign, the scarcity of silver
halfpence and halfpence, up to the
introduction of tokens or pledges for
money among tradesmen, many of which are
thereafter employed to what in what has been said
by Erasmus, and other learned
men. Elizabeth, it appears, would neither
hears of a copper coinage for the country;
and though farthing tokens of copper were
issued both under James and Charles the First,
they were considered rather as pledges of
a government than legitimate money. The
death of Charles the First put an effectual
stop to their further currency; and till 1672.
the farthing was employed with town pieces
and tradesmen's pledges; seven, in the
latter year, halfpence and farthings of copper
were made public money, and the circulation of
tokens forbidden. His present majesty has
added two-shilling pieces.

MEDEOLA, Clingking African aegraphe, a genus of the hexandria order, in the
trigynia class of plants, and in the natural method
ranging under the 11th order, sarcc-
mentacea, a family of the corolla is sepertite and revoluted; the
seeds are spurious. Its characters are these: the flower
has no emplente; it has six oblong oval
petals, and six and-bladed zamina terminated
by a single pistil, and a straight
germina terminating the style; the
germina afterward turn to a roundish trided berry with
two cells, each containing one heart-shaped
seed. There are three species.

MEDICAGO, small-trained, a genus of
the decandria order, in the diacleral class of
plants, and in the natural method
ranging under the 22d order, papilionacea. The
leaves is compressed and screwed; the cali-
bris of the corolla is doved in the vex-
illum. There are 12 species, though only
five are commonly cultivated in this country.
They are low trifling plants, adorned with
small yellow flowers, succeeded by small
round snail-shaped fruit, which are downy,
and armed with a few sharp spines. They
are easy propagated by seeds. The M.
sempervirens, has been latterly much
reputed as a green fodder for cattle, and
has been cultivated by some farmers with
success.

MEDICINE, is the art of preserving
health, and of curing or alleviating disease.
It is the same science in its application to
animal, as agriculture to vegetable, life.

Origin and progress of medicine. "Med-
cinae usque ad non est." This art arises
out of the natural, as others more gradually
and indirectly originate from the artificial and
adventitious, wants of mankind. The exact
period, however, in which medicine began
to be formally practised as an art, or sepa-
rately cultivated as a profession, has by no
means been accurately ascertained. All the
accounts which have been transmitted on
this subject from a date prior to the time of Hip-
ocrates, are either conjectural or fabulous.
Hippocrates first effected a separation of
medicine from philosophy and science, and
gave it the form of a distinct science: he has there-
fore been generally regarded by the moderns
as the father of physic; and from his time
the history of this science may be made with

Hippocrates was a native of Greece. He
was born in the island of Cos, and flourished
about 400 years prior to the christian era.
He was, in his character as a physician, an
estimate cure, professedly with the accuracy,
be formed from his writings, or from those works
which have been attributed to him, but which
are generally regarded as in a great measure
the inventions of his disciples and successors.
"Hippocrates," says an authority,
"lived at too early a period to be acquainted
with the collateral branches of science. He
studied life and disease in the book of nature,
and had the merit of an original observer."
We do not, however, appear to have
this author fully to acquit the "Coan sage
of the many idle theories which have been
imputed to him." It may well be conceived that
he was influenced in his opinions on the
disease of the cause and the nature of disease,
particularly, if not by the splendid ficitions of the Greek
philosophy, by preconceived theory and vague
conjecture. Indeed, the hypotheses contain-
ed in the reputed writings at least of Hippo-
ocrates, have been, with trivial modifications,
the hypotheses of modern times; for in this
author's perceiving and pressing principle
of nature, and in his attraction, depuration,
decosition, and crisis of disease, he may be traced
the same mode of theorizing which has been
adopted by later systematics.

The humoral pathology, and even the vis
natural medicatrix of modern times, appear
to be modifications or relics of Hippocratic
reasoning.

The immediate successors of Hippocrates
began to direct their researches into the aux-
iliary departments of medicine; and among
these, Praxagoras, Chrysippus, Hephatus,
and Erastius, particularly the two last,
made no inconsiderable discoveries (when we
consider the scantiness of their materials)
respecting the structure and functions of the
human frame. It was during his period, ac-
cording to Celsus, that the science was di-
vided into the three distinct branches of
dietetic, pharmacological, and chimerical
medicine—vis manu operata, vis medicamentosi,
tertia quae manu medicatur. Shortly
after the time of Herophilus, the medical
work became divided into the two sects of
empirics and dogmatists; the one, rejecting
the reasoning and deriding the practice of
their predecessors, affected to divest all
authority but that of experience; the other,
retaining their faith in the scholastic philoso-
phy of the times, and their conviction of the
utility of physiological knowledge in detect-

ing the causes and regulating the treatment of
disease. The empiric sect was founded by
Sparacio of Alexandria, about 257 years be-
fore Christ.

The next revolution in importance in
the medical art was occasioned by the introduc-
tion of the Epicurean philosophy into the
schools of medicine. This was effected by
Asclepiades, who was succeeded by Themi-
sion, the founder of the medical sect, the
members of which were equally hostile to the
dogmatists and empirics. They discarded
what they considered the occult reasoning of
the former, and substituted in the room of the
laborious observations of the latter, indica-
tions of treatments deduced from the analogy
of diseases, or the mutual resemblance they
bear to each other, "nullus causae nostrum
quisquam ad curatum pertineat; satius
case quidem commuee morborum medici
temethodici contundit," Celsus. The most
celebrated of Themison's followers were
Thelephilus, who flourished under the em-
peror Nero, and Soranus, a native of Ephesus,
who lived during the time of the emperors
Trajan and Adrian.

We have now arrived at a very conspicu-
ous era in the science of medicine. About
the 13th year after Christ, in the reign of
Adrian, lived the celebrated Galen, who was
more than 150 years before our period.
Galen undertook the reformation of medi-
cine, and affected to reconcile the Epicurean
philosophy and practice. Instead, however,
of abiding by the doctrines of his master, his
system was almost entirely of his own in-
vention. "Both philosophy and science had
made some advances; and from those sources
Galen introduced many corruptions into
medicine." Like Hippocrates, he supposed
the existence of four humours, from the pre-
dominancy or deficiency of one or other of
which the varieties of constitutional
theisoic,

The complexity and nature of disease
were conjured to originate. These
humours are, in the Galenic system, the blood,
the phlegm, the yellow bile, and the black
bile. He likewise attached different
kinds of spirits—the natural, the vital, and
the animal; the first of which he supposed to
be a subtle vapour arising from the blood;
the last, to the heart, becomes, when
conjoined to the air taken into the lungs,
the vital spirits, which are changed into the
animal kind in the brain. These three species
of spirits our author imagined to serve as
substrates to distinct faculties: the
natural faculty, which he supposed to reside
in the liver, and to preside over the nutrition,
growth, and generation of the animal body;
the vital faculty, which he lodged in the
heart, yellow bile, and the black bile.
He likewise attached different
kinds of organs—arteries, veins, nerves, and
the like. The special functions of each
organ or principle of motion in these respective
faculties, Galen, as well as Hippocrates, calls
nature.

The authority of Galen, notwithstanding
the tissue of extravagances and idle conject-
ratures of which his systems were founded,
con-
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In this work it is asserted, or rather perhaps conjectured, that a known channel, passes from the pulmonary arteries into the veins. Even allowing that this intimation justly laid claim to the title of a discovery, it is merely a discovery of the passage of the blood through the lungs, could in no measure interfere with the merit or be regarded as an anticipation of the Harveyan doctrine.

The period, however, had not yet arrived when a rational system to be made of medical facts and important in question. As the alchemists had derided the Galenists, so the reasons of the latter were now to give way to the mathematical art of physicians, who by axioms, postulata, theorems, problems, experiments, and corollaries, ("a capite alcali armatss, et necem unidine ministrant," attempted to explain, in the most futile manner, the functions of life, and to regulate the remedial practice.

The learned and industrious Boerhaave, of Leyden, whose name stands conspicuous in the annals of medicine, at length attempted to restore the authority of the ancient writings; and by uniting the doctrines of Hippocrates with those of Paracelsus, he framed a theory of medicine upon the supposition of acrimony, leucor, and other changes in the circulating fluids. From these changes he inferred the origin of all disease; and the process of cure is, according to Boerhaave, either the process of correcting or expelling acrimony from the body, or the correction of morbid viscidity or tenuity in the humourists. Boerhaave has, therefore, been considered the founder of the humoral pathology; a pathology which even to this day retains a material influence on the opinions, the phrenologism, and the practice at least of the vulgar.

Contemporary with Boerhaave was the illustrious Hoffmann, a German professor, and founder of a medical system. Dr. Stahl havig first suggested, or rather borrowed from the ancients, the idea of the rational soul of man governing the economy of his body, and divating the adverse tendency of noxious agents by exciting such actions in the system as are calculated to effect their expulsion, or destroy their malignity; Stahl endeavoured to state, that the first operation of the cause creating disease was the production of universal aloy or spasm in the primary moving powers of the system, and did not consist of changes produced either in the quantity or quality of the humours or fluids of the body, as taught by the celebrated Boerhaave.

The humoral, however, continued to prevail over the pathology of Hoffmann; and Dr. Cullen informs us, that "when he came to take a professorship in the university of Edinburgh, he found the Boerhavian system then in its full force." In framing a system of his own, Dr. Cullen reverted to the theory of Hoffmann; and indeed the whole of his pathology, in fact, relates to two leading diatomic doctrines, is scarcely anything more than an attempt to unite the hypothesis of Hoffmann with the Stahlian principle of an intelligent, preserving, and preservative power.

We have thus rapidly conducted our readers over the ground of medical history, and have presented a faint outline of the prevailing systems of medical philosophy, from the time of the Grecian to the time of the "Future Hippocrates," to the period when the fanaticism and prejudice of system were shortly to give way before the precepts of genuine philosophy and temperate induction; when new eras should be established upon a new foundation; when chemistry was to undergo a reform, equally rational and important; when by consequence a new alliance was to be formed between these two sciences, the language of metaphor and hypothesis was to be discarded from either; and when enquirers after truth were to be influenced and directed by the independent and invaluable axiom, "Nil prius regeri, nisi primum intelligi."
which Brown aimed at. His division is a guide to the student, but not to his physician. A recent attempt has been made to include in one scheme both general principles and particular facts. This plan, however, notwithstanding the boldness of conception by which it was conceived, and the brilliancy by which it has been executed, is defective. It rests upon a hypothetical, and therefore upon a sandy, foundation. Our readers who are acquainted at all with modern medicine, will be at no loss to conclude that we refer to that system of the late Dr. Darwin. By this author, excitability, which was left as an ultimate fact in the Brutonian theory, is attempted to be traced to its origin. The sensorial power, excitability, or spirit of animation, is conceived to be "a subtle fluid, residing in the brain and nerves, and liable to general or partial accumulation." The vital changes effected by the medium of this imaginary fluid, are, 1st, "Irritation, which is an excitement or change of some extreme part of the sensorium residing in the muscles or organs of sense, in sequence of the appulse of external bodies. 2. Sensation, which is the power to perceive the several parts of the sensorium, or of the whole of it, beginning at some extreme parts of it, which reside in the muscles or organs of sense. 3. Volution is an excitement or change of the central parts of the sensorium, or of the whole of it, terminating in some extreme parts of it, which reside in the muscles or organs of sense. 4th. Association is an excitement or change of some extreme part of the sensorium residing in the muscles or organs of sense, in consequence of some antecedent or attendant fibrous contractions."

With these assumptions as his guide, Dr. Darwin endeavours to penetrate deeper into the cause of disease than is allowed by a mere knowledge of the condition of the fibre. The powers of the sensorium are the proximate cause; the fibrous action, the excitement of Dr. Brown, the proximate effect; and hence, from an incomplete knowledge of the mind, the sensorium, statement of the mode in which excitations are produced, he treats of diseases as occasioned by the comparative redundancy or deficiency of the sensorial power of irritation, and not of the fibrous action. It would carry us far away beyond our limits to pursue this theory through the minutiae of its ramifications. Some opportunities will be afforded in the course of the present article to acknowledge the obligations which medicine is under to its ingenious framers. We shall here confine ourselves to the statement of what we consider fundamental objections to the doctrines, and, by implication, the nosology or arrangement of Zoonomia.

In the first place, it does not distinguish between cause and effect, between the resultant motion and its source. Secondly, it substitutes, like the antient systems, mere statements of phenomena for explication of their origin. Thirdly, and what is more immediately applicable to our present enquiry, it divides that which in nature is indivisible.

Dr. Brown had defined excitement to be a certain state of fibrous action produced by the exciting powers acting upon the excitable substance, and that after him considers irritation or excitement as an exertion of the spirit of animation, exciting the fibres to contraction. Here we observe the want of precision, indulged in, and the conclusion originates from forsaking induction to embrace hypothesis. "On Dr. Darwin's principles the identical fibrous motion exists before the faculty of irritation can be exerted." The spirit of animation, according to Dr. Darwin, is stated as "the unknown medium ("quo pacto adducitur ignoratur") through which the excitement or irritation is produced.

Again, the sentient and fibrous changes which in the Darwinian system of life are thus connected, are not rendered more explicable by the intervention of a subtle fluid. The spirit of animation of Darwin, allowing its existence to be capable of proof, in no measure facilitates the conception of vital causation. As an explanation of the last of the above objections, it may be urged, that when Dr. Darwin, in framing his classification, referred all morbid afection to the heads of irritation, of the voluntary and associative, he seems to have overlooked his former assumption, founded upon the inseparability and identity of the sensorial power or fluid, and not to have been aware he had laid down a principle of action, whether it be called irritability, sensibility, voluntariness, or associability, is only another mode of expressing the quantity of sensorial power residing in the organ to be excited."

The conception of one of these energies necessarily supposes an increase or diminution of all, and the disorder of decreased irritability, ought also to be the disorder of decreased sensibility, voluntariness, or associability. The classification, then, is even in contradiction to the principles of Zoonomia. It is intricate and erroneous.

Perhaps the most consistent and comprehensive plan of arranging individual diseases would be that which, while it preserved the important fact in view, of the indivisibility of the living system, would take into account the three degrees of irritation, or fibrous action, separate, functions performed by the arterial, the nervous, and the glandular organization.

As approaching nearest to this plan, and likewise because it is in most general use in this country, at least for a book for teachers of medicine, we shall make use in the present article of the nosology of Dr. Cullen, requesting the reader to recollect the unavoidable objections which oppose themselves to all systems and all classifications of morbid affections.

The following are the classes, orders, and genera of Cullen, with the exception of the class locales, which relates to those disorders principally that come under the head of surgery.

**Table of Classification.**

**Class I. Pyrexie.** A frequent pulse, succeeding to shivering or horror; increased heat; disturbed functions; prostration of strength.

Order I. Frigidus. Pyrexia, independent of local attention and cause languor, lassitude, and other signs of debility.

Sec. 1. Intermittens. Fevers arising from the insinuation of marshy grounds, with an evident remission, the returning fits being almost always ushered in by horror or trembling. One paroxysm only in the day.

Genera. Tertiana; quartana; quotidian.
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in ascertained syphilis—

class I. Order I.—Febria.

What is fever? To this question it appears difficult to give a precise and satisfactory reply. It is observed by the author of Zoönomia, that the term fever is given to a collection of morbid symptoms, which are indeed so many distinct diseases that sometimes appear together, and sometimes separately; hence it has no determinate essence, except it signifies simply a quick pulse, which continues for some hours; in which sense Dr. Darwin employs the word throughout his ingenious work.

On this head, however, we differ in opinion with the author just mentioned. An increased action of the sanguiferous system shall be induced sometimes by, and at other times independent of, a diseased irritation, without being accompanied with other peculiar feelings, which, not restricting ourselves to the etymological significance of the term fever, we purpose regarding as necessary constituents of this, as a distinct entity.

In every proper fever, there is a feeling of debility, which essentially differs from actual debility. "A diminution of strength in the animal functions," which constitutes part of Dr. Cullen's definition of the febrile state, is scarcely characteristic of the condition to which we allude. It is a feeling, with which every one is more or less familiar, and appears to indicate rather obstructed than exhausted strength. Dr. Rush endorses this necessary constituent of genuine fever as a distinct expression from simple irritation of the blood-vessels on the one hand, and mere debility on the other, by comparing it with the smothered sound which may be supposed to be emitted from a musical instrument, provided a heavy weight were applied to the chords; which ought to be suffered to vibrate freely and without obstruction, in order to produce a fine musical sound. Another illustration of a similar nature is likewise employed by Dr. Jackson.

Dr. Brown defines fever, "an asthenic disease that disturbs the pulse." In this, however, there is the want of definition which we have just complained of in the definition of Dr. Cullen. Asthenic diseases are diseases of deficient excitement; but in fevers we have an interruption rather than diminution of power. The faculties are locked up, not lost.

Of the phenomena of fever. Dr. Cullen very properly selects the more ordinary circumstances that present themselves in the course of an attack of intermittent fever, as an example of what occurs with more or less regularity in every case of genuine febrile disorder.

The following, he says, "are to be observed in such a paroxysm. The person is affected with laugor or sense of debility, a sluggishness in motion, and some uneasiness in existing it, with frequent yawning and stretching. At the same time the face and extremities become pale, the features shrunk, the bulk of every external part is diminished, and the skin over the whole body appears constricted as if cold had been applied to it. At the coming on of these symptoms, some coolness of the extremities, though little taken notice of by the patient, may be perceived by another person. At length the patient himself feels a sensation of cold, commonly first in his back, but then passing over the whole body; and now his skin feels warm to another person. The patient's sense of cold increasing, produces a tremor in all his limbs, with frequent successors or rigors in the trunk. After which, so long as the cold and its effects have continued for some time, they become less violent, and are alternated with warm flushings. By degrees the cold goes off entirely; and a heat greater than natural to the skin comes on the forehead, and by degrees becomes a sweat, which gradually extends downwards over the whole body. With this heat the colour of the skin returns, and a preternatural redness appears especially in the face. Whilst the heat and redness come on, the skin is relaxed and smooth, but for some time continues dry. The features of the face and other parts of the body, recover their usual size, and become even more turgid. When the heat, redness, and turgescence, have increased, and continued, the skin becomes dry, and a moisture appears on the forehead, and by degrees becomes a sweat, which gradually extends downwards over the whole body. As this sweat continues to flow, the heat of the body abates; the sweat vanishes, and in a gradual manner, the skin returns to its usual temperature, and most of the functions are restored to their ordinary state."

Specia of fevers. Dr. Cullen divides the division of systematics into continued and intermittent. The very correct description above given answers, as we have stated, to a single paroxysm or fit of fever. It is not however often that the chain and continues with the decline of the paroxysm. In the course of a certain time it is renewed; and according to the suddenness or tardiness of the paroxysm's recurrence, the fever is called continued, recurrent, or intermittent. Sometimes, indeed, the disordered actions recur with such celerity, that the fever appears to be one continuous series; "the remission is inconsiderable, is perhaps without sweat, and the returning period is marked by the usual symptoms of a cold stage, but chiefly by the exacerbation or aggravation of the hot one."

The disease in this last case is considered as a continued fever; in which, however, there is thought to be stages of an intermittent, almost invariably, especially in the earlier periods, a diurnal remission and recurrence of paroxysm. Of intermittent fevers, the paroxysms, such as we have just described, are always finished in less than 24 hours, and most frequently are not extended to nearly this time.

We are then furnished with a natural division of fever into intermittent and continued, which however have many circumstances in common, and often pass into each other; thus, what is termed in the schools a quasian intermittent, formed by an interval of 72 hours, and goes from the last paroxysm to the commencement of another paroxysm, will in its course become a tertian ague, with only 48 hours of interval: this again shall fall into a quaquater, characterized by an interval of only 24 hours. A quaquater shall pass into the state of a remittent, and this last be converted into a true continued fever.

Besides, however, this leading distinction of fever, from the times of the recurrence of the fit, we have many others arising from the nature of the constitution of the individuals attacked, the prevailing condition of the atmosphere, and other extraneous circumstances (and, likewise what is ascertained however with less exactness) the specific difference of the exciting cause; thus, common fever has sometimes the inflammatory, at others the typhoid, character. Thus are accounted the fever of damp and warm climates, the yellow fever of the West India islands, the fever of crowded prisons, and the plague in Eastern countries.

On Cullen's genera. It will be perceived that under the appellation of fever we confine ourselves to the consideration of what has been by way of distinction termed simple fever, and perhaps with propriety regarded by Mr. Wilson as "the only general disease," other diseases being either local, or general and local. Thus the sensitive irritated fever of Darwin, which forms principally the pleidogenesis of Cullen, is a disorder either systematic of, or at least supported by, local irritation.

The genera of Dr. Cullen of continued fevers are.

1. Synocha. "Great heat, pulse frequent, strong, and hard; high-colored urines, the functions of the sensorium not much impaired, such changes, not answer to any case of simple fever; it is the definition of what Dr. Brown calls the alethic, which is opposed to the true febrile state."

2. Typhus. "A contagious disease, the heat not much increased, pulse frequent, small, and weak; urine little changed, sense much impaired, and the strength greatly diminished." This definition approaches nearest to the more usual form of fever in this country. That part of the definition, however, is extremely defective which describes the heat as not much increased.

3. Synoachus. This is made by Cullen a kind of intermediate disease between synoachus and typhus.

Exciting causes of fever. On this subject the most opposite opinions prevail. It is imagined by some, that no case of genuine fever, beyond those ephemeral irritations which possibly originate without the previous application, either through the medium of the lungs, or the surface of the body, of a certain something generated in the system of another individual in the course of the same disease. Others infer, from the daily observation of febrile diseases where no communication with the sick can be traced or suspected, that although the febrifacient matter just spoken of be in man, it is not in all instances the cause of fever; that cold, damp, heat, putrid exhalations whether animal or vegetable, insufficient ventilation, the depressing passions, &c. are all, either singly or in conjunction, capable, under some circumstances, not merely of predisposing to, but of actually engendering, proper fever. Lastly, there are some who consider contagion, or the generation of fever by specific febrifacient matter, as totally imaginary; it is a fallacious inappellations in instances where fever has spread by communication, that either certain undetected conditions in the air, or the confined effluvia of animal excretions accumulated by want of


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cleanliness and ventilation, with other circumstances, are causes sufficiently adequate to produce the affection, without supposing the agency of a specific and occult power.

"It is from nastiness," says one of the most celebrated of the anticontagionists, "degenerate into infection by chemical changes, that the bodies, clothes, beds, and apartments, of the poor in Great Britain, derive their poisons, their pestilential charge. By a common paternostive process, the septic exuvia is formed, and derived to some extent from pulsating arteries or glands. Away then with this preposterous phrase, 'from the poison engendered by septic process.'

Let human contagion for the nature mean nothing but small-pox, vaccinated arising in kindred forms of morbid secretions." (Dr. Rush.)

Notwithstanding, however, the circumstances, that they are not met upon, we conceive the general facts to be in favor of poison engendered, independent of mere putrefaction or filth; and we shall shortly state the grounds upon which our opinion is established, without subject of question, in the spread of fever. That contagion, however, is absolutely requisite to the production of this disorder, in every instance, does not seem an opinion authorized by facts, although it must be adduced as a palpable proof; for when we refer to its generation from mere filth and sloth, under the circumstances just mentioned from Dr. Rush, it may be replied, that contagion in such cases may be used in some instances by accident without suspicion, and that the situation of the recipient constituted merely a predisposition to suffer from its application.

A context has likewise arisen respecting the production of intermittent as well as contine-nent fever. Intermittent fevers are observed to prevail especially in situations the soil of which is marshy; on this account it has been imagined, that they are sensibly consequent upon a certain tint or miasma arising from moist ground. "The similarity of the climate, season, and soil, in the different countries in which intermitents arise, and the similarity of the situation of the sick in different regions, concur in proving that there is one common cause of these diseases, and that this is the marsh miasma." (Cullen.) Dr. Brown and others have contended, that the noxious influence of cold or of heat, "when the common ashenhous noxious powers accompany either," are sufficient to occasion genuine intermittent. It however appears an established principle, that intermittent fevers are most frequently the offspring of poison arising from marshes or moist ground. That other causes act in conjunction, and augment the predisposition, is likewise an established fact; for the ages of mortality which occur most abundantly at cold seasons which have succeeded hot ones, and especially amongst those whose diet has been iniminct and unstimulating. It is also beyond dispute that mere cold or poor living will induce symptoms after the habit has been once established.

**Proximate cause of fever.** On this subject the following errors appear to have misled systematics: 1. A want of distinction between final and proximate cause; between inquiries instituted in order to divine the operations of nature, and a careful examination of the phenomena of nature as they occur in sequence. The indivisibility of the body, and the unchangeable constitution of the disorder, have been too much overlooked. Fever has been considered as an affection of parts rather than of the universal system. 3. An error which results from the conjunction of the two former; that shrinking of the coldness of the external surface, which is merely a consequence and concomitant effect resulting from a febrile attack, has been viewed as the cause of the other symptoms which present themselves in the course of the affection.

"The remote causes of fever," says Dr. Cullen, "are certain sedative powers applied to the nervous system, which diminishing the energy of the brain, thereby produce a debility in the whole of the functions, and particularly in the action of the extreme vessels; this debility proves an indirect stimulus to the saguineus system, whence by the intervention of the cold stage, and spasm connected with it, the action of the heart and larger arteries is increased, and continues till it has the effect of restoring the energy of the system, or of extending this energy to the extreme vessels, of restoring therefrom, their action, and thereby especially overcoming the spasm affecting them."

In the historical sketch of the progress of medical theory with which we introduced the present article, we observed that the spasmodic theory of Hahnemann was engendered that of Dr. Cullen. In the hands, however, of this last systematist, the doctrine in question appears to have received modification rather than amendment: Dr. Cullen added another set of entangled links to the previously entangled chain. The shrinking, coldness, and general inactivity, observed at the commencement of fever fits, and which require the necessary consequences of the sudden quiescence throughout the system, induced by the peculiar action of the noxious powers producing fever, our author considers as one of nature's first steps in obtaining relief and obviating the progress of the fever.

On this theory we may in the first place remark, that when the progress of a febrile affection is arrested by remedies applied during the first or cold stage, both the torpor of the brain and the shrinking of the surface may be removed without the intervention of the hot fit. Indeed, obviating the recurrence of this constitutes the cure of fever. The succession, then, of the hot fit is not a necessary consequence of the previous cold; much less is it an agency contrived by nature to remedy this last. The theory is likewise "erroneous, in as far as it enters into the supposed intentions of nature."

Secondly, the action of the heart and larger arteries is hot, as is justly observed by Dr. Darwin, occurred in the mechanical manner of reaction, which the theory we are canvassing supposes. During the continuance of the cold fit, the whole circulation is lessened, or in a manner suspended, the blood is not retreating for safety to the centre, less blood passes through the lungs as well as through the vessels on the surface of the body; the fortress, and not merely the outposts, has been invested by the cold. Now, when the hot fit comes on, the marks of irritation, or as Dr. Brown happily terms it, of "counterfeited vigour," by which it is characterized, are merely consequent upon the natural stimuli acting upon accumulated irritability, of irritability accumulated by the previous quiescence of the cold stage, and are not to be attributed to the blood's reacting and flowing back in order to influence and occupy the parts and cavities which it had deserted. This supposed action and reaction cannot indeed take place in that mode and to that extent which our theorists imagine. The manner of the body is a living and not an hydraulic machine. The blood is not dammed up at one part in order to rush with violence into another. To illustrate: When even a part of the body only, as the hand, is immersed in cold water, then, when the hand is not unexpectedly exposed to a diminished temperature for a short period, a lessened fibrous or vital action is the immediate consequence, the sensorial power or excitability accumulates in a consequent part, and becomes a matter of general sensation; indeed, the hand, if continued in this condition for any length of time, will become quite anaccelerated, but not properly speaking, increased motion, with blear heat, the consequence.

You have perhaps conceded too much to the spasmotic theory of fever, in likening the state of the surface in the cold fit to that produced in consequence of diminished temperature, for in this last the shrinking is direct, while in the former, it is occasioned indirectly, or, as we have previously noticed, is merely one of the effects arising from the general interruption of the functions. Fever does not commence by attacking exclusively the extreme parts, but the capillaries and the capillaries of the surface.

The spasmotic theory of fever then, is not only a substitution of terms for an explanation of facts, but even the phrenology which it employs is out in order to maintain that the leading symptoms of the malady, appears to be deduced from defective knowledge of the laws and qualities of life. It is physically, metaphorically, and practically wrong. "Fever fits are efforts of nature to relieve herself." Darwin.

Before proceeding further, it may be proper to notice one or two defects, as they appear to us, in the ingenious theory of the author of _Zoonomia_. In our remarks on homoeopathy, the mistakes which Dr. Darwin had been led into from his unsound division of sensorial power, were hinted at. These mistakes have been modified; and it is evident in the learned author's attempts to form a sympathetic theory of the disorders under notice: a theory, which, in our opinion, involves the second error which we have above stated, viz., that of overlooking the individuality of the body, or the universal distribution of sensorial power, and regarding fever rather as an affection of parts than of the whole frame. It likewise, by consequence, embraces the erroneous doctrine of attributing the secondary actions in fevers to the cutaneous tachy tera. The cold fit of simple
fever," says Dr. Darwin, consists of a torpor of the cutaneous capillaries, with their mucous and serous mucous glands, which is gen-
tered by direct sympathy to the heart and arteries. The torpor, however, of the heart and arteries is consistent with, and not conse-
quently upon, the injection of the cutaneous vessel; and the power residing in them, for the time at the time of an attack of fever, must be affected in the same manner as the sen-
corial power of the latter; and the admission of association, is the introduction of an un-
necessary law, an additional cause of confusion. That distant parts sympathize with each other, in a manner which physiology has not hitherto been able to unfold, as the stomach with the surface of the body for example, is admitted; in the case of fever, however, we wish particularly to insist upon such sympathy as an explanation of symptoms being super-
fluous: the heart and arteries, the stomach, the surface of the body, the secretory glands, all receive a diminution or sudden interrup-
tion of their functions at the same moment of time, and from the same cause: they are simultaneous and not successive effects. Dr. Darwin seems equally unfortunate in replacing a hot skin and remaining quiescence of some internal organs, as of the stomach, in the second stage of fever, to re-
verse sympathy. Sympatysis cannot be de-

t in one instance, and reverse in another: "The laws of association are irrevocable, or they do not exist."

What then is the cause of fever? It is an abrupt suspension and consequent disruption of all the connected movements of the ani-
mal frame by which the balance of excite-
ment is overthrown, the laws of excitability are changed, and in consequence of which the same agents no longer produce the same

Fever differs from debility insoman as the latter is a gradual and regular ex-
haustion, not an abrupt interruption of the powers of life; it differs from strength of strength consists in a powerful and equable excitement, while fever, however it may "counterfeit vigour," is never attended by the same consequence of vigour, regular and orderly display of power.

The primary cold, or as the Latins term it, "horror," is from the quiescence that has been induced, during this state of quiescence, a new and inordinate condition of the excita-

bility is established, and by consequen-
tion both the external and internal stimuli excite perturbed in the place of orderly and usual actions; action without power commences; hence morbid heat is generated, diseases associations are formed, and without being in a state of actual weakness, the whole sys-
tem sinks, oppressed. The plain indications of

Treatment in fever, are therefore to break the morbid associations on which this op-

pression is caused, or to diminish effects by which it is continued; to diminish the cold in the cold stage, the heat in the hot stage, and not to await the sanative process of nature, 'either of dissolving spasm, or of cooling heat, and expelling morbid cause. The various remedies employed for these purposes are, the external and internal use of cold and warm water; refrigerants, sudor-

nics, opiates, emetics, purgatives; on each of these, we shall introduce a few separate remarks; in the course of which an oppor-
tunity will be afforded, of enquiring more minutely into the pathology of the febrile state.

Of cold and tepid applications, and ablation.—Cold water internally.—Cold air.—The medical reports of Dr. Currie, on the effects of water cold, and warm, in the treatment of fe-

ver, are introduced in the following manner.

Narrative of Dr. Wright:

"In the London Medical Journal for the year 1786, Dr. William Wright, formerly of Edinburgh, published a case of the true and the successful treatment of some cases of fever, by the ablation of the patient with cold water."

"On the 1st of August, 1777," says Dr. Wright, "I embarked in a ship bound to Liverpool, and sailed the same evening from Montego-bay. The master told me he had several sailors on the same day we took our departure, one of whom had been at sick paroxysm on board ship for some time, but in a condition, of very serious state. On the 23d of August, we were in the latitude of Bermuda, and had had a very heavy gale of wind for three days, when the abovementioned man relaxed, and had a fever with symptoms of the greatest malignity. I attended this person often, but could not prevail on him to be removed from a dark and confined situation to a more airy and convenient part of the ship; and as I refused medicine and even food, he died on the eighth day of his illness.

"By my attention to the sick man, I caught the contagion, and began to be in-
disposed on the 5th of September; and the following is a narrative of my case, extracted from notes daily marked down: I had been many years in Jamaica, but except being somewhat relieved by the climate and fatigue of business, I ailed nothing when I embarking. This circumstance, however, might perhaps dispose me more readily to receive the infection."

"Sept. 5th, 9th, 7th: Small rigours now and then; a chilliness of the skin, and a dull pain in the forehead; the pulse small and quick; a loss of appetite, but no sickness at the stomach; the tongue white and sunny; little or no thirst; the belly regular; the urine pale and effusive; and the night relatively clear, with starting and delirium."

"Sept. 8th. Every symptom aggravated; with pains in the loins and lower limbs, and stiffness in the thighs and hands."

"I took a gentle veinot on the second day of this illness, and next morning a desoration of tumar.idis; at bedtime an opiate joined with antimonial wine; but this did not pro-
cure sleep or open the pores of the skin."

No infallible remedy being procured, a drachm of Peruvian bark was taken every hour for six hours successively, and now and then a glass of port-wine, but with no appe-
s. I was bitten upon my deck, my pains were greatly mitigated, and the collier the air the better. This circumstance, and the failure of every means I had tried, encour-
gaged me to put in practice on myself, what I had often wished to try on others, in fevers similar to my own."

"Sept. 9th. Having given the necessary directions, about three o'clock in the after-

noon I slipt off all my clothes, and threw a sea-cloak loosely about me till I got upon deck, when the cloak also was laid aside: three buckets of salt water were then thrown at once upon me; the shock was great, but I felt immediately relieved. The headache and other pains instantly abated, and a fine glow and diaphoresis succeeded; towards evening, however, the same febrile symptoms threatened a return, and I had again recourse to the same plan. The same day, and the same good effect. I now took food with al-
petite, and for the first time had a sound night's rest."

"Sept. 10. No fever, but a little uneasiness about the hams and thighs; used the cold bath twice."

"Sept. 11. Every symptom vanished; but to prevent a relapse I used the cold both twice. Dr. Thomas Kirt, a young gentle-
man, passenger in the said vessel, and of the same profession as his master, on the 9th of August; his symp-
toms were nearly similar to mine, and having taken some medicines without experiencing relief, he was disposed of trying the cold bath; with my approbation. He continued on the 11th and 12th of September, and by this method was happily restored to health. He lives at this time (Jan. 1780) near Liver-

pool."

We have thus presented our readers with this important narration of Dr. Wright, both as it furnishes a history of fever, as it details the mode in which the cold afflictions should be employed. It was consequently the means of introducing this most valuable reme-
dy into general practice. We shall now add from Dr. Currie the more particular rules which ought to govern the use of the affliction in cases of cold water in fevers, and then make one or two observations on the nature of its operation."

"The safest and most advantageous times," says Dr. Currie, "for using the cold water is, when the exacerbation is at its height, or immediately after its declension has begun; and this has led me almost always to direct it to be employed from six to nine in the evening; but it may be safely used at any time after the commencement of the attack. The time of chilliness present, when the heat of the sur-
fase is steadily above what is natural, and when there is no general or projeff porpi-
ration.—These particulars are of the utmost importance in the use of cold water in fevers, and must be used during the cold stage, the respiration is nearly suspended; the pulse becomes flut-
tering, feeble, and of uncalculable frequency; the surface and extremities become doubly cold and relaxed, and the patient seems to struggle with the pangs of instant dissolution. I have no doubt, from what I have observed, that in such circumstances the repeated affusions of a few buckets of cold water with extraneous liquid, this remedy should therefore never be used when any considerable sense of chilliness is present, even though the thermometer applied to the body should indicate a degree of heat greater than 101."

"And neither ought it to be used, when the heat measured by the thermometer is less than, or even only equal to, the natural heat, though the patient should feel a degree of chilliness. This is sometimes the case towards the last stages of fever, when the pow-
ers of life are too weak to sustain so powerful a stimulus."

"3d. It is also necessary to abstain from the use of this remedy under profuse suf-

fused;"
sible perspiration, and this caution is more important in proportion to the continuance of this perspiration." 

"Under these restrictions," our author adds, "therapeutic operation may be useful at any period of fever; but its effects are more salutary in proportion as it is used early. When employed in the advanced stages of fever, where the heat is reduced and the bodily complaint should be given immediately, and the best is warm wine."

Observations. Cold water, as a remedy for fever, may be conceived to operate upon a twofold principle. In the earlier stages, and before the vital power is too much impaired and aggrased and oppressed to endure a violent shock, the copious and sudden affusion of cold water all over the naked body, appears to effect its beneficial purposes in part by the abruptness of its agency; if in a manner severs the chain of disease associations, and restores the healthy and orderly movements of the frame. This operation is not, as has been suggested, mechanical: it is in some measure attended by a rise of temperature from the application of an emetic, to which it is in every respect greatly preceivable, or to sudden mental agitation. In the language of the schools, it causes short fever.

When, however, the disease associations are more firmly established, and the vital power greatly oppressed by the disorder's continuance, although the surface of the body retains its morbid heat, the water to be applied must be cold, not merely tepid or even tepid as to be comforted by the patient, by washing with a sponge, and this under the restrictions enjoined by Dr. Currie, or we may safely say, while it is found genial to the patient's feelings, ought to be resorted to in every case of simple fever. The action of the water at this time is somewhat different from that in the previous period, or under different circumstances of the disorder. It proves a direct stimulus. But how, has it been urged, can the negative of a power prove stimulative? "Darkness might as well be called a stimulus to the eye, or hunger a stimulus to the stomach, as cold to our sense which perceives heat." Darwin.

To this, he replies, Dr. Beddoes, and before him by Dr. Beddoes, that the objection is founded upon a disregard of the sentient principle: "Cold," says the latter author, "may very often be so applied as, by removing the very disadvantageous sense of heat, that attends some diseases, to produce an effect equivalent to stimulation. It is, I believe, exactly in this way, that bathing the body with cold water proves serviceable in low fevers."

From the urgency, however, of the debility, or from the prejudices of the patient or his friends, in some periods of fever, even the application of cold water in the way of ablation may be regarded as too severe. In this case tepid ablation has been made to supply its place, and often with propriety and success; it is, however, particularly deserving of remark, that unless this last be used in the gentlest manner, the object of the practitioner in its choice is defeated, as the evaporation from the surface is more copious from the tepid ablation; and this is one of the most powerful, indeed, strictly speaking, the only direct manner of ablation, which is applied by Dr. Currie to water, from 87° to 97° of Fahrenheit; from 87° to 75° the water is denominated cool. Cold water may be given internally, and with the utmost freedom, in the hot stage of the fatal paroxysm. Its use, however, requires to be carefully regulated by the same restrictions as in the external application; it must not be given unless the heat of the surface be steadily above the natural standard. Draughts of cold water have been known, when properly administered, to procure a sudden solution of the disease.

Cold air. The extraordinary melloration in the modern practice of medicine, as it relates to the treatment of fever and febrile diseases, is not confined to the use of ablation and ablation. The terror of our predecessors, in relation likewise to cold air, are fast departing; and the importance of its free admission in the apartments of the febrile sufferer especially, comes to be generally acknowledged and applied. It has been stated by a physician, above all praise for fidelity of observation and justice of remark, that the corrupted air of sick rooms, is more highly objectionable as being much more fatal even among the higher classes of society, than the virulence of the disease itself. "Vener em cudiam agnoti non tam morbo quo puerorum, quam habitibus putridis, quos diescur dri nume propter amicorum cura." Heberden.

The utility of cold air in fever is referable to two principles: 1st. That of immediately lowering the heat of the surface, and thus tending to supress the occasional accretions by such heat; and 2ndly, from affording a larger quantity of oxygen at each inspiration. The first of these principles is sufficiently evident, and does not require any further illustration: if cold ablation prove beneficial chiefly by virtue of diminishing the temperature of the body, it necessarily follows that coldness in the circumambient atmosphere must be attended with precisely similar effects: but on the purity, as connected with diminished temperature of the atmosphere, it may not be improper to preserve the present opportunity of offering one or two remarks. A given bulk of air at an inferior temperature, contains more of the principle which is essential to sustain life than the same quantity at a superior degree of heat; hence the greater refreshment which is experienced from the inhalation of a cold and dense, over that of a warm and rarefied atmosphere; hence, in part, the more vigorous digestion and keen appetite of a healthy individual during the winter, than the summer months; and finally, by the relief a febrile patient experiences from the inspirtation of such air, it is rendered evident, both that the heat of fever originates, and is kept up, independently of those organs which modern chemistry and physiology have supposed to be the sole organs for the supply of heat to the living system. From this fact Dr. Reid infers, and we think with justice, that the constant equality of animal temperature in a condition of health, has more dependence upon living actions in general than upon a full degree of oxygen in the lungs, according to the ingenious theory first suggested by Dr. Crawford, but since materially modified. See Physiology.

But the frigoric virtue of a more oxygenated atmosphere means the admission into the lungs of a febrile invalid, is a further proof, that however violent the reaction, as it has been erroneously called, such reaction is, in every case of genuine fever, far from being an evidence of actual increase of power. Whatever theory we adopt respecting the precise mode in which pure air influences the animal oxygen as partaken of, it must prevail, that it is, in the strictest sense of the word, an exciting agent. Now as far as it operates beneficially in fever, it reduces the irritant power; that power which actually prevail is from this very agency, which modifies the turbulent action, and by consequence reduces the prevailing morbid heat. The admission of cold air requires likewise to be restricted to the hot stage, and to be limited by the patient's feelings; a current of cold air passing rapidly over the body while in a state of perspiration, may be productive of fatal consequences.

Of refrigerants in fever. Besides, however, the free admission of a cool and pure atmosphere, other agents have been had recourse to, and with considerable effect, in order to abate the morbid heat of fever. From possessing a cooling influence on the system, certain medicines have been distinguished by the term refrigerants: refrigerants are principally chosen from the vegetable acids, and the different neutral salts; and are found in their power in reducing the prevailing temperature, that they have properly been made to constitute a considerable part of regimen in fever. Indeed nitre, and other neutral salts, with the vegetable acids, have been received into some systems of classification, under the distinct head of febriferous medicines. The modus operandi of refrigerants has not perhaps hitherto received explanation; the substances of which they are composed are for the most part those which contain oxygen in a concentrated, and, at the same time, loose state of combination; from this circumstance, their action has been inherently that of perhaps satisfactory accounted for. "It has been sufficiently established," says a modern writer, "that the consumption of oxygen in the lungs is materially influenced by the nature of the ingesta. The fresh air, which is supplied by the respiration through animal food and spirituous liquors, and, in general, by whatever substances contain a comparatively small quantity of oxygen in their composition. But the superior temperature of animals is derived from the consumption of oxygen gas by respiration: an increase of that consumption must necessarily, therefore, occasion a greater evolution of caloric in the system, and of course an increase of temperature, while a diminution in the consumption of oxygen must have an opposite effect. If, therefore, when the temperature of the body is morbidly increased, substances be introduced into the stomach which, containing a large proportion of oxygen, especially in a state of loose combination, and capable of being assimilated by the digestive powers, the nutritious matter received into the blood must contain a larger proportion of oxygen, that principle will be consumed in the lungs, by which means less caloric being evolved, the temperature of the body must be reduced; and this operating as a reduction of stimulus, would diminish the number and force of the contractions of the heart." Murray's Medicina.
MEDICINE.

This reasoning is perhaps more specious than just. In the first place, the remarks which we have above introduced on the actual diminution of febrile heat from inhaling an oxygenous atmosphere, seem to oppose the theory of perspiration as the cause of the oxygenous principle being consumed in the lungs. Secondly, it may be noticed that the effects of these medicines are too speedy and direct to admit of the supposition of this intermediate kind of agency; and thirdly, although the refrigerantia are for the most part, they are not universally, substances which contain this superabundance of the oxygenous principle. The saline draught, for example, appears to moderate febrile heat primarily, by reason of the carbonic acid gas that it contains.

Chemical reasoning has recently been extensively applied to the development of the mode in general in which the functions of the lungs and lungs are connected, and as this enquiry is closely related both to the theory of febrile heat, and the dietetical as well as the medical management of the febrile and the hot fit in general, it is proper to determine the reader by one or two further reflections on this very interesting point of discussion. It is an axiom of Hippocrates, that animal food should not be given in fever; an axiom which was no doubt founded upon observation of its general irritating and disordering tendency. Modern physiology, however, has not rested content with a knowledge of the fact, but has endeavoured to determine its influence upon pulmonary organs. Hence it is said, we are furnished with an explanation why animal diet is uncongenial to the patient in fever. The pulmonary circulation is impeded by febrile oppression, less oxygenous atmosphere, and the power of assimilating materials which contain the hydrogenous and azotic principles in abundance is consequently weakened, or, as we have heard, it expressed still more chemically, less fuel or combustible matter is required, on account of there being less power of consuming such fuel, or of maintaining combustion.

Perhaps the peculiarity or distinct nature of living beings, has not been sufficiently attended to by modern physiologists of the chemical school. That hypothesis, the outline of which we have just delineated, appears at first sight perspicuous and unobjectionable, but when pursued more in detail, facts present themselves which are in some measure at variance with its fundamental principles.

Animal food may, perhaps, prove less congenial to the patient in fever, than under circumstances of debility without febrile disturbance, on account of the direct irritation it communicates to the fibre, independency of its chemical properties, the difference between animal and vegetable diet in this particular, is abundantly obvious. But it may further be urged, that several materials taken into the stomach during the burning heat of fever, appear to be productive of nearly similar effects, in their immediate operation, with a diet of animal food; of this stock, which when duly administered is congenial and salutary, when given while the skin is dry, and there is no disposition to perspiration, proves irritating and harassing; it still further impairs the wound digestive organs, augments the tendency to costiveness, and increases febrile heat. These properties it surely does not possess by virtue of the quantity of hydrogen or azote that it contains.

Of Sudorifics.

We now proceed to consider the agency of sudorifics as febrifuge remedies. Moisture on the surface of the body may be procured by medicines which appear to have a direct power over the cutaneous vessels, or by those whose action seems to be directed primarily to the stomach. These last are principally of the saline class, which are by far the most suitable for this purpose. The physiology of perspiration, and the principles by which it operates as a cooling process, are, notwithstanding the recent discoveries in chemistry, and their application to this interesting subject, still involved in much obscurity.

The ancient imagined, sweat to be not merely an excrementitious product, but the vehicle of conveying that portion of the body which has been the occasion of disease. This opinion does not, in the present state of science, require to be confuted. The questions of most interest, to this interesting subject, respecting the phenomenon and cause of perspiration, are, in what relation does it stand to the respiratory function; and is that moisture on the surface of the skin which closes a febrile paroxysm, to be regarded as a cause or consequence of the disorder's diminution?

"That an animal," says Dr. Currie, "possesses to a certain extent the faculty of rendering sensible heat latent, or, to speak more philosophically, of changing calorics from a free to a latent state, in cases in which the stimulus of heat might otherwise overpower the living energy, there is reason to believe, from a variety of experiments and observations, and that this is in part performed by perspiration from the surface can scarcely admit of a doubt. The process of perspiration, which is continually going on from the surface of the body, is in this point of view the converse of respiration; as in respiration, air is constantly converted into a solid or fluid, and thus heat evolved, so in perspiration a fluid is constantly converted into a vapour, and thus heat is absorbed. A vessel is placed, and exposed to the atmosphere, cannot be raised above 20° of Fahrenheit by any quantity of fuel, because, heat is applied from below, evaporation carries it off from the surface; in like manner we may suppose the heat of the living body to be kept uniform, by the evaporation from its surface increasing or diminishing, according to the quantity of heat extracted from the system, or received from the surrounding medium."

These speculations are beautiful and highly ingenious. It however admits of question, whether Dr. Currie, in applying them to the subject of febrile heat, may not have given too much weight to the analogy of absorption of caloric to animal matter, the excretion of the cooling process in the living body; and whether sensible perspiration, produced by medicine or otherwise, may not be consequent upon, rather than prior to, the diminution of febrile heat? But, for example, a large quantity of water be swallowed in the heat of a febrile paroxysm, and be directly succeeded by general diarrhoea, or sweat, with relief from the burning sensations of fever, although it be natural to attribute such relief to the sweat that is produced, this last may be subsequent to that altered condition of the fibres by which the evoluction of caloric is diminished. Such an opinion has been ingeniously argued by Dr. Reid: and if the following observations of Dr. Darwin are just, they appear to place the matter beyond dispute.

"The perspirable matter," says this latter, "is secreted every second quantity during the hot fit, the hot fit begins to decline, their increased action lessens, and hence the abstraction of sweat is diminished, whilst the increased secretion of it continues for some hours afterwards, which occasions it to stand in drops upon the skin. As the skin becomes cooler, the evaporation of the perspirable matter becomes less as well as the abstraction of it. And hence the dissipation of aqueous fluids from the body, and consequent thirst, are perhaps greater during the hot fit than during a cold one.

For the sweats do not occur, according to Dr. Alexander's experiments, till the skin is cooled from 112 to 108 degrees of heat; this is till the patient is in a decline to their increased action lessens, and hence the abstraction of sweat is diminished, whilst the increased secretion of it continues for some hours afterwards, which occasions it to stand in drops upon the skin. As the skin becomes cooler, the evaporation of the perspirable matter becomes less as well as the abstraction of it. And hence the dissipation of aqueous fluids from the body, and consequent thirst, are perhaps greater during the hot fit than during a cold one.

It appears that the sweats are not critical to the hot fit, any more than the hot fit can be called critical to the cold one, but simply that they are the natural consequences of the decline of the hot fit. And hence," continues our author, "it may be concluded, that a fever fit is not an effort of nature to restore health, but a necessary consequence of the previous torpor; and that the causes of fever would be less detrimental, if the fever itself could be prevented from existing, as appears in the cool treatment of the small pox."

Of Paracetemol and Emetics.

Nothing, perhaps, is of greater moment in almost all afebrile and every kind of fever, than to preserve the whole of the alimentary canal free from accumulations of colics, &c. From a deficient attention to this principle, since the introduction of the card to the treatment of this, and indeed in a variety of other diseases. Viscidities and impurities in the sto-
march and bowels, are often both effect and cause of the persistence of the febrile state; for the inflammation is always first excited by the induction of fever, so the consequent accumulations of foreign matter in the alimentary and intestinal canal, themselves prove direct sources of irritation and disease. In the ordinary stages of fever, an emetic has been known abruptly to arrest its progress, and the same purpose is sometimes accomplished, especially in ephemeral affections of the intestinal kind, by the employment of a brisk purgative. In the more advanced periods however of the disorder, the object of the physician ought to be rather that of keeping the bowels gently open, and this is best effected by saline in place of a saline purgative; the former of which principally operate by exciting the exhalants on the internal surface of the intestines to pour out their contents, the latter by stimulating in a forcible manner the intestinal fibres.

It is a fact worth particular notice in the treatment of fevers especially, that where as due attention is given to ensure regular evacuations from the bowels, those stimuli, the copious use of which is often necessary to support the attacks of fever in the last stage of the disease, are more freely admissible and abundantly more efficacious: this is indeed an important principle in the treatment of diseases generally; and it is perhaps chiefly by virtue of this rule, that in an orderly and due condition for the agency of other stimuli, that purgatives, like sudorifics, form so useful, and indeed the former, almost an indispensable part of the regimen of the greater number of ailments. In intermittent fevers it is generally necessary to evacuate the bowels by more stimulant cathartics, more especially when the cure of these fevers is conducted by the Peruvian bark.

Having thus discussed the nature, causes, and treatment of fever, it may be proper to present the reader with a recapitulatory view of the remedies which are required in the different stages of the disease; but more particularly, to such recapitulation, we shall make one or two remarks on the more unfavourable symptoms with which fever is sometimes attended, and on the periods in which the disease works a greater or less duration to terminate.

The unfavourable signs are, in the first place, an abrupt alteration of type. If during fever, indicating in its primary stages no particular severity of disease, a rapid change take place in the feelings and expressions of the invalid; if upon the more ordinary symptoms, suddenly and unexpectedly supervise delirium, prostration of strength, an observable change in the primary stages of fever, accompanied by irregular and partial alternations of heat and cold, without the intervention of the perspiring state, the patient's life is in considerable danger. These above changes are often indeed preludes to a speedy death. Weakness, quickness, and irregularity of pulse, delirium, tendency to fainting when in an erect posture, prostration of strength, partial and irregular sweats, difficult respiration and cyanosis of the tenens, unusual fever in the excretions, great faintness of the tongue and fauces, are all evidences of a fatal tendency in the complaint; in general likewise it may be observed, that in cases where marks of great nervous irritation are absent or of a fever, even though the disorder may not assume that has erroneously been termed the putrid type, much danger is to be apprehended. Indeed, the management of fever is not to be recommended or the indications of treatment less decided, from the absence of such type. Genuine nervous fevers are often the most obstinate and malignant.

Reverses of this kind, indeed, the heat is often so partial and irregular as not to admit of the cold affusion. Dr. Currie in his Medical Reports, describes a fever in which this remedy was tried without success. This fever, says Dr. Currie, does not appear to originate in contagion, or to be propagated, by contagion.

Calculations respecting critical days have been in some measure forced and systematized. It is worthy however of remark, that the critical days and fever, as well as intermittent in the successive stages of their course, are disposed to assume progressively the quidian, tertian, and quartan aspect.

Thus, if in the first or second day there be more than a week, the ninth and eleventh days from its first attack are those on which we may anticipate its declination; after the second week the seventeenth and twentieth are the more usual period of termination. These however, are by no means unexceptionable rules.

RECAPITULATION OF THE TREATMENT OF FEVER.

Treatment of continued fever during the first three days. Cold affusion. Water to be impregnated with salt, its application to be confined to the hot stages of the paroxysm. Large draughts of cold water taken under the same limitation. Cold and pure air. Emetics. Purgatives. Aperient and saline infusions.

After the fifth or sixth day, Cold and tepid ablation. Water employed to be impregnated with salt or mixed with vinegar. In the morning two glasses, or dilute alcohol, camphor, pudicium, or the warm bath. Bowels to be kept gently but constantly open, by saline or mild purgatives and subacid drinks. While the skin is preserved moist by these medicines, these last, or any other, which are almost invariably improper when the skin is dry and hot, and the bowels costive. For head-ache and other nervous affections, blisters, ether, camphor. In the last stages, when critical sweats break out, and the powers of life appear to be shrinking from the contest, repeated glasses of port wine with mixture of opium in large quantities. During the whole course of the disease, the appearance to be diligently preserved cool, clean, constantly ventilated, and free from all individuals but those who are necessary attendants on the sick.

TREATMENT OF INTERMITTENT FEVER.

Cold affusion immediately upon the full accession of the hot fit. Warm bath, warm spiced wine, during the cold stage of the paroxysm. Tincture of opium, either previous to the accession of the cold, or towards the decline of the hot fit, and immediately preceding the accession of the paroxysm. Calomel purges before the administration of tonics; arsenic, zinc, Peruvian bark, quassia, and if any enlargement of one of the viscera (ague cakes) appear, sted. Hope; upon the expectation of hope the power of clausus altogether depends; these sometimes succeed in ague, when other remedies are contrariwise by the violence of the complaint.

Although we have judged it expedient to enumerate the different medicines which in the event of fever's protection may be requisite, it is proper to observe that the progress of the complaint may be for the most part be abruptly arrested, and the necessity of other means of cure consequently superseded, by an early and judicious employment of the cold affusion. If the application of the water in the mode described in the narrative of Dr. Wright he objected to, a slower bath may be employed, or, what is an excellent and convenient substitute for the latter, a common gardener's watering-pot; the patient is to be taken out of his bed, if convenient, conducted or carried into an adjoining apartment, and the water poured from this instrument as hastily as it will admit of over his naked body; the skin is then to be quickly and effectually dried with towels, and the invalid re-conducted to his bed; this course of treatment is to be continued with the application of the hot paroxysm, even should this be on the same day, and continued, if requisite, on the following days, until the disorder's decline; or, in the pointed language of a modern writer, "the evil may be swept away." (Reid's Medical Reports, Monthly Magazine.)

Fever Houses, &c.

The rapid and extended diffusion of fever through families and individuals might be deemed sufficient evidence in favour of matter engendered by febrile action, having the power to produce a similar disorder in another individual. The fact, however, appears to have been placed beyond doubt by the unfortunate result of several experiments made with sceptical tenacity in order to prove the negative of this assumption.

While the writer of the present article was published in his article on fever at the medical university, several anti-contagionists, as those gentlemen were denominated, freely exposed themselves within what they regarded the imaginary sphere of contagion, in the wards of the infirmary of the university; and they observed that once these individuals were infected with fever, and in some instances the disorder had a fatal termination. In these instances the production of the disease could not be referred to want of cleanliness, or to any peculiar condition of the atmosphere; for the fever did not extend to those gentlemen attending the hospital, who were fortunate enough to remain satisfied with the previous evidence in favour of contagion.

But with a knowledge of the evil, we have at length acquired a knowledge of its antidote; and it has been demonstrated by experiments upon a multitude of the male and female, that, whether the matter producing fever be introduced into the system by the lungs, the surface of the body, or the stomach, its power to infect extends but an exceedingly small distance—three feet at the most; and the patient in whom it is generated, "when he is confined where the air has free entrance and egress." This fact, it has been well observed, "cannot be corroborated by too great a variety of testimony, nor repeated too often, until it shall..."
be familiar not only to the most learned of the profession, but well known to the community at large." (Dr. Bateman.)

Its application with that of another fact immediately to be mentioned, has already gone a considerable way towards the actual extirpation of contagious fever.

This second fact is, that although infectious matter be rendered almost immediately inert by exposure to the air, it is capable of being rendered concentrated, and even transported at an unlimited distance, when made to come in contact with any material, even "a rag or a bit of lint," if such material be excluded from the air. From these, one should expect unquestionable premises, separate receptacles, apartments, and houses, have been exclusively devoted to the admission of the sick in fever, and, as we have just observed, with the most evident and extended benefit, particularly to the inferior classes of the community.

The example of fever institutions was set to the metropolis by the very active and laudable exertions of provincial physicians. In being thus hitherto a Companion, Liverpool, Cork, and other large towns in the British isles, the plan of thus separating the infectious fevers from other diseases, had already been adopted, and at length its extension, and was found in New York, in London, and with the happiest effects. Among the internal regulations of these houses, the following are the most important—they have been adopted in this country, and are now considered essential, and apply in a general manner to private practice.

Every patient when admitted into the house, is to change his infections for clean linen; the face and hands are to be washed clean with warm water, and the lower extremities fomented. "The effect which this salutary change has upon the patient before any medicine is given, is often more beneficial than those which all the antihypertensive drugs in the world could better." All discharges are to be speedily removed. The floors of the sick room are to be washed twice a week, and near the beds every day. The clothes which the patient brings with him are to be thoroughly purified by washing the linen, and exposure for a length of time of the other habiliments to pure air.

Blankets and other bed-clothes are to be exposed to the open and fresh air before they are used by another patient. Several windows of the apartment are to be constantly opened in the day, unless the weather is very cold and wet; and some of them should not be shut in the night, if the patients are numerous, and the weather moderate.

By a due enforcement of these regulations, the necessity in general may be obviated of employing the acid fungicides recommended by Chestworth, Carmichael Smith, and others, which have been ingeniously, and we think justly, imagined to operate upon the same principles with atmospheric or pure air, viz. by oxidizing, and thus destroying the various fungous effusions.

By cleanliness then, and procuring a free circulation of air, by guarding against the lodgment of contagious matter, and by keeping as much as possible from actual contact with the sick in fever, every cause is obviated from which infection can be communicated. The individual who resides in the house adjoining to a fever institution is equal-

ly out of the sphere of contagious influence with one at fifty miles distance; may, in the contagious apartment, and even in the sick room itself, the immunity is precisely the same: such are the preventive as well as the experimental effects of cleanliness and ventilation, which, whether in sickness or in health, cannot be too highly appreciated, or too extensively adopted.

**ORDER II.—Phlegmasia, Inflammations.**

When any part of the body has an unusual heat and redness, with pain and swelling, it is said to be in a state of inflammation, and such a state of a part, an inordinate action and disposition of vessels have generally been esteemed sufficient. Such opinion, however, has been questioned by the author of Zoonomia. "Inflammation," says Dr. Darwin, "is uniformly attended with the production or secretion of new fibres, constituting new vessels; this, therefore, may be esteemed its essential character, or the criterion of its effects. At the old parts of the body, where the reaction seems rather a consequence than a cause of the germination or pulsation of these new ones; for the old vessels may be enlarged and excited with unusual energy, without any production or secretion as in the head of name or of anger." On the contrary, however, we are disposed to regard the formation of new vessels, which does not perhaps take place in every case even of genuine inflammation, consequent to the wound, or the occasion of capillary dilatation. The case which Dr. Darwin puts in opposition to this theory is not in point. It is permanent and forcible, not transient and slight, extension of blood vessels, which constitute the inflammatory state. The eye may be exposed to a vivid light, its vessels consequently act with more than ordinary excitement, and this to a certain extent without actual inflammation; but if such excitation be extended beyond a certain point, the small vessels of the organ shall be deprived of their proper resistance, and thus shall not merely transmit a more than the quantity of blood, but shall in a manner become congested in their vessels, and shall cause pain, unusual redness, heat, and tumour. This induced weakness of the capillaries, ought then, perhaps, according to the opinion of some authors, to be regarded as the proximate cause of inflammation; the too great or too little excitement on which it may have depended the remote cause; and the increased action of the larger vessels of the part, the proximate effect.

The augmented action, if considerable, is accompanied by an irritation of the whole system; such irritation constitutes the "senitive irritated inflammation"—Dr. Darwin, who is distinguished from simple, or what we have considered genuine fever, by its being a sequent of local affection.

**Sthenic and asthenic inflammation.** The disturbance of the System does not correspond more with the magnitude of the local disorder, than with the constitutional character of the individual affected. Of two persons that are the subjects of inflammation, as of the mucous membrane of the nostrils, constituting inflammatory catarrh, or a cold; of the serous vessels, of the adjacent organs of the lungs; or of the joints, forming rheumatism; one shall previously have possessed much constitutional vigour, the other shall have been languid and feeble—the former will have a sthenic, the latter an asthenic disease. This distinction in practice will be found of immeasurable importance. It was of the utmost consequence to Dr. Darwin, and we believe, however, that this author was mistaken in the mode in which the inflammation of a part, and the disorder of the system, are connected; for the purpose of cor-

firmed his favourite theory of atheistic and asthenic disorder, he laboured to prove that the systematic in many cases of inflammation actually preceded the local disease—this is not the case. Even in the most violent fevers of pulmonary origin, Dr. Darwin says, "the lunge precedes that of the system; and indeed asthenic disorder, independently of local irritation, is in some measure a contradiction in terms. High excitement, to whatever extent it may be carried, while there is no irregularity of want of balance in any of the corporeal or mental function, and no affection of a part, cannot be properly regarded as a disease, however it may predispose to the disease of the system."
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as of the lungs. For example, in small-pox
and in measles, we shall have the same degree
of inflammation of the skin, the burning of the
mouth, and cold air would be equally indicated in either, were we to
infer the proper method of treatment alone from the inflammatory excitement;
but in measles the lungs are often the principal
seat of the local affection, an oxygenous
or pure atmosphere would prove too stimu-
lating to these organs, and thus if we pur-
sue general doctrines without particular ex-
ceptions, or overlooked the peculiar na-
ture of the part or organ injured, the object
of our plans would be frustrated and de-
feated.

As it relates to this important principle in
medicinal agency, the system of Dr. Brown
is exceedingly deficient. The peculiar sus-
ceptibility of the separate organs our author
overlooked in the rapid and general survey
which he took of the animal economy.

Genus I. Pulmonary, inflammation of the
lungs.

Species 1st. Cynanche tolistallis, a com-
mun inflammatory sore throat.

M. M. Acid gargles. Saline purgatives.

Species 2nd. Cynanche maligna. An acci-
dental, but very common, symptom of scar-
let fever. See SCARLATION.

Species 3rd. Cynanche trachecialis, croup.

See Infancy.

Species 4th. Cynanche pharyngea, a more
extensive in the pharynx of the cynanche
tolissalis.

Sp. 5th. Cynanche parastrachea. The mumps
manifestation of the parotid and maxillary glands,
which appears in the form of a swelling under
the jaws: it is more common in some than in
other counties of England. It sometimes
appears as an epidemic. The mumps is in
itself a slight disease; but after its declension,
which is in general about the fourth day, the
tests in men, and breasts in women, are very
apt to be affected with swelling, in conse-
dquence of some peculiar sympathy of these
parts with the throat.

M. M. If delirium supervene upon the
retrogression of the swellings, blister. "To
suckle the head with warming water." Darwin.

Genus IV. Pneumonia, inflammation of the
lungs.

Genus V. Corditis, inflammation of the
heat or pericardium.

Genus VI. Peritonitis, inflammation of the
peritoneum.

The disorder which is usually termed
inflammation of the lungs varies in some mea-
sure its seat. Thus the diseased action shall
be directed towards that part of the pleura
which is irritated, and the blood, which may
be called carotis; or it may pass down the
diaphragm, or the peritoneum, and form the
peritonitis of Cullen, the diarrhagitis of
Darwin.

The general symptoms are, pyrexia, pain
in the chest, and deadly symptoms of the
heart, and, if the disorder happens in the
stomach, the pulse is hard and frequent.
Sometimes the expectation is tinged with
blood.

The particular symptoms are, in caroticis,
palpitation, with unequal intermitting pulse,
pain in the region of the heart, vomiting,
fainting: if the inflammation be particularly
directed to the diaphragm, the pain is situated
towards the lower ribs; the respiration in a
recumbent posture is extremely difficult, and
the corners of the mouth are sometimes so
retracted as to form a disagreeable smile,
called rima sardonicum.

M. M. It is of the utmost importance to
attend to the prevailing diathesis. If the
constitution be shenic, and the disorder ur-
tant, immediate and exact remedies are
required; for, with such a disposition, the
frigant and emollient cathartics. Cool and
equal, not cold and irregular, atmosphere.
Dilute drinks. Total abstinence from an-
imal food, sometimes during the first five
days. Antimonial preparations. Avoid compres-
sing it a blister on the painful part. Digitalis. In
Dr. Currie's Medical Reports we find the fol-
lowing observations: "I have employed the
digitizs to a very considerable extent in in-
flammations of the brain, of the heart, and
the lungs; and have succeeded with it in
cases where I otherwise should have despaired."
In Dr. Reid's Treatise on Consumption we meet
with an acquiescence in this sentiment on the fox-glove. Our experience,
however, has taught us to value this remedy
principaliy in other pulmonary affections than
the more violent kinds of inflammation, as
is mentioned under the head of phthisis. After
the excitement has been moderately, opium
in small doses. "Do neutral salts increase the
tendency to cough?" Podalivum. Small
doses of calomel, to prevent adhesions.

N. B. If pneumonia run on into suppura-
tion, we shall be discharged by cough, and
thus a species of consumption be formed; or
will be detained in the cavity of the chest,
and constitute cementum. In other cases, di-
gitalis in large doses. Calomel. Optimum:
Pervian bark.

Genus VII. Gastritis, inflammation of the
stomach.

Symptoms. Violent pain in the region of
the stomach, with pyrexia; small, frequent,
and sometimes contracted, pulse; vomiting;
laugh.

Causes. It may be occasioned by any thing
acid taken into the stomach; by blows on
the region of the organ; and a slight species
of it is often consequent upon taking cold in-
quiries after exercise.

M. M. In inflammation of the stomach
and bowels we have, in some measure, an
exception to the general rule of curative ac-
ting as the disease appears sphenic or a-
henic. The pulse and vital powers are often
udently reduced, and yet venesection is re-
quired. Warm bath. Fomentations. Ano-
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Genus XII. Cytisus. Inflammation of the bladder.


Genus XIII. Hysteris. Inflammation of the womb.

Heat, pain, tension, and swelling in the lower belly; pyrexia; vomiting. M.M. Venesection. Mucilaginous clysters, with opiates. Anodyne tonifications.

Genus XIV. Rheumatisma. Rheumatic inflammations never, like others, terminate in suppuration. Dr. Darwin attributes this circumstance to the secondary and associative nature of the disease; the original cause, like that of the gout, not being in the inflamed part; and therefore not continuing to act after the inflammation, continued action of the hands at a distance would be more properly referred to the nature of the parts that rheumatism attacks.

Division. Rheumatism is sthenic, or asthenic: the former, chronic rheumatism, often succeeds to the former; which the author just quoted refers to the deposit of nucos, or coagulable lymph, which the inflamed vessels had poured out in the first stages, remaining absorbed on the synovial membrane of the joints. It would probably be more correctly attributed to the loss of energy in the parts affected: an opinion which appears to receive support from the circumstance of the asthenic form of the complaint sometimes coming on in a direct way, without the intervention of the acute species.

M.M. Bleeding would appear to be indicated in the sthenic kind of rheumatism; in this disorder, however, the physician is so often unexpectedly foiled by the rapid occurrence of indirect debility, that venesection is almost never advisable; it lays the foundation for obstinate chronic complaint. Leeching to the joints, and taking a cold bath after the inflammation has in some measure subsided, Calomel, and opium. Sudorifics. Warm bath. "I have found digitalis an excellent remedy in inflammatory rheumatism, one of the most tedious and incurable of all diseases." Dr. Currie.


Genus XVI. Podagra, gout.

Symptoms. Pain in the joints, principally the great toe, and, with it, stiffness of the foot and feet, returning at intervals. Previously to the accession of the inflammation the muscles of the stomach are generally disturbed. The fits generally come on in the morning.

Causes and peculiarities. Gout is invariably a disease of the asthenic diathesis. It is produced in a system predisposed to its influence by the indirectly debilitating powers of certain vegetables and watery food, depressing passions, &c. The inflammation of this disease often alternates with, and appears in a manner vicarious of, torpor in other parts of the system; as of the brain producing delirium.

Dr. Darwin supposes the original seat of the gout to be the liver, which is probably affected with torpor not only previous to the annual paroxysms, but to every change of its situation from one limb to another. For this principle of associate action there does not, however, appear sufficient support; and indeed the sympathy is displayed with more force and frequency between the liver and the foot, than we have before mentioned (the stomach, the lungs, the brain), than the hepatic viscera. It is indeed the nervous system, and not the glandular, with which the paroxysm of the gout appears to have the most intimate connection; and it would have found a more appropriate place under the head of nervous diseases, that where it now stands in the Nomenclature. It is, however, very often combined with calyceal inflammation of the bladder.

The gout is evidently hereditary; but the attacks of this malady may, in general, be warded off, even from the most susceptible habit, by a temperate mode of living. This principle is illustrated in an extraordinary manner by the history of Dr. Gregory, the present professor of the practice of medicine in Edinburgh. We have often heard him in his lectures produce his own as an instructive case of the beneficial effects of abstinence from fermented and spirituous liquors. Gout has been imagined, like fever, to be a savant process of nature, for the purpose of expelling something from the constitution. The doctrine, in either instance, is equally erroneous.

M.M. In treating gout it should never be forgotten that it is an asthenic disease: white excitement is kept up in the system by paroxysms are suspended. Dr. Beddoes, in his Illness, says, that one of the greatest marvels to gout he ever met with informed him, "that his freest year was that of a warm, contested election, at which he was candidate for a county. He both drank and exerted himself at this time more than at any period of his life." This evident principle of the asthenic nature, even of the actual inflammation in gout, ought to render the physician extremely careful in his applications of the remedies lately introduced into practice, the application of cold water to the inflamed part, in some violent cases this may be proper; but it should never be extended beyond the limit of pleasurable sensation. To bless is like to curse, for the mode of suspending the paroxysms has already been referred to; and every artifice experiences temporary benefit from his dinner, his glass, and pleasurable company. It
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is by acting on the imagination that empires suspend the threatened attacks of gout. In this, as in many other instances, constitutes the virtue of remedies; both therefore in chronic rheumatism and gout, we might place among the curative agents metallic tractors, whether authorized by Paracelsus, or formed of old nails, as in the instructive experiments of Dr. Haygarth. Even a piece of scaling-wax, or stick, when supposed by the patient to be the genuine tractors, operated in a most astonishing manner. (Haygarth on Periarthritis.) The influence of the imagination over the body, whether in health or disease, has not been sufficiently acted upon in the professional practice of medicine. The irregular affections in gout must be combated by stimulants carefully adapted to the excitability; for the spasmodic affections of the stomach areatics and bitters, as ginger and quassia. If the head is affected camphor, muri, ether, opium; these like wise are remedies for the humors. The Portland powder, which is a composition of bitters and aromatics, may prove for a time highly useful; but the protracted use of medicines of this class is objectionable, as eventually detons stomach and bowels. Regular and steady, and not capricious and merely temporary, abstinence from wine, spirits, and spices. The body to be preserved gently. Pure air, moderate exercise, cheerful mind, in a Warm and cold sea-bathing. Bath waters. Very small doses of digitalis. Hop (humulus lupulus)?

ORDER III.—Exanthemata, Eruptions.

The exanthemata are more nearly allied to genuine fever than those disorders of which we have just been treating, as the local affections are consequences rather than symptoms of the general irritation. They have been called eruptive fevers. They are defined by Cullen contagious diseases, affecting a person only once during the whole of life, contracting with fever, and succeeded by eruption on the surface of the body, upon which these depend may indeed operate upon certain parts more particularly, and thus the disease be entitled to rank among the sensitive, irritative, or symptomatic fevers. The eruption is by no means the primary indication of the exanthemata: the primary action of contagion, whether of a specific or general nature, has hitherto escaped the penetration of the pathologist.

Genus I. Ermplies, St. Anthony's fire.

Symptoms. This disease does not correspond with the whole of the above definition; it is not contagious; and it has frequently been found to recur. The disease is more ordinary seat of this affection. After febrile irritation has subsided, and continued for a short time, during which there is often an unusual dryness, and sometimes delirium, the face suddenly becomes bloated, the eyes lids swell, and the skin is red and blistered. If the disorder is violent, or ill-treated, the inflammation and redness extend down the neck, and spread so on times on the shoulders: the tuft appears more discolored, and sometimes hemorrhages, and the patient has been known to die apoplectic. The erysipelas is an exanthematic inflammation. Its seat is the retic mucous. Its tendency is to gangrene, rather than to suppura- tion. A fatal termination is said to be principally on the 7th, 9th, or 11th day.

M. M. In no other affection is it of more urgent moment to decide on the treatment by the nature of the prevailing diathesis. It has been observed, that in large and populous towns, Measles appears in the form of asthenia; and in this case requires wine, bark, opium: while in the hardy constitution of the rustic it assumes a sthenic character, and demands the vigorous emollient. It is in the latter that remedies become the object of the physiologist. Venusenosis. Saline purgatives. Ditter drinks. Might not digitalis be employed with a propect of singular advantage, as the disease has an evident their pertinence of species? With respect to external application, it has been customary to use meaty substances, such as flour. Solutions of lead, zinc, or alum, are improper, "as they stimulate the secreting vessels into too great action." (Darwin.) Cold water.

Genus II. Pestis, the plague, an epidemic typhoid fever.

Genus III. Variolata, small-pox.

Symptoms. After the pyrexial symptoms have continued for three days eruptions appear on the skin, which on the eighth day begin to appear. Species. The small-pox is divided into the distinct, and centrifugal. the first has more of the sthenic, the latter of the asthenic, character. In the former the eruptions are of a phlegmonic, in the latter of an erythematous spreading, nature. The eruption of the distinct small-pox makes its appearance in circumscribed red spots on the face; in the course of two days the body and legs receive their characteristic spot. If these, the face swells, the pustules enlarge, and on the eighth day are mature. The swelling of the face now goes off, and the hands and feet begin to swell, with a slight return of fever, which however soon declines.

In the continent, or asthenic, species, the fits are not so regular; the eruptions are not circumscribed and prominent, but diffused, and scarcely appearing above the skin; a lacerated appearance. The eyes swell, the throat, and every symptom denotates debility. The fatal termination is often on the 11th day.

Incubation. The advantages of inoculation for the small-pox need not be insisted on. The circumstance, however, upon which depends the more favourable character of inoculated over natural small-pox, does not appear to have been satisfactorily accounted for. The only caution requisite in preparing for inoculation, are to preserve the three fingers' breadth, always a space for the insertion of the matter when feeling, or other irritable processes, are not going on in the system. With respect to the time, it has been well said, that inoculation ought to be performed either before the second month, or alter the second year.

M. M. Cold air. The bowels to be preserved open. Animal food to be denied. If the fever runs high, antimonials and nitre. In convulsive fits, barbituric acid, and when the internal canal is with the utmost solicitude to be preserved free from congestions by purgatives, the bark, small doses of nitre, wine, pure air; vinegar aspirated about the head, veins, and floor of the apartment. Pericardium.

N. B. For an account of the vaccine disease, see the article Vaccination.

Genus IV. Varicella. The chicken-pox is a very slight disease; the eruptions sometimes assume nearly the character of the distinct small-pox; but there is not much irritation of the system, and they generally disappear in the course of three or four days from their first breaking out.

Genus V. Rubella. Marks. Symptoms. Pyrexia, sneezing, inflamed eyes, dry cough, drowsiness; about the fourth day, or later, small red points appear on the skin, which in the course of about three days fall off in branny scales. "As the contagious material of the small-pox may be supposed to be diffused in the air like a fine dry powder, and rising with the saliva in the mouth to infect the tonsils in its passage to the stomach, so the contagious material of the measles may be supposed to be more completely dissolved in the air, and thus to impart its poison to the membranes of the nostrils which contains the sense of smell; whence a catarrh with sneezing ushers in the fever." Zoonia. Measles.

M. M. Measles too often lay the foundation of pulmonary consumption, to prevent which the symptoms demand inflammation of the lungs are to be with much solicitude observed; and for this purpose small doses of mixture of digitalis are to be preferred to every other medicine. Venusenosis cannot with propriety be used, however, imperiously called for; and digitalis supplies its place without the risk of inducing indirect debility. Steady and cool atmosphere, not cold air in currents. Refrigerant cathartics, with calomel. Animal food, not to be given. Digitalis, with a very small quantity of opium, for the cough succeeding to measles.

Genus VI. Miliaria, military fever, is merely a sympathetic eruption. Small points appear about the neck and face, which in two days become white pustules, and desquame. They have a peculiar smell. Much anxiety and difficulty of breathing precede the eruption. This disorder appears to be a consequence of an improper heating regimen in fever.

Genus VII. Scrofula, scarlet fever.

Symptoms. After pyrexia has lasted about four days a scarlet eruption appears on the skin, sometimes attended with inflamed tonsils and cervical glands; these last sometimes appear without cutaneous eruption, and the disease has been called scrophularia malignant. This disorder is apt to be mistaken for measles; but in scarlet fever there are no catarrhal symptoms as in measles. This disorder is very irregular in its aspect; and often, without much care, fatal in its termination. Sometimes, without any alarming symptoms in the onset of the fever, a change takes place, and in the course of a few hours the patient falls into the arms of death. The unfavorable symptoms are the same as in the previous form, but more principally of children. Whether it depend upon an affection, like measles and small-pox, is not perhaps utterly ascertained.

M. M. Cold air. Air. Antimonials, opium, bark, wine, saline purgatives or cinemas,
of some other discharge, such discharge to be restored.

Genus II. Hæmoptysis. Spitting of blood. Symptoms. Redness of the cheeks, a sensation of weight in the breast, difficult respiration. Slight taste in the mouth, irritation in the trachea, coughing up of florid blood.

Hæmoptysis more usually appears in individuals with a slender make and contracted chest, who are of an irritable habit, and who have been subjected in their earlier years to epistaxis. It generally comes on at the age of puberty.

Causæ. Violent irritation of mind or body, sudden vicissitudes of heat and cold, too powerful excursions of the lungs, as in singing, coughing, playing upon wind instruments. Like epistaxis, and indeed more frequently, it immediately originates from obstructed nostrils. Sometimes it appears vicarious of a gouty paroxysm.

M. M. "The faculty," says a modern author, "of repressing the primary symptoms of phthisie pulmonary, is proportioned to its difficulty of cure when the characters of the disorder are fully complicated, and the texture of the lungs not wholly destroyed." (Reid on Consumption.) In no case, perhaps, is neglect or early management of disease more pregnant with irreconcilable evil, than in the consumptive affections. Digitals properly and timely had recourse to is the "anxiet of hope." In families where this fatal disease (pulmonary consumption) is hereditary, the use of this remedy as a prophylactic, will, I have no doubt, save many lives that would otherwise have been cut short. (Dr. Currie.)" Digitals is a remedy in pulmonary consumption in its earlier periods, which nullifies the disease regulations, and with sufficient attention on the part of the individual, circumstances of regimen and diet, may be employed with a prospect of almost invariable relief. (Dr. Reil.) Other testimonies, equally decided, might be adduced in favour of this valuable remedy. Warm bathing. A regular temperature in the air that the person breathe. Warm clothing. Avoiding currents of air. Assiduously guarding against damp, and especially against cold in the feet, as by sitting with the feet on a stone floor, or in oil-cloth. Milk diet, of which Hoffmann elegantly says, "Qua perplexis phthisicis, myocardium Clavotis facillitatem, et animum, saluabat." Avoiding all spirituous liquors, and spiced or high-seasoned meats. Keeping the bowels gently open by manna, castor-oil, senna, &c. Uva ursi has recently been recommended by Dr. Leeuwenhoek, to be used as a very gentle and efficacious purgative. Dr. Leeuwenhoek, by purgatives, prefers the use of the root over the bark, of Uva ursi. It is allowed to be a very powerful reneging in the stomach, and is considered as a purge, by some of the most Laennecian and modern authors.

These are the remedies of the first stage, or, more properly speaking, the menacing symptoms of consumption. When the lungs have actually become ulcerated after gradual and protracted irritation, very little expectation of recovery can remain. Griffith's mixture, composed of steel, myrrh, and aloes. Digitals in larger doses, and combined with the above tonic. Uva ursi, and vitriolic acid. Digitals combined with calomel.

Change of climate. If a tendency to absorption from the surface of pulmonary ulcer could be induced greater than the disposition of it, we might have some prospect of curing it in a more easy manner. In order to produce this absorption, sailing so as to occasion sea-sickness has been had recourse to. Swinging, riding in a carriage, and other modes of occupying a degree of vertiginous affection, and consequent nausea, have likewise been recommended and practiced. In
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It is true that the exact contrary is the fact, for the malady will be occasioned with most facility when the circulation is weak and irritable.

Vvhy the membrane of the nostrils, &c., should be the readiest to suffer more particularly, it is not to seem of an easy explanation; it is important, however, to recollect that what has been pointed out in an explicit manner by Dr. Beddoes, and since by Dr. Reid, that this membrane is a part of the same expansion with that which lines the windpipe and enters the lungs; so that in fact a common inflammatory cold is a degree of the same disease with an inflammation of the lungs.

M.M. Moderate and equal temperature.

The bowels to be kept gently open. If the phlegmatic irritation is considerable, subtorics, Animorials, &c., are to be given. Oil or other substances may be used to lay the cough, but irritating balsams, such as cough medicines are generally composed of, are in the highest degree detrimental; they too often increase the disposition to, and sometimes actually produce, confirmed consumption. Liquorice, honey, boiled fig, almond emulsion.

If the phthisical tendency is conspicuous, digitals (see the section on Phthisis pulmonalis).

Genus II. Dysentery, dysenteria.

Symptoms. Frequent stools, mixed with mucus, and sometimes with blood, attended with griping and tenesmus, the proper definite remedy being opium, either sulphureous, or pyrexia, pulse quick and feeble. The disease is sometimes contagious and epidemic.

Causes. Dysentery depends upon the irritability of weakness, determined by particular circumstances to the alimentary canal; its predisposing and exciting causes are alternations of heat and cold, more especially when accompanied by damp, as when an army is encamped on marshy ground; the putrid miasma arising from the marshes; the contaminated effluvia proceeding from the discharge in the disease; and, according to Sir John Pringle, from dead bodies left unburied in the field of battle.

The immediate cause of the symptoms seems to be, a spasmodic constriction of the larger intestines, retaining the feces.

M.M. Colonel, opium, and rhubarb, to relieve the spasm, and discharge the contents of the bowels; magnesium acetate, as of starch with tincture of opium. Emetics. Small doses frequently repeated of peruvian. Colombo. Turpina bark. Warm bathing.

Class II. Neuroses, Nervous diseases.

Men is indebted for all his acquisitions to casual observation, leading to experiment. That the faculty we call the sentient resides in, or was developed through, the instrumentality of a peculiar and distinct organization, we should not, a priori, have conceived; there is nothing in the composition either of brain or nerve to lead to this conjecture. If, however, a portion of the bony defence of the conception be accidentally pressed in upon its substance, and an obstruction in the faculties of sensation and voluntary motion be the consequence; if such accident be repeated with the same result; finally, if it be found, as it has been, that by voluntarily producing pressure on this organ, similar effects may be occasioned in proportion to the degree and extent of the force employed; the impor-
ence will come at length to be indispensible, that the brain is the organ or reservoir of sensation, and that a lesion in the medium through which locomotion is effected.

Again, if it be found that at pleasure we can deprive any portion of the body both of sense and motion, by dividing the nerve supplying said part, or cutting off its common trunk with the brain, we are like to be fully justified in inferring, that the chord we have severed was the instrument by which the empire of the will had been exercised over the actions of the body of the brain itself, or at least the nerve supplying the organ in question.

This mode of inferring the nature of what is not an object of our senses, by comparing it with what can actually be observed, will be found equally satisfactory, in relation to partial as to total interruptions of sense and motion; thus, by a less degree of injury done to a nerve, as by lacerating or puncturing, instead of severing it, we shall perceive not an entire deprivation of, but merely an impediment to, the loco-motive faculty; the actions of the member will be in a manner refractory; and convulsive or irregular, instead of orderly and steady motion, will follow the mandates of the will. If then, without the interference of an experimenter, and without visible injury to the animal structure, the movements of an organ become improperly accelerated, or cease to be exercised in their usual mode; if, to instance by example, the heart perform two, or three, or four, or five, or six, or seven, instead of twelve, to twelve, to twelve, in the course of a minute, we conclude that the body is in an uneasiness which Hartley concedes to depend upon vibrations and vibrations, whether we embrace the doctrine of universally pervading ether, or subscribe to the tenable positions of the author of Zoonomia. Depressed perception and interrupted motion, are therefore the essences of nervous disease: the percipient, however, is to be distinguished from the motive faculty; for we have a class of living actions, which, although equally under the influence of nervous power with those over which the will presides, are nevertheless, in a state of health, incessantly carried on without perception or consciousness; thus, by impeding the functions of the nerves of the stomach, we may interrupt the function of digestion. Digestion, however, is a process performed without design, and independently of volition; on the other hand, it is necessary that it should be impeded by a derangement in the nervous system, while the digestive power shall proceed without the least impediment.

Dr. Cullen's definition of a nervous disease, would therefore have been more accurate, had he added an infection of either sense or motion, without idiopathic pyrexia, or visible disease of parts. The orders of this class (neuroses) are four:

1. Conatus. A diminution of voluntary motion, with sleep or impaired sense.
2. An insufficiency of the involuntary motions of either natural or vital functions.
3. Spasms, morbid motions of muscular fibers.
4. Vesane, disorders of the judgment or intellect without pyrexia, or observable affection of any particular part of the body.

ORDER I. Conatus.

Genus I. Apoplexia. apoplexy.
Symptoms. Abolition of the sentient and loco-motive faculties, the sleep in general attended with snoring. The respiration, motion of the heart, and other involuntary actions, remaining.

Causes. We conclude from the anatomy above-stated, that there is some degree of the pressure on the brain, or the apoplectic stupor; but that effusion of blood takes place in the manner described by the generality of authors, is exceedingly problematical; if the appearances on dissection are appealed to in behalf of this theory, it is answered, that such appearances can alone apply to fatal cases of the disease; and in such, an actual rupture of veins and effusion of blood will readily be admitted.

Epilepsia, palsy, and apoplexy, were confounded by Brown to originate from the mere irregularity of nervous power consequent upon debility or deficient excitement; and to be occasioned without either an unusual impetus of circulation to the vessels of the brain, or impeded return of blood from this organ. We believe, however, that although the cause of apoplectic often is in one sense mere deficiency of excitement directed to the action of circulation, the immediate occasion of the apoplectic symptoms is for the most part the state of the vessels of the brain.

Apoplexy, for the sake of illustration, may be divided into static and asthenic. If a vigorous and phletoric man, sitting down to his dinner and his glass, suddenly, during the excitement of conviviality, of mirth, and of alcohol, fall on the floor with deprivation of sense and apoplectic seizure, it must be evident that the fit has been induced by a greater flow of arterial blood into the vessels of the brain, than the veins of this organ could, in due time, convey away. The apoplexy has been induced in the manner of a silene disease.

If, in the other hand, a debauched and debilitated individual be the subject of an apoplectic attack, at the time when the excitement of intoxication shall have been succeed by the condition of indirect debility, the disease will here have been brought about in a different manner; the impetus in the vessels of the brain shall have partaken of the general diminution of power throughout the whole system; sluggish vascular action shall have caused congestion; which congestion, in union with the deficient excitation on which it had depended, shall have induced that sudden suspension of the sentient faculty which constitutes the apoplectic paroxysm.

Apoplexy often immediately succeeds to a full meal: what more natural than, under such circumstances, to attribute the fit to a distended stomach pressing upon the aorta or large descending blood-vessel, and consequent expanse or dilatation of the heart, and increase in the imordinate measure to the head? Such conclusion, however, will not bear the scrutiny of strict enquiry. Upon this principle, the apoplectic stercor and incommensurability ought to be induced within the cranium, and not in one dysy or night-mare, while the body is in a recurrent posture, and the stomach is most distended from the extrication of gas which takes place in consequence of the weakened digestive power; in place of this, however, the fall is immediate; the attack is made while the body is in an erect position, and often before the stomach has become in a very great degree distended; the fit then arises, in this last case, from an insufficiency of the digestive powers they have called off to their aid, leaving the brain in a condition of insufficient energy, properly to propel the vital fluid through its own vessels; congestion will result, and this last will produce the apoplectic or immediate cause of the fit.

M. M. The strictest attention to the manner in which the disorder has been brought on. If the disease is ethicus, and the physicals are called while the paroxysm still continues, immediate and copious bleeding from the arm, the jugular veins, or the temporal artery. Every ligature about the patient's body, especially about the neck, to be loosed immediately. Press hard with the thumb and fore-finger upon the carotid arteries, taking care to avoid the jugular veins. Place the head of the patient high on his pillow, or seat him erect in a chair. Preserve the apartment cool. Cold water may in some cases be applied vigorously to the forehead and temples. Afterwards saline purges, and subacid drinks. Encem. Careful preservation from irregular and violent excitations, either of body or mind. In theէ harvest form of the complaint, bleeding with much less freedom and only during the paroxysm; in general, it is not at all proper. It is better to open the temporal artery, if convenient, than to allow the complaint to continue. The application of cupping-glasses is still preferable; apply blisters to the neck. When the power of deglutition has returned, cordials and stimulants. Opium and wine in very small doses. Volatile alkali. Sprinkle vinegar about the room. To prevent the returns of the fits; tonics, particularly bit ter, as colocombo, gentian, quassia; exercise and mental amusement, without violent excitation. Journeys to Bath or elsewhere. Preserve the body regularly open, without violent purgations. Avoid sudden exposure to cold, especially cold and wet feet. If the fit has followed the suppression of any accustomed discharge, or cutaneous eruption, let them, if possible, be restored.

Genus II. Paralysis, palsy.
Partial interruption of the loco-motive faculty, sometimes with a degree of apoplectic stercor.

This is partial apoplexy, arising from similar causes operating in a less degree. It
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Cuonik daces to a full fit of apoplexy, and continues for some time during life. The pulse often affects the whole body, and is confined to that side; hence it has been supposed, that the injury of the brain is likewise partial; and from the degeneration that has been in the brain from the encephal, Dr. Darwin and others have concluded, that the origin of the disease is on the side of the brain opposite to the affected side.

Palsy, however, certainly originates at times (even if genuine apoplexy does not) from interrupted excitement, without any congestion in the brain, as its more immediate source, as it results from the poison of lead and other poisons.

M. M. Ascertain the exciting cause, and, if possible, counteract it. Emetics, purgatives, preceding stimulants and tonics. Tonic and stimulants, and whilst in the paralyzing state of life, and have been many remedies. This is said to be the case when the loco-motor power, and the energy of the muscular fibre, shall have been restored to their former state. In such cases the recovery is rapid, and the past, and anticipation of the future, have both probably been irrecoverably lost.

The more possibility of his being reduced to this condition of humiliating existence, one would think a motive sufficiently powerful to check the imponderable in his course.

Order II. Agyria. Secyno. Stump, fainting. Syphon, spasm of constriction, or even, for a time, a total cessation, in the action of the heart.

Fainting may arise from passions of the mind; from sudden reduction of stimulus, either from loss of blood in the region of the heart; from perspiration; from the irritation of worms, or other poisons, in the stomach and bowels; much heat, offensive ejecta, &c.; in these cases the disorder has been called syncope cerebral. When fainting arises from deficiency of oxygen in the circulating air, as in a crowded assembly, the cessation of the heart is produced nearly upon the same principles as in actual suffocation, drowning, or hanging. It is termed syncope pulmonae.

M. M. Immediately obtinate, if possible, the exciting cause. Endeavour to restore sensation by aspersing cold water on the face and neck; attempt to clear down a small quantity of blood; and in cases, but more especially when the affection arises from impure air, throw open the windows, and prevent compassionate spectators from crowding to the scene of action.

N. B. If fainting, or palpitation, recur frequently, and without any manifest cause, perhaps as a prodromus or exciting, there will be reason to suspect that the disorder is not nervous, but depends upon some malformation in the heart, or neighbouring blood-vessels. In this last case it is irremediable.

Genus II. Dysepsia, indigestion. Symptoms. Hypochondriac pain, indigestion,-nausea; vomiting; inflammation from flatulence; heartburn; pain in the stomach, especially when the body is in a hot position; nervouss breathing; costiveness.

This disease evidently arises from deficient action in the muscular fibres of the stomach, which in violent cases amounts to inverted motion and vomiting. It acknowledges the same sources as other affections of weakness; these are, inter alia, various liquors, and of tea; exposure to damp and cold; irregular hours of repose; intense study; mental depression and anxiety; when originating from this last source the disorder has an equal claim to the appellation of hypochondriasis, or low spirits, with that of dyspepsia.

M. M. Purgatives, with calomel, previous to giving tonics. An emetic. Coluchsia, gentian, quassia, &c.; in diagnosis, in order to neutralize the acidity, and case the consequent pain of heartburn.

Chalk, which is used with the same induction, is improper, on account of that neutral compound which it forms with the acid of the stomach becoming insalubrious, and more and more tending to increase the digestive state. The dyspeptic must be persuaded that a horse is a better physician; and that temperance of every kind, with reasonable disposition and exercise in a dry healthy air, will do more for him than all the medicines in the world. (Townsend.) Cold, or shower, bath, in very warm, and warm bathing in cold weather. A glass of warm water after dinner, and supper.

Genus III. Hypochondrisis, low spirits. Indigestion, with languor, and causes apprehension of evil, more especially as it relates to the patient's state of health.

This disease and dyspepsia only deserve to be distinguished by separate names, inasmuch as the mental depression in hypochondria appears especially to increase the disease by which it is, in part, constituted; and such disease is again supposed to be beyond measure by the morbid imagination of the invalid. Thus, in some cases of confirmed hypochondriasis, the dyspeptic sensations shall be attributed to the sufferer by the immediate agency of a medical impostor.

M. M. Aim at converting soliloquy and apprehension into confidence and hope; not by deriding the feelings of the hypochondriac, and treating them as fanciful, but by breaking the chain of excited associations. Procure a gradual change of scene and of habits. Journeys to Bath, or elsewhere, according to the previous disposition of the patient. Bath waters. Warm bathing. Preserve carefully the alimentary canal free from colitures and viscerities by drastic purges and calomel. Maintain a regular moisture of the skin, without copious perspirations. Tonics with aromatics. Dr. Darwin particularly insists, and with justice, on the advantage of uniformity in the hours of meals: this uniformity should be extended even to medicinals, the same hour of repetition being invariably observed. "Sic et si dormit."

Genus IV. Colic, or green-sickness. Dysepsia; paleness of the skin and of the lips; lassitude; difficult breathing, and palpitation of the heart, after using more exercisers than usual, especially in going rapidly up stairs; pulse small, feeble, and sometimes very quick; coldness of the extremities; appetite deficient, and oftentimes deprived; pain in the back and limbs; coldness of the extremities; emaciated ankles, especially towards morning; and obstructed menstruation. "Chloros haurit debilis pulsa totum corpus, laxo utas et frigent omnibus." (Van Swieten.)

Dr. Cullen has, with much impropriety, classed this among the nervous diseases; it ought to have been transferred to the next contumacious division of disease, or rather regarded as an affection of the lymphatic absorber system. In cases of much debility, especially of disposition to torpor, in the absorbing and secreting vessels; if, at the time when nature demands a new secretion and discharge from the system, in place of generative living, due exercise, moderate and pleasant excitation of the mind, the ever-springs hope of youth, &c. be substituted to poverty and unforesomeness of diet, water and vegetable food; and verbosity, concealed, unproperly, and unreservedly, in the hours of pleasure; the effect is the disease now under notice: which, however, from much natural debility, independently of either mental depression, or physical actions, or any other cause, may be, and very often is, occasioned. Chlorosis, indeed, is of exceedingly frequent occurrence.

The immediate cause is evidently an inactive state of those vessels, more especially of such which supply the lungs, with the deficiency of red blood in the vessels, want of propelling power in the heart and arteries: hence want of menstruation, emaciated swellings of the feet, "patient et frigent omnibus."

M. M. Almost as certainly as some kinds of pain yield to opium, does even obstinate chlorosis fall before the power of steel. "Dum hoc utilius, inquit orbe, melius major calor." To steel, then, must the physician have just, and trust in every case of genuine green-sickness. It is necessary, however, frequently to commence with an acute; and in almost all cases it is perhaps best to give a purgative, joined with calomel, before the use of steel. Tonic bitters. Aromatics. Moderate exercise in a pure atmosphere. Flesh and milk. A bath of about eighty degrees, as Buxton, not by any means colder. Marriage.

Order III. Spasmis, Spasms.

In the introduction to the class Neuroses, we endeavoured to describe briefly the manner in which a knowledge was acquired of the separate functions and distinct diseases of the nervous system. In the case of spasmodic affections this is especially illustrated. If in any animal the nerves supplying a limb be denuded, and a violent stimulus be applied to its surface, the whole member shall be immediately thrown into convulsive agitation; a fact which is perhaps too often demonstrated in the same and other experiments. When then such convulsions movements appear, without experiment, and sometimes without apparent cause, a similar change is justly inferred to take place in the nerve or nerves passing to the organ which, may be the subject of the disease. There's one circumstance with respect to spasms, that,
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both in theory and practice, ought always to be retained in the memory; this is, that the spasmodic or convulsive state of parts invariably implies debility. To act irregularly, is in all instances to act with deficient vigour; for the total destruction of these disorderly movements, performed in a given time, will not amount to the quantum of power displayed in the same time by healthy and steady action. This fact appears to be a sufficient refutation of Mr. Darwin's hypothesis, that convulsions are voluntary exertions of the muscles to relieve pain, even if we concede to this author, that the strict definition of volition ought to be the active state of the sensorial faculty in producing motion; in consequence of desire or aversion, whether we have the power of restraining that action or not; for, according to this principle, convulsion should be an actual and positive increase of vigour, which it is not; for while the utmost agitation is carrying on in the convulsed member or organ, if a due quantity of stimulus be thrown in, excitement will immediately follow, and in consequence of this excitement, false difference and firmness; in the same manner, but upon a different principle, as tightening the sail of a ship arrests its vibratory motions, but increases its actual and integral force.

If it appear difficult to conceive why a stimulant or exciting agent should produce this debilitated action, we must refer to the invariable law of existing excitation, that carried beyond a certain point, is immediately productive of indirect debility; thus when the galvanist convulses the leg of a horse, he throws in more of stimulus than is adapted to the fibrous excitability of the organ in question; he exhausts the irritability of the part; and the convulsion that follows is the consequence of such exhaustion, exactly upon the same principle that half a pint of wine shall give steadiness to the tongue, and firmness to the step, while a quart of this stimulus, taken in the same time, shall produce a temporary paralysis of the limbs, and render the speech softening and inarticulate.

We have indiscriminately employed in the above observations, the terms spasm and convulsion. As it relates to the excitement, they are virtually the same states; and thus, whatever convulsion is a spasm, that is, whatever rigid unmovable contraction, or rapid alternations of contraction and relaxation, follow the debilitated causes upon which they depend, in one sense they are scarcely to be distinguished; the difference of physiognomy, which they assume appears to have dependance upon the complicated associations of living actions, which are but little understood, and both in theory and practice too much disregarded.

From the above remarks we hope it has been rendered evident, that in attempting to overcome a spasm or convulsion, the leading principle of cure must be stimulative; the disease in question, however originating, invariably requiring dignity, or tender propery; perhaps, deficiency of excitement.

Sect. I. Spasmodic affections in the animal functions.

Genus I. Tetanus. A spasmodic rigidity of a great part of the body; in some instances it is drawn violently backward, at others forwards, and in both cases the disease is generally followed or attended by trismus or lock-jaw; these symptoms may last with greater or inferior violence from twenty-four hours to a month or more.

The immediately exciting causes of tetanus are, either prick or pressure of the hand, the sudden application of cold after extreme heat; great intertemporance, or other vices: the disease may likewise be consequent upon viaciar muff, worms, and other irritating substances, in the alimentary passages.

M. M. Purges, followed by tonics; mercury combined with opium.

Genus V. Epilepsia, epilepsy. Violent convulsions of the muscles, attacked with sleep.

Epilepsy in its nature and causes appears to hold a kind of intermediate situation between apoplexy and convulsion; it has the same duration as the spasm of the one, with the irregular muscular action of the other. Epilepsy, in a greater or less degree, is a disease of extreme frequency: indeed, all the convulsions of children may be called epileptic. In its full and formidable shape, it is not so frequently met with as several other diseases. A physician, however, may denominate, with propriety, all fits epileptic, of which alternate or combined convulsions and sleep constitute the characters, especially if these are connected with the increased action of the salivary glands.

M. M. Epileptic fits are sometimes congenital, hereditary, and depend upon some occult state of the nervous system. In these cases, the disorder is generally irremediable. All those that can be directly or indirectly ascertained, and endued, if possible, to obviate the exciting causes of the disease; and during the paroxysm to lessen every kind of danger to the head and head, preserve the aperture in which the fall is made as airy as possible, and be careful that the patient do not inflict injury upon himself by the violence of his agitation. In some cases, indeed, the individual can obviate the full formation of the paroxysm by laying a ligature round the limbs in which the sensation threatening the attack is perceived, between the point at which such sensation commences and the brain. This sensation constitutes what is called the epileptic aura; its abstract cause is obscure; but no less so than the phenomena of spasm in general.

In treating the complaint, particular attention is to be given to the predisposing and exciting cause or causes, which are extremely liable to this such irrepressible, indulgence in secret vices, mental passions and affections, imitation of other epileptics, lively recollections of previous impressions, repelled eruptions or discharges, sudden alterations of the extremes of temperature, unpleasant odours, and, as by far the most common source of those epileptic fits which scarcely amount to absolute epilepsy, worms. These causes must all necessarily be removed before the physician can have the least prospect of overcoming the disease. Emetics, cathartics with colonel; antiepileptics; suddenly discover the chain of associations, by plunging the patient in the cold bath, or delivering with violence cold water into the body. Induce a new disease, as the itch; a plan which Dr. Darwin adopted with success in the treatment of St. Vitus's dance, with which the present has a great affinity. Patients have likewise been cured of epilepsy by the accidental occurrence of a quartan ague. These are instructive cases to the reflecting and speculative. Tonics. Galvanism. By this newly discovered source of nervous excitation, the writer of this article recollects to have wit
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Genus II. As hina.

**Symptoms.** Difficult respiration returning at intervals, with a sense of tightness across the breast. Whizzing at the commencement, and scarce secretion of any cough but what is hard; towards the close of the paroxysm it however becomes more free, attended with a discharge of mucus.

These symptoms certainly arise from a spasmodic constriction of the bronchial tubes, "which may be produced by consent to the larynx and diaphragm."

The causes of asthma are numerous, while its predominance is often hereditary, and dependent upon a peculiar conformation and temperament; the actual disease may be excited by temperance; either in eating or drinking, violent exercise, mental agitation, eruptions or discharges abruptly or unreasonably expelled; the tunes of metallic poison, as of lead, &c.

**M.M.** Spasmodic asthma, when fully established, scarcely admits of a radical cure.

The paroxysms to be relieved by opium and ether; coffee; tonics in the intervals, principally of the class of bitters and aromatics.

Avoid distending the stomach inordinately. Emetics; emesis previous to the anticipated accession; gentle horse exercise; pure air; oxygen gas. If eruptions have been expelled, endeavour to restore them.

**Genus III. Pertussis,** hooping cough.

**Symptoms.** Convulsive strangulating cough, with noise inspiration and hooping, and sometimes attended with vomiting. It is contagious.

The precise nature, or, as physicians express themselves, the proximate cause of hooping cough, does not seem to have been accurately ascertained. It is, however, supposed to be "an inflammation of the membranes which line the air-vessels of the lungs, and that it only differs from pericardium superficialis in the circumstance of its being coughing out."

It has been observed to be a morbid irritative fever; we are inclined, however, to think that the infection principally operates upon the stomach; and that the inflammatory disorder of the mucous membrane is merely a consequence of the irritation, or erroneous treatment, of the complaint. It is not attended, in the first instance at least, with the symptoms of inflammatory irritation; and the vomiting, by which the violent fits are often relieved, proves that the stomach, in pertussis, is in a morbidly irritable state.

It deserves however to be remarked, that the membrane in question is very apt to parake of the preceding irritation, to become inflamed, and thus, like the inflammation after small-pox, and measles more especially, to lay the foundation of consumption of the lungs.

**M.M.** Antimonial emetics. Very small doses. Warm bathing. Above all, digitalis; in no disease, perhaps, is the power of this valuable medicine displayed more forcibly and evidently than in hooping cough. Its effects are generally almost instantaneous. After the violence of the paroxysm has been subdued, and even before, change of air. Cicuta (cnicum maculatum) has been much employed in this complaint.

**Sect. III. To the animal functions.**


**Symptoms.** Sudden eruption of watery fluid with or without heartburn; the fluid brought from the stomach sometimes transparent.

**M.M.** The author of the present article recently had an opportunity of witnessing in this disease the beneficial effects of the ingestion of tobacco-smoke by a person not previously accustomed to smoking; this man had taken tonics, antispasmodics, and atacks, without effect. "A gram of opium twice a day, soap, iron powder, a blister." (Darwin.)

**Genus II. Colica, colic.**

**Symptoms.** Permanent and excruciating pain in the belly, with a sensation as of twisting about the navel, constipation, and sometimes vomiting.

**Causes.** These symptoms evidently originate from spasmodic constriction in some part of the intestinal canal, which may be occasioned by various causes: such as indigestible food, the sudden application of cold; acid substances received into the stomach; poisons, especially lead; hence colic is a kind of epidemic disease among painters, attended with paroxysm of the arms, &c. It is likewise common in cold countries.

**M.M.** Opium. Cataractis, principally of cataris oil. Warm bathing. Anodyne clysters, Fomentations and blisters to the part. In obstinate cases of the painters' colic, Bath waters. Carefully obviate the exciting causes of the disease.

**Genus III. Cholera.**

**Symptoms.** Vomiting and purging of bilious matter, violent pains in the stomach and bowels, with great and violent perspiration.

Cholera is one of the diseases of the autumnal months; it is very often produced by the sudden succession of cold to unusually warm weather: it sometimes follows the taking of indigestible substances, as of much cold cucumber, especially at the period of the year above-mentioned, when the directly debilitating power of cold abruptly succeeds to the indirectly debilitating operation of heat, and the biliary secretion is more than ordinarily copious.

**M.M.** During the violence of the vomiting and purging, give water-gruel, and inject starch clysters, to each of which add a little of opium. After the disorder has in some measure subsided, restore due excitement by cordial and nourishing diet, with stomachic medicines. If febrile irritation is induced, the saline draught, composed of salted wormwood and lemon-juice.

**Genus IV. Diarrhea.**

**Symptoms.** Frequent stools, without primary pyrexia, and not induced by contagination.

A morbid action in the exertories of the intestines constitutes this disease; sometimes however, and frequently, purging arises...
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from more loss of excrebin in the intesti-
nal fibres, without increase either of bile or
any other secretion. It is immediately oc-
casioned by acrid matter in the stomachs;
by acids, by mental passions, or by the
sudden application of cold, more especially
to the feet.

M. M. 3. According to the exciting causes.
If there is reason to suspect the lodgment of
acrid matter, cologne, with jepa, senna, or
rubarb. Afterwards astringents, of which
one of the best is good red wine. Opium.

Chick, if acridity prevails. An emetic if the
disease is obstinate.

Genus V. Diabetes. 

Symptoms. Superabundant discharge of
urine, in some cases amounting to fifty
pounds in twenty-four hours, limpid and
very close to the taste, with urgent and
perpetual thirst, dry skin, weakness, emaciation.

This disease often, perhaps, exists to a very
considerable extent without being detected.
It is not an uncommon complaint among the
poor, especially of the north of Brit-
ain.

The principal circumstances that have
attracted the notice of the pathologist in re-
ference to this complaint, are the saccharine
quality of the urine, its evacuating nature, and the
at-
tentive evacuation. One of the principal
ingredients in the nutrition of the body has
been supposed to be the saccharine principle;
from the inordinate discharge of this prin-
ciple in the diabetic urine, the disorder has
been therefore referred to some to a de-
ciency of assimilating power in the stomach
and digestive organs, while others have in-
ferred from it to originate entirely from alter-
cation in the kidneys. Perhaps both of
these causes may operate in producing dia-
betes. Upon dissection, the kidneys are al-
ways found lacerated. Dr. Darwin, after Mr.
Charles Darwin, attributes the copious flow of
urine to the inverted or retrograde action of
the urinary lymphatics; but besides that
thesis does not account for the super-
abundance of sugar or of mucilage in the
water, it has been proved that such inver-
sions are not always accompanied with their
structure and general economy.

M. M. 4. Animal diet. Dr. Rollo and
others have observed that when the patient
live on animal food, the saccharine quality of
diabetic urine abates. Alkaline and ac-
sthetic medicines, such as tart-galls and
limewater. Bark. Steel. Opium. Ament-
away. 

N. B. A copious flow of urine is fre-
cently observed to attend nervous affections, and
indeed is one of the characteristics of the
disease we are next to notice; in these cases
however, the water has not the superabun-
dance of the saccharine principle as in genu-
ine diabetics, which last disorder has been ex-
tremely placed in the class Neuroses.

Genus VI. Hysteria. The hysterical disease.

Symptoms. A gurgling of the bowels, fol-
lowed by gulsms hystericus, or a sensation
of a ball ascending to the throat, and mean-
ing suffocation. Convulsive agitations, al-
ternate laughing and crying, a general flac-
kuiness and languor of the body, followed
by extraordinary fatigues. A deficiency of
vitality of straw-coloured or limpid urine. Hys-
teria, like epilepsy, is in a certain degree
extremely common; it generally first occurs in
}females about the time of puberty. It is
like all other convulsive diseases, a symp-
tom of a lux habit, and is consequent upon
the irritation of the nervous system. It may be
brought on by mental agitation, or by irrita-
tions in the stomach, bowels, uterine or-
ines, &c.

The discharge of urine which attends or
precipitates hysteric presentation, is attributed by
Dr. Darwin to the inverted motions of the
lymphatics about the mouth of the bladder,
as in diabetes; a temporary torpor, or spasm
of these vessels, would appear sufficient to ac-
count for the superabundant excretion, the
watery part of the urine not being taken
up.

M. M. 5. Avoid every occasional and ex-
citing cause of the disease. Park, quassia, and
other tonics. To remove the present symp-
toms, camphor, asetatecd, caustor, opium; if this
does not succeed, the best and most effectual
is the patient, the hyposyamus will generally
be found an excellent substitute. This has
not the constipating tendency of opium; and
in hysteric cases it is of importance, while
it is easy to be obtained, to preserve a freedom
both in the alvine and cun-
nacular discharges. Emetics, N. B. The cus-
mary plan of bleeding in hysteric affec-
tions is extremely detrimental to the general
health, and especially to the return of the
rigorons. If it is judged necessary in some
cases of hysteria to withdraw a small quantity
of blood, it should be done not by ven-
section in the ordinary mode, but by the ap-
plication of a crotchet, which is thought to
be of some service.

Genus VII. Hydrophobia. 

A dread of water as exciting painful con-
vulsions of the pharynx, caused for the most
part by the bite of a mad dog, violent spasms,
violent irritation, death.

M. M. 6. "When the contagion of a pad-
tic fever is taken by the saliva into the stom-
bach and bowels, when the integuments are
quivered (quiver) at the patient the moment he finds
himself attacked with a sense of chilliness,
loss of appetite, and an unpleasant taste in
his mouth, has recourse to two emetics at
proper intervals, one of which is an emetic and
the other the inorganic. If the first emetic
takes a cathartic, he has certainly got rid of the infection in
the same manner, even after three days, or per-
haps a week, if the part bitten by the dog be
not cut off with the knife, the danger is escaped."
(Townsend.) Dr. Thornton advises the ap-
lication of hot vinegar, sharpened with vi-
ricose acid, to the wounds of five men who
had been bitten by a rabid animal, and the
application was attended with seeming suc-
cess. Mercury, by this has been ex-
tolled as a specific for hydrophobia.

Order IV. Vesania. 

Disorders of the intellect, independent of
pyrexia or convulsions.

Every nervous disease, (says a author
whom we have before quoted) is a degree of
insanity. But, however, imagination carried to
the height of sentiment perception, or, as
it has been expressed by Dr. Baty, the rais-
ing up in the mind of images not distinguish-
able from impressions on the senses, is the
proper definition of the insane state;* the
cardinal point on which madness turns, the
above apothegm of Dr. Reid may be
regarded as rather bold and impressive than
strictly accurate. It were surely improper to
demonstrate the apoplectic, the paralytic,
the hysterical, or the tetican, insane; yet an
individual under these maladies, is as truly
as any other disease considered as one who:
like the lunatic animal, consents to give
himself to possess the mastery of the ele-
ments, commands rain to shed fertility on the
barren soil.

That the disorders of the intellect are dis-
orders of the nerves, we ready admit; it is
the converse of the proposition we presume
to question; and in so doing, we justify Dr.
Cullen, in considering the vesania, or nex-
tal affections, as a distinct order of nervous
diseases.

The pathology of such diseases is peculiar-
ly perplexing. We find by experience, that
an increase of vascular action in a tender
organ will give rise to the feeling of pain,
we have ascertained by the conjunctive and
mutually reflexive aid of casual observation
and direct experiment, that convulsive
movements in the muscular fibre are occasioned
by an immense injection of nervous excitement in
whatever that may take the brain is exer-
pressed upon, and the apoplectic stupor fol-
low; but in endeavouring to trace deranged
consciousness to disordered organization,
temporary or permanent, an increase of in-
tracranial action and intensity of manner to grow out of
labour and research.

Dissection does not afford that assistance to
the pathologist in this, as in many other
departments of his inquiries; for indepen-
dently of the great want of uniformity that has
been observed in the brains of the unfortunate
victims to mental derangement, it is impos-
sible to judge from an inspection of this or-
organ, how in the altered structures and ap-
pearances have been causes, and how far
consequences, of the malady.

Dr. Cullen has four genera in his order vesania, viz. amania, melancholia, mania,
and oncoelia, on each of which we shall
introduce a few remarks.

Genus I. Phrenopsie, insanity.

Amenia is defined an inabibility of judg-
ment, preventing the proper reception of the re-
collection of the relations of things.

Man is born with merely a susceptibility
of knowledge, a capacity of acquisition; he
is educated from observation to comparison,
and from comparison to principle. Place an
infant in a spacious apartment, give him for
the first time the use of all the senses with
which nature has furnished him, and he
will stretch out his hand to perhaps the most
distant object in the room, with a full per-
ception of being able to grasp it. Like the
youth counselled by Chlodon on Epict. Down,
everything within the scope of his vision
appears to him in a manner to touch his eye,
he has not the smallest conception of the
distance or magnitude, and the same total
ignorance prevails in respect to objects
which have relation to all his other senses.

Insanity results from the experience of
something which may make a comparison of
the relations of things.

As man, however, essentially differs from
the brute, by the more extended compass of
his intellectual grasp, the superinduction
of a period, and the anticipation of future
events, so different individuals have varied
susceptibilities of acquiring informa-
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tion; and this variation, which constitutes every shade of the different suicidal characters, must necessarily arise either from difference in the perceptive organs, or circumscription and retaining faculty. When then, without any apparent deficiency of the external senses, which are the inlets to knowledge, we find an individual not to have arrived at a given standard of intelligence by the constant employment of such senses, not to have obtained a due knowledge of "the relations of things," we place him out of the range of intelligent existence; have an obscure conception of something defective in the interior structure of his sentient organization, and denominate him an idiot.

This is the amentia congenita of Cullen, idiocy from birth.

Idiocy, however, may be produced. Facility may succeed to intellectual vigor, and the whole fabric of acquired knowledge be undermined and overthrown. Thus man may be reduced to the state of a second child. This state may be engendered abruptly and visibly, or gradually, and almost in an imperceptible manner. It may follow violent agitations of the mind, or be traced to a prolonged mental state, or may be brought about by the gradations of natural decay.

The causes of idiocy, when it is not the result of original malformation, are, all kinds of atrophy, more especially indulgence in the use of spirituous liquors: "it has been traced up to somnolence too much indulged." The media through which it is principally occasioned are mania, apoplexy, and above all epilepsy. When epilepsy is established even in youth, very little hope of recovery can be entertained by the friends of the unfortunate victim to his own impiety. The vindication of idiocy is a condition beyond the reach either of physical or moral influences!

Genus II. Melancholia.

Genus III. Mania.

We have placed these two genera of Dr. Cullen together, as we deem our author fundamentally erroneous in considering them distinct affections. Melancholia is "partial madness without dyspepsia." From this mode of reasoning, mania, instead of being distinguished by the character of universal madness, would have been with as much propriety designated partial madness without fever.

Insanity is intensity of idea, creating imagination into implicit belief, and thus producing an incongruity of action; incongruity is it respects former, consistency as it relates to present, improbability and associations. It partakes of the character of mania or melancholia, of violent rage or gloomy despondency, according to the previous temperament of the sufferer, and the nature of the prevailing idea. In each the disordered associations are engendered upon precisely the same principles.

Madness differs from idiocy, as the conclusions drawn from erroneous principles, in philosophy we differ from the conceptions of ignorance: the one proceeds from erroneous premises, the other is defective judgment from defective information.

How this intensity of idea is produced, we have no means of ascertaining: we do not indeed feel it difficult to comprehend, that an absorbing attachment to one object, or an exclusive attention to one particular pursuit, may come at last to make shipwreck of the understanding; but it is the susceptibility of being carried away by this idea, that constitutes the maniacal mania, the qu’un atome déplace, pour t’en faire périr, pour te dégrader, pour te ravir cette intelligence dont tu parais si fier! So precarious is the tenure, even of the most exalted possessions of man!

Madness, however, like idiocy, may be produced through the medium of bodily disorders; thus, fever will often occasion delirium, which is a species of temporary insanity. Thus, an obstruction of the menstral discharge will frequently be the cause of the development of disordered ideas, or maniacal disorder, occasioned by previous disease, resulting from erroneous education, or depending upon hereditary conformation. Indeed, almost the whole range of nervous diseases may, under predisposing circumstances, come to be excusable in cases of genuine insanity. When lunacy has been brought on by bodily disorder, the completion of the derangement shall be formed by the previous temperament, or the natural disposition of the sufferer; thus, the favourite ideas of health shall, in their increase, be the predominant and overwhelming ideas of madness; again, when the insane state has more immediately proceeded from passions of the mind, or moral rather than physical causes, the ideas that have vanquished the intellect shall continue to reign. The imaginary monarch shall preserve his dominions and sway, and through the medium of his distempered fancy, shall observe menials and attendants in the persons who surround him; the melancholy lover shall require but a female form to pass before his cell, to be persuaded of the actual presence of his affections; and the religious enthusiast shall read a special embassy from heaven, in the countenance of every compassionate visitor.

Prognosis. "The chances of recovery are against those madmen, who can trace their indisposition to lunatic ancestry. When the causes are accidental, or obviously corporeal, a favourable termination may be expected. "The insanity subsequent to parturition, is generally curable if the curative attempts be rational. (Cox.) "Patients who are in a furious state recover as eagerly proportion, than those who are depressed and melancholy. When the furious state is succeeded by melancholy, and after this shall have continued a short time the violent paroxysm returns, the hope for recovery is very slight. Indeed whenever these states of the diseased frequently change, such alteration may be considered as unfavourable. When insanity supervenes on epilepsy, or where the latter disease is induced by insanity, the case is very seldom effectual. (Halsted.) "When a person becomes insane who has a family of small children to solicit his attention, the prognosis is very unfavourable, as it shews the maniacal hallucination to be more powerful than those ideas that generally interest us the most." (Darwin.) "Though individuals of every temperament become insane, it has been observed that those of the singuine more frequently recover."}

M. J. Endeavour to draw off the mind from the prevailing idea, or to convince the maniac of the errors of his conceptions, and fallacy of his pretensions, by relating the incongruous conceits of other maniacs which have some affinity with his own. M. Pinel states, that in the Bicetre of Paris, a maniac was cur'd by a suggestion that he had been a party to the guillotine, and that mother of mother had been placed on his shoulders, by a person judiciously ridiculing in his hearing the miracle of St. Denis, who was said to carry his head under his arm, and to kiss it. When the maniac was endeavouring to prove the posibility of the fact by an appeal to his own case, the narrator of the story suddenly exclaimed, "Why, how, you could kiss your own head? was it with his head?" In inept and equivocal madness, cautiously abstain from expressing suspicions in the hearing of the patient. Nothing is more certain than the ideas of a person mad than the idea of being thought so. (Reid.) On this account, premature confinement is to be deprecated, not merely as cruel, but as injudicious in the extreme. Those who are placed in the lunatic asylum as guardians, should unite decision and firmness of character with tenderness of disposition and gentleness of manners.

In strong phlegmatic habits, venesection. Cathartics. These last, especially in melancholy, often require to be of the drastic kind, and united with calomel. "Distillation very often proves a natural cure of insanity." (Haslam.) Vomits. Camphor. Opium in large doses. Cold bathing during the violence of the paroxysms, and in some cases warm bathing in the intervals. During the urgency of phrenzy, apply cold water to the head. Clay exp. Bisters to the scalp. In some cases the production of a vertiginous state by rotatory movements has been found effectual in breaking the morbid associations constituting phrenic and melancholy paroxysms, Digitals in very large doses, but regulated with care. Introducing a new disease, which shall fascinate, sooth, and easy of cure. "I should place considerable hopes on inoculation, had the party not previously had the small-pox, taking care, by proper medicines and management, to increase the symptoms that usually attend this last disease" to such a degree, that the whole system be considerably affected without the life being endangered. (Cox.)

In instances where madness has originated from corporeal diseases, it scarcely requires to be observed, that a considerable part of the treatment must be constituted by the administration of those remedies that in common cases of these affections have been found to be effectual.

Genus IV. Oneirodynia. This genus is described by Dr. Cullen as a violent and distressing imagination in time of sleep." It is divided into two species: the active, or that exciting to walking and various other motions; and the grasp, with sense of weight or pressure on the chest. This last is the
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habit of authors, or nightmare, which is constantly placed erroneously among the disorders of the judgment.

The former of these is generally either congenital, induced by unknown causes; it is perhaps primary, and strengthens the almost unlimited power of one sense, when concentrated as it were, or employed to the exclusion of the rest. Dr. Darwin relates the case of a gentleman who had lost his sight, entering his room, and immediately inquiring of him the length, breadth, and height of the apartment, by the undivided exercise of his sense of hearing; an accuracy which he could not have arrived at, had he retained the faculty of sight. In like manner the sleepwalker "will unlock his door, wanderer from home, avoid opposing obstacles, and pass with safety over narrow bridges," which during his waking hours he would have deemed as unable to accomplish.

The incubus, or night-mare, appears to arise from an interruption of the circulation of blood through the lungs, from defective irritability in those organs, induced by fatigue, or worse, "a full supper and wine," which last, in some persons, will almost invariably induce the disease.

M. M. Temperance; especially moderate suppers. "To sleep on a hard bed with the head raised." Enemias of loch and colon. Tonics. Sleeping in a literary apartment, and without curtains to the bed.

Class III. Cachexia. Cachexies. Previously to an acquaintance with the distinct structure and separate functions of the nervous system, before the important discovery of the circulation of the blood, and more recent, but hardly less important, development of the anatomy and physiology of the secreting and absorbent vessels, the notions of pathologists on the mode in which disease, local and general, is occasioned, were indistinct and erroneous.

When, for example, on the surface of the body appeared a peculiar eruption, which after a certain time broke through the outer skin, and discharged an offensive matter, it was natural to infer that such discharge was expressed from a deprived condition of the solids or fluids of a diseased system in the same manner as exhalations proceed from dead and putrid animal or vegetable substance, or as water is formed in the fermenting vat. Hence, the use of the terms had habit of body, foulness of blood, pecuniary of humour, cachexies.

These gross and indiscriminate opinions respecting the actual nature and immediate cause of disease, are now retained alone by the vulgar; and as the separate functions should keep pace with the advances of science, the word cachexy, as descriptive of those affections we are now to notice, ought to be banished from the phraseology of the nosologist, and a generic title substituted, indicative of disordered or deranged action in the secreting, absorbing, and glandular organs.

Order I. Marcores. A wasting of the body or general emaciation.

Genus I. Tubes. Asthenia, emaciation, and hectic.

Genus II. Atrophia. Asthenia, and emaciation without hectic.

Dr. Cullen has properly distinguished the emaciation connected with hectic fever, from that independent of this as a primary and essential character. The latter, however, or atrophia, should not appear in the last class of diseases. When, for example, in consequence of mental affections, of engorgement of the brain, of the fluids, of deficiency in the quantity or depravation in the quality of the diet, a loss of flesh and strength is perceived, the effect shall have been occasioned without any loss in the absorbent vessels; and consequently without hectic; for let it be retained in the recollection, as a principle of the utmost importance in practice, that where hectic fever is present, a greater or less degree of derangement in the lymphatic vessels is likewise present. Hectic fever is a disease of the absorbent system.

For the purpose of illustrating this distinction between tabid and atrophic disorders, let two individuals be supposed equally emaciated and equally weak; but this weakness and emaciation in one shall have been induced by an indisposition to take a due quantity of nourishment, in order to supply the losses which the body has been in a state of continues, by the loss of bulk and of strength, an equal, or even greater quantity of aliment shall have been received into the stomach. Now, in this latter case, the tabid state has been occasioned by a moral condition or improper action of those vessels whose office it is to separate the nutritive part of the food, and convey it, properly prepared, to the blood-vessels (see the article Dr. Cullen); the other has proceeded from a want of those materials upon which these vessels exercise their functions. In the one the hectic flux from the very onset of the malady shall imprint the check; in the other, hectic will not be occasioned until the absorbents, from not being properly exercised, come at length to be disordered. The one complaint is the tubes of Dr. Cullen; the other is the atrophia of the stomach; the one is consumptive, the other atrophic.

We have been particular in pointing out this distinction, because it is not sufficiently noticed by writers in general, notwithstanding its extreme importance in practice; and because, by keeping it distinctly in view it shall be enabled to reconcile the apparently contrary operation of those medicines which are employed with varied effect under different circumstances of debility and emaciation.

Steel, for instance, is one of those articles which on account of their almost magic power over so many diseases of debility, have been indiscriminately recommended in all; it has acquired this repute in the hands of a tonic medicine, but as a tonic it often fails.

Now let us trace its effects in the two species of emaciation just alluded to. In the first stage of atrophy its administration will be often followed by irritable action, in the place of due excitement; the attendant febrile heat (not hectic fever) will be augmented, costiveness and an acid skin will follow, and indeed all the symptoms of the malady be heightened.

In tabid diseases, on the other hand, the reverse effects will arise. Here the fever is hectic; and in the same degree that this valuable medicine, when duly employed, had increased the febrile irritation in atrophia, it will assuage the fever of tabs, and from the same cause, the stimulus which it imparts to the absorbent and hectic state.

How hectic fever originates, it is difficult to explain: its symptoms have been attributed by a writer of the present day to that surplus of excitement being expanded upon the arterial, which is supported by the deficient excitability of the absorbent system. This, however, is rather a statement than an explanation of its essence. The characteristics of hectic are principally the circumscribed redness on the cheek appearing more evidently once or twice in the course of the day, usually after meals, and alternating with a more than ordinary paleness of countenance; the pulse is feeble and quick; like the crimson flush of the cheek, it is accelerated by any thing received into the stomach; the urine is for the most part high-coloured, but deposits a bran-like sediment after standing for some time; the tongue is not furred in the same manner as in fever in general, but is clean; and often, as the disease advances, it increases in redness, the exact contrary to what is observed in genuine fever; the sweat is partial and irregular, and not attended with the same degree of temporary relief as in other cases; and in the advanced periods of the complaint, principally breaks out about the neck, breast, and shoulders; as the disease proceeds, debility and emaciation succeed, the legs and feet become atrophied, and (particularly) the skin (though the fatal close of the malady on which the hectic depends) delirium at length supervenes.

M. M. In atrophia, a supply of nourishment, equivalent to the loss that may have been sustained; if emaciation has arisen from mental disturbance, the remedies must chiefly be made to apply to the mind. Tonics from the vegetable class, such as colocynth, quassia, and gentian; not steel. Minute the febrile irritation, by keeping the bowels gently open by the milder purgatives, such as rhova, senna, and castor oil. Preserve a slight moisture of the skin by small doses of animalia, i.e. calomel, sugar of lead, not violent or agitating, exercise. Shower-bath in very warm, tepid bathing in cold weather. Pure air.

M. M. or emaciation, accompanied by primary hectic. An exercise that may accomplish the double purpose of forcibly expelling vitreous and intestinal acidity, and exciting the languid absorbents. Draught purgatives, as jalap or aloes, with calomel, with the same intention. Steel, in conjunction with Peruvian bark or biters. Force exercise. Warm bathing.

N. B. Tabs is for the most part symptomatic of other complaints, as of a disease of the lungs or the liver; and in such cases the remedy by which it is to be overcome is the treatment of the original or radical malady.

Order II. Intemaeceutia, general swellings.

Sec. I. Adipsos, Fatty swellings.

Genus I. Palynsecelia, obesity. This arises from the deposition of oil in the adipose membrane—becoming distended by the exhalations of the body. It proceeds in general, from indolence and intemperance.
Genus I. Pneumonial, a tense elastic swelling of the abdomen, tense, elastic, painful, and attended by costiveness.

Pneumonial, or the breaking of the cellular membrane from air; it may arise without any evident cause, and in this case is denominated by Dr. Cullen the spontaneous or the distending phalanx, which may be introduced by means of an external wound, as of the thorax, in compound fracture of the ribs: sometimes elastic swellings of the whole body follow, from the application of poison; and at others, pneumonial appears as an attendant upon the hysterical disorder.

The pathology of this disease, unless when it arises from wounds, is exceedingly obscure.

M. M. Scarifications, compresses, tonics.

Genus II. Tympanites, a windy swelling of the abdomen, tense, elastic, and painful, attended by costiveness.

Tympanites, swellings, both of the intestinal canal and of the cavity of the abdomen, often take place in conjunction with anaesthesia, or other disorders of debility, and frequently arise from sedentary habits, hypochondriacal affinities, or morbid symptoms. Tympanites are sometimes connected with obstructed menstruation, and in this case is seldom overcome but with the return of the menses.

Genus III. Physometra, an elastic swelling in the hypogastrium, consequent upon fluctuating distension of the womb.

It has frequently occurred in the female with the hope of pregnancy, till nature explains the mystery, and her expectations vanish in air.

Sect. III. Aqueous, watery swellings.

Droplexial enlargement is distinguished from pneumonial by its being inelastic, or pitting from the pressure of the finger, and slowly recovering its former form.

While considerable obscurity attends the nature and probable cause of windy swellings, the theory of droplexial affection is sufficiently evident. Droplexia is a collection of serous fluid, either in the cellular membrane, or in the cavities of the body. It is invariably occasioned by exhalation being disproportionate to absorption; this increase of exhalation and diminution of absorption results from debility, which may be either direct or indirect; the latter follows increased action of the vessels, as in the dropsy succeeding to intemperance; the former arises out of deficient excitement in the lymphatic system, as when an individual becomes droplexial from incontinence, inactivity, mental depression, and poverty of diet. Partial droplexes, or anaesthesial swellings of the cellular membrane, as well as effusions into cavities, may also originate from pressure on the veins in dependently of original debility in the lymphatic vessels, such pressure obstructing the free reflux of blood through the venous system, and occasioning occasional a more than ordinary determination to the exhalant arteries in the vicinity. Such are the droplexial accumulations which sometimes occur in pregnancy, and which are relieved by delivery. In this manner likewise, that swelling of the abdomen, constituting ascites, partly originates when it is caused or attended by an obstructed circulation through the liver, the blood in the venae portae accumulating in an inordinate measure, and by consequence supplying the lymphatic vessels of the part with more than their due proportion of fluid. Lastly, we have the intestinal and debility in the exhalant and absorbent vessels, droplexial swellings may arise from inflammation, as is illustrated in the anaesthesial collections following eczema, in the diphteritic swellings on the neck, in the dropsy of the chest resulting from inflammation of the lungs, and in ascites following peritonitis inflammation.

In whatever mode, and to whatever extent, dropsy may be occasioned, the accumulation of serous fluid by which it is constituted, always argues debility in the lymphatic vessels of the part in which this accumulation occurs. This debility, perhaps, is primarily and principally sedent in the lymphatic exhalants; for we do not find hectic fever a characteristic of hydrops, as it is of other affections, in which an original torpor of the cellular texture is evidenced by the most evident symptoms. Hectic only comes on in the last stages of dropsy, when the absorbents are worn out with constant exertion to absorb the effused fluid.

We have hitherto spoken indiscriminately of droplexy of cavities, and of dropsy in the cellular membrane; these, however, although they often exist conjointly, require to be distinguished; for instance, an accumulation of water in the thorax, may be confined to the cellular texture of these organs, and form the disease properly distinguished by the designation of anaesthesial pulmonum; or it may be diffused in the cavity of the chest, and constitute the true hydrops pectoris, or hydrothorax. The former generally arises from an universal torpor of the lymphatic system, and is almost constantly connected with hydrops swellings of other parts, particularly the ankles and legs; the latter often originates as a local disease, as from an inflammation of the pleura, and is sometimes confined entirely to the chest.


Dropsy is the cellular membrane immediately under the skin appears principally in the lower extremities, on account of the dependent situation of these members, and the universal connection between the cells of which the membrane is constituted; and partly on account of the deficiency in lymphatic excitement, from which it originates, being more conspicuous in those vessels which are the furthest removed from the centre of the circulation. Anaesthesial, as it arises from exhausted excitability in the lymphatic vessels, is always a disorder indicating much danger.

M. M. Digitalis, in considerable doses, are especially indicated in droplexy of the chest, and its effects are more visible as well as more certain in the anaesthesial pulmonum, than in the hydrops pectoris, because this medicine influences powerfully the whole extent of the absorbent system. Squill, in combination with digitalis, for the hydrops pectoris, and if the cellular membrane be anaesthesial, connect steel with both the above medicines. Chrysts of tartar, especially in the anaesthesial pulmonum. Diuretics of other kinds, the same as in general anaesthesial. Opium, in hydrothorax, or dropsy of the chest, without anaesthesial, may be employed, but not in the side. It is sometimes impossible even to relieve the dropsy of incontinence; and the
dyspeptic from this cause can never expect again to enjoy the pleasures of existence in full measure." (Beddoes.)

Genus V. Ascies. Dropsy of the abdomen.

The swelling of the abdomen is tense, scarcely elastic, but fluctuating; the fluctuation can sometimes be perceived by placing one hand on one side of the abdomen, and striking with the other hand on the opposite side. Ascites is attended with scanty of urine, thirst, and after some time a degree of hectic fever.

As a rule, most usually originates through the medium of a diseased liver; and such disease is, in the greater number of instances, itself induced by intemperance in spirituous liquors. Like the disease, however, of the lungs, preceding dropy in the chest, liver complaints productive of ascites, may be brought on by the precipitate application of cold, succeeding to the extremes of heat, by inebriety, mental affections, and other causes. Ascites is also supposed to originate from debility in the abdominal lymphatics, without the intervention of any hepatic disease.

M. M. Ascertain by inquiry into previous and present symptoms, whether any degree of liver complaint has preceded the dyspeptic accommodation; whether there is any disposition to jaundice of the skin; whether the alvine excretions are insufficient, whitish, and slimy; whether there has been any pain in the region of the liver, difficulty of tying on the side, especially on the left side, high colour of the urine, pain in the right shoulder, &c., and adapt the treatment accordingly. If the water is independent of disease in the liver, chryscals of tartar, digitals, other diuretics, and steel, may be immediately had recourse to, without the intervention of calomel purgatives and of emetics which last are almost always indicated in the more usual form of ascites, that form a morbid affection of the biliary organs. Emetics in hepatic ascites are often attended with most beneficial effects. "Per vomitus solutum cuncta tenaci, concurrentur obstructa, expelluntur stagnantes, male mirabiliter in urinam proponent." (Boerhaave.) In the administration of asitic purgatives, care must be taken that, from the violence of excitement which they occasion, they do not induce peritoneal inflammation. A combination of gamboge, elaterium, and calomel is frequently employed as a purgative in ascites. Mercurial ointment to the region of the liver. Tonics, especially steel. The inflammation of vital air, as recommended and employed by Dr. Thornton and others. Tapping. This is to be regarded in general as merely a palliative: if however there has not been any very considerable disease of the liver, or the debility is not extremely urgent, tapping may be advised with a prospect of effecting a radical cure, provided due care is at the same time employed to maintain a proper excitement, or, as it is generally expressed, to restore and preserve the tone of the liver system.

Genus V. Hydrometria. Dropsy of the womb.

This, like the physometra, already mentioned, often assumes a deceitful resemblance to pregnancy. It is characterized by dropical swelling, continued to the region of the uterus, not being accompanied by other symptoms of dropy.

It is a disease in which the unmarried and the barren are principally obnoxious; sometimes it follows abortion.


Sect. IV. Solida. Swellings of solid parts.

Genus I. Physiologia. A swelling chiefly occupying a portion of the abdomen, increasing gradually, and neither tense nor resonant as in pneumatic nor fluctuating as in dropy.

This disease is principally formed by a serous state of the several parts, and viscera, which form its seat. These serous enlargements are generally incurable.

Genus II. Rhachitis. Rickets. See infancy.

Older III. Impetiginis.

Deforinities and discolorations of the external surface from general disease.

Genus I. Scrophula. King's evil. Swellings of the lymphatic glands, terminal in ulcer, are perhaps the only proper characteristics of actual scrophula; the thick upper lip, transparent skin, and other appearances which are considered as symptoms of the disease, are merely marks of peculiar predisposition.

A scrophulous habit is merely a susceptibility of disease, arising from torpor in the lymphatic vessels, and when brought on by the agency of exciting causes, constitutes a peculiar action of the lymphatic glands, by which inflammation and at length ulceration, with a discharge of grumous matter, are induced.

Its exciting causes are those which encourage the original debility, and the disease may almost certainly be avoided by attention to diet and regimen; by nutritious food, a pure oxygenous atmosphere, cleanliness, exercise, etc.

When by neglect, the predisposition has been permitted to break out into disease, calomel purges, steat, small doses of digitalis, warm and soothing baths, and phosphates of lead, above all clean and clear ventilation, stimulating nutritious diet. Let the mind be preserved free from the erroneous idea, that to cure scrophula is to purge away gross humours. See Surgery.

Genus II. Syphilis. Venereal disease.

After impure conception, a disorder of the genitals, ulcers in the mouth and nose. Eruptions on the skin of a copper colour, terminating in ulceration; these principally situated near the margin of the hair, blisters on the surface of the body, especially on the surface of the face. Nocturnal pains in the centre of the bones.


N. B. For the local application to venereal ulcers, the more particular treatment of the complaint, and the mode of curing gonorrhoea vulvulina, see Surgery.

Genus III. Strobilus, scurvy.

Indigestion and lassitude; bowels and tumid countenance; gums livid, and disposed to bleed spontaneously, or from the slightest irritation; skin dry, and covered with livid spots; edematous swellings of the ankles. Scurvy appears to originate from want of, or exhaustion of excitement, both in the venous and absorbent system; it is produced by a protracted course of salt food, and by mental depression.


The elephantiasis, phlegmasia, and trichomas, forming the fourth, fifth, sixth, and seventh genera of this order, are diseases of such rare occurrence in this country, as not to require any particular description.

For the more common complaints which require local application, see Surgery.

Genus III. Intemperance.

Symptoms. Yellowness of the skin and eyes; white and shiny faces; high-coloured obstructing the biliary, yellow, bilious, and extreme oppression of spirits.

The yellow colour of the skin, which constitutes jaundice, arises from the diffusion through the system of that bile, which, in the nature of matter, is produced through the biliary ducts into the intestinal canal. This impregnation of the system with bile has been supposed to be effected in three ways, viz. through the medium of the biliary vessels; by the injection of blood; and in the duodenum; and by regurgitation through the hepatic veins, or absorption by the lymphatics of the liver, when the obstruction is in some part of the bile's course previous to its union.

This interruption of the biliary secretion may originate from a spasmodic affection of the duodenum; from chronic inflammations, or other diseases of the liver interfering with the secretion; or from certain concretions lodging in some part of the hepatic organs, called gall-stones; and, as pointed out by Mr. Townsend, from visceral mucus stopping up or obstructing the biliary ducts. Indeed, whatever hinder the bile from passing into the duodenum may prove a source of jaundice.

The first of the above species of jaundice is generally of a temporary nature; it occurs principally in those who have much irritability of habit, in consequence of violent passions, and other sources of spasmatic affections.

The second species is not of so decided a nature; it follows upon a long course of intemperance in spirituous liquors, and is only to be remedied by removing the disease of the liver itself.

The biliary calculi, which give rise to the third species of jaundice, appear, like urinary concretions, to arise from some defective action in the secretory or absorbing vessels of the parts in which they are formed or lodged; as the stone in the bladder, is evidently favoured by a retention of fluid, from which they are formed. It may therefore be inferred, that gall-stones are never, or seldom, produced without some previous jaundice having taken place. Thus they are both the cause and consequence of the disease. Their presence may be ascertained from jaundice frequently disappearing and returning, from the appearance of biliary concretions among the faces, and from the disease being attended with shooting pains in the epigastric region, and right hypochondrium. Nasusae, difficult respiration, and sickness, often likewise accompany this species of jaundice.
The icterus mucosus of Townsend, which is perhaps the most frequent species of jaundice, is unattended either by pain or spasmodic affections; there are no gall-stones observed in the face; but these are generally discharged mixed with much slime and viscidities. It is generally accompanied with, and is most commonly occasioned by, depression of mind, especially when favoured by sedentary habits, breathing an impure atmosphere, living upon unwholesome intubitions, or indulging in the too free use of spirits and tobacco.

While it is the most frequent, and oftentimes the most protracted, of any of the species of jaundice, it is at the same time most easy of cure when properly understood and managed.


In icterus spasmodicus, opium, asaefatica, atrop, electricity. If the skin depends upon any irritations in the stomach: or bowels, these to be removed by emetics, purgatives, anthelmintics. Similarly in intermittent, emetics to facilitate the passage of the gall-stones, and spasmodics. Warm bathing. Enomolent clysters. Vegetable tonics, and steed.

N. B. The average doses of medicines will be found in the articles Materia Medica, and Pharmacy.

MEDEIATAS LINGUE, a jury or inquest impaneled, whereas the one-half consists of natives or denizens, the other strangers; and used in pleas wherein the one party is a stranger, the other a denizen.

MEDIAM, in logic, the mean or middle term of a syllogism, being an argument, reason, or consideration, for which we affirm or deny any thing; or, it is the cause where the greater extremity is affirmed or denied of the les in the conclusion.

MEDEIUM, or MEAN, geometrical. See MEAN.

MEDULLA OBLONGATA. See ANATOMY.

MEDULLA SPINALIS. See Anatomy.

MEDUSA, a genus of vermes of the order molusca. The generic character is, body gullionated, generally generally flat underneat: mouth central beneath. The animals of this genus consist of a tender gelatinous mass of different figures, furnished with arms or tentacular processes, proceeding from the lower surface: the larger species, when touched, cause a slight tingling and redness, and are usually denominated sea-nettles; they are supposed to constitute the chief food of cetaceous fish, and most of them shine with great splendour in the water. There are 44 species. See Plate Nat. Hist. fig. 202.

MEIONITI, a mineral found only among the lava of Vesuvius, always crystallized. Prismatic form, a prism whose bases are squares. It occurs usually in eight-sided prisms, and terminated by four-sided pyramids. Sometimes the edges of the prism are truncated. Colour greyish-white; fracture flat; melts before the blowpipe into a white spongy glass. MEL, a genus in the family of the natural order syngenia polygama necessary. The calyx is five-leaved; recept. cathe, chystical; down one-leaved, involuted, converging.

There are three species, herbs of the West Indies.

MELETITE, a mineral found in the neighborhood of Vesuvius, and formerly called the green glass. It is black or brownish. Crystalized in six-sided prisms, terminated by trihedral summits. It is composed of 40 silica. 28.5 alumina. 10.0 oxides of iron 10.0 magnesia. 3.5 lime. 0.25 oxide of manganese.

MELEAGRICA, a genus of the polyandria order, belonging to the polyandria class of plants. The calyx is quinquepartite, superior; the corolla pentapetals; the filaments are very numerous, and collected in such a manner as to form five pencils: there is one style; the capsule is half-celled with the calyx, formed like a berry, and is trivalved and trilocular. The species are 11, natives of India and the South Sea Islands. The most remarkable species is the leucodendron, from the leaves of which (or brown-leaved leucadendron) the cepalet oil is obtained; a medicine in very high esteem among the Eastern nations, particularly in India. It is said to be obtained by distillation from the fruits of the tree; but brought into this country it is a liquid of a greenish colour, of a fragrant but at the same time a very peculiar colour, and of a warm pungent taste. Some authors, however, represent this oil as being of indescribable quality, a white or colourless fluid; and it has been said by the authors of the Dispensatorium Brunsvicense, when prepared in Europe from the seeds sent from India, to be entirely of this appearance. Whether the oleum cepalet has been but little employed either in Britain or on the continent of Europe; but in India it is used both internally and externally, and is highly extolled for its medical properties. It is applied externally where a warm and peculiar stimulus is requisite; it is employed for restoring vigour after luxations and sprains, and for easing a violent pain in gouty and rheumatic cases, in tooth-sache, and similar affections of the skin; but it has been breathed in taken internally, and it is particularly said to operate as a very powerful remedy against tympanic affections.

MEALPYRUM, cow-wheat, a genus of the angiosperma order, in the duidynemia class of plants, and in the natural method ranking under the 40th order, persoonia. The calyx is quadrifid; the upper lip of the corolla is compressed, with the edges folded back; the capsule is bicolour and oblique, opening at one side: there are two gynious seeds. There are five species, four of them natives of Britain, and growing spontaneously among corn-fields. They are excellent food for cattle and fowls. It tells us, that where they abound, the yellowest and best butter is made. Their seeds, when mixed with bread, give it a ducky colour; and, according to some authors, produce a vertigo, and other disorders of the head; but this is denied by Mr. Withering, though he allows that they give it a bitter taste.

MELESTOMA, the American gooseberry tree, a genus of the monogyria order, in the decandria class of plants, and in the natural method ranking under the 17th order, caly-
fatigued, and take to the highest trees, where they will suffer themselves to be shot one after another, if within reach of the marksman. They were first seen in France under the reign of Francis I. and in England in that of Henry VIII. By the date of the reign of these monarchs, the first turkeys must have been brought from Mexico, the conquest of which was completed A.D. 1521.

The turkey he began to lay early in the spring, and will often produce a great number of eggs, which are white, marked with redish or yellow spots, or rather flecks. She sits on the first of her crop; of which in this climate she will often have from 14 to 17 for one brood; but she scarcely ever sits more than once in a season, except allowed thereto by putting fresh eggs under her as soon as the first set are hatched; for, as she is a close sitter, she will willingly remain two months on the nest, though this conduct, as may be supposed, is said greatly to injure the bird. Turkeys are bred in quantities in some of the principal counties of England, and are driven up to London towards autumn for sale in flocks of several hundreds, which are collected from the several cottages about Norfolke, Suffolk, and neighbouring counties. The fish is that part of the pelt in which it is worth their while to attend carefully to them, by making these birds a part of their family during the breeding-season. It is pleasing to see what pains the drivers take in picking them up by thousands of a bit of red rag fastened to the end of a stick, which, from their anti-pathy to it as a colour, acts with the same effect as a scourge to a quadruped.

Of the turkey there are several varieties, which have arisen from domestication. The most common is dark-grey, inclining to black, or barred dusky-white and black. There is also a beautiful variety of a fine deep copper colour, with the greater quills pure white, and the tail of a dirty white; it is when old a most beautiful bird. A variety with a pure white plumage is also now not unfrequent, and appears very beautiful. It was once esteemed as a great rarity, and the breed supposed to have been brought in Holland. The salpinus inhabits India, and is sometimes less than the last. See Plate Nat. f.lit. fig. 261.

MELES, in zoology, See Ursus.

MELIA, acaci, or the head-free, a genus of the monotypic order, in the decanthera class of plants, and in the natural method ranking under the 23rd order, tribulina. The calyx is quinquedentate; the petals five; the nectarium, cylindric, as long as the corolla, with its mouth ten-toothed; the fruit is a plum with a quinquangular kernel. There are three species, all of them exotic trees of the latter, rising near 20 feet high, adorned with large pinnate or wangled leaves, and clusters of pentapetalous flowers. They are all of them trees, which have arisen on hot lands.

MELIANTHUS, honey-flower, a genus of the angiospermae order, in the dixymadia class of plants, and in the natural method ranking under the 24th order, corydalis. The calyx is pentaphyllous, with the lowest four petals, and there are four petals, with the nectarium under the lowest ones. The capsule is quadrilocular. There are three species: 1. The major has many upright, ligeous, durable stalks, and from the sides and tops of the stalks long spikes of chocolate-coloured flowers. 2. The minor has upright, ligeous, soft, durable stalks; and from the sides and ends of the branches long, loose, pendulous bunches of flowers tinged with green, saffron-colour, and red. Both the species flower about June; but rarely produce seeds in this country. They are very ornamental, both to foliage and flower, and merit admittance in every collection. They are easily propagated by suckers and cuttings. They thrive best in a dry soil, and in a sheltered warm exposure. 3. The common, h. kernel.

MELICA, rograper, a genus of the digitaria order, in the triandria class of plants, and in the natural method ranking under the 4th order, gramina. The calyx is beaked, baldous, with an embryo of a flower betwixt the two florets. There are three species, of which the most remarkable is the native. It is a native of several parts of Britain, and of the adjacent islands; and it is common in the borders of the stream, the streams make ropes of it for fishing-nets, as it will bear the water for a long time without rotting.

MELICOCCA, a genus of the class and order octandria monogynia. The calyx is four-parted; the petals two; the anthers four; the style is one, and the stigma subulate, drapie coriaceous. There is one species, a tree of South America.

MELICYTUS, a genus of the class and order dioecia pentanthera. There is one species, of New Zealand, little known.

MELISSA, baum, a genus of the digitaria gynoomerica class of plants, with a monopetalous ringed flower, the lower lip of which is divided into three segments, whereof the middle one is cordate; the seeds are four in number, and contained in the bottom of the cup. There are six species.

Baum is greatly esteemed among the common people as good in disorders of the head and stomach; but is less regarded in the shops. It is most conveniently taken in infusion by dissolving a large grain of the drug in a little water, and then adding a little sugar. It is less bitter than the dry, which is contrary to the general rule in relation to other plants.

MELITIS, bastard baum, a genus of the dixymadia gynooemerica class of plants; the upper lip of whose cup is emarginated; the upper lip of its flower is plain, and is the lower one crested. There are two species.

MELIUS INQUIRENDUM, in law, a writ that lies for a second inquiry to be made of what lands, &c. a man died seized; when the party is suspected upon the writ deman clause.

MELLISÆ. This genus of salts is but imperfectly known, in consequence of the scarcity of mellicale. It has been examined only by Klaproth and Vanquelin, and even by them too slightly to admit a description of their properties. The following are all the facts hitherto ascerained:

1. When mellicale is neutralized by potass, the solution crystallizes in long prisms.
2. When mellicale is saturated by ammonia, the solution yields flat transparent needles transparent crystals, which become opaque when exposed to the air, and assume the white colour.
3. When mellicale is deprived of amonia, the solution yields green transparent silica crystals, which become opaque when exposed to the air, and assume the white colour.
4. When mellicale is dissolved into barytes water, strotian water, or lime water, a white powder immediately precipitates, which is dissolved by adding a little more of the acid.
5. When the acid is mixed with a solution of sulphat of lime, very small gritty crystals precipitate, which do not destroy the transparency of the water; but the addition of a little ammonia renders the precipitate flaky.
6. When this acid is mixed into a solution of a salt, a flat precipitate appears, which is dissolved by adding more acid. With mutrari of barytes it produces no precipitate; but in a short time a group of transparent needle-form crystals is deposited, consisting most likely of sulphuric acid.
7. When this acid is mixed into sulphat of alumina, it throws down an abundant precipitate in the form of a white flaky powder.

MELITE, hornstone, needle of alumina. This mineral was first observed about 100 years ago in Thuringia, between the layers of wood coal. It is of a honey-yellow colour (whence its name); and is usually crystallized in small octahedrons, whose angles are often transcluted. Fracture conchoidal. Specific gravity, according to Abich, 1.666. When heated it whitens, and in the open air burns without being sensibly charred. A white matter remains, which effervescs slightly with acids, and which at first has no taste, but at length leaves an acid impression upon the tongue.

Klaproth analysed the melilit in 1799, and ascertained it to be a compound of alumina and a peculiar acid, to which he gave the name of mellicale. A more accurate research was soon after confirmed by M. Vanquelin. MELLITIC ACID has been found only in the melilit. It may be procured from that mineral by the following process: Reduce slowly to powder in about 72 times its weight of water. The acid combines with the water, and the alumina separates in flakes. By filtering the solution, and evaporating sufficiently, the mellic acid is obtained in the state of crystals.

These crystals are either very fine needles, sometimes collected into globules, or small short prisms. They have a brownish colour, and are at first sweetish-sour, and afterwards bittersweet.

This acid is not very soluble in water; but the precise degree of solubility has not been ascertained. When exposed to heat, it is timelessly decomposed, yielding an abundant smoke, which however is despicable of smell. A small quantity of insipid ashes remains behind, which do not alter the colour of litmus paper.

All attempts to convert it into oxalic acid by the action of nitric acid have failed. The nitric acid merely caused it to assume a straw-yellow colour.

The effect of the simple bodies on this acid has not been tried. It combines with alka-
hils, earths, and metallic oxides, and fori
with them, which are distinguished by
the name of minerals. The properties of these
compounds will be considered afterwards.

From the analysis of M. Euphrate, we
learn that the mixture is composed of
40 parts of conic acid
16 parts of alumina
33 parts of water

100.

From other analyses by the same chemist,
he infers that metallic acid is composed of
carbon, hydrogen, and oxygen, but the pro-
portions are not yet known.

MELOCHIA, Lethe melbola, a genus of the peacandia order, in the monadelphia class of plants, and in the natural m-th order
ranking under the 37th order, columnaria.
The capsule is quinquelocular and monosper-
rous. There are 14 species: but the only
remarkable one is the peacandia, or common

MELODICUS, a genus of the class and order
peacandia digynus. It is contain;
sect. in the middle of the tube, stellate; berry
two-celled, many-seeded. There is one spe-
cies, a shrub of New Caledonia.

MELODY, in music, the agreeable effect of
different sounds, ranged and disposed in
succession; so that melody is the effect of a
single voice or instrument, by which it is dis-
tinguished from harmony.

MELOE, a genus of insects of the order
coleoptera: the generic character is
monadelphia, with the last joint oval; tho-
rasful; wing-sheaths soft, flexible; head
inflected. Among the principal species of
meleoe may be numbered the meloe procac-
bus, commonly called the oil-beetle. It is
of considerable size, often measuring near
an inch and a half in length: its colour is
violace-black, especially on the antennae
and limbs; the wing-sheaths are very short, in
the female insect especially, scarcely cover-
ing more than a third of the body, and are of
an oval shape. This species is frequent in the
advanced state of spring in fields and pas-
ture, creeping slowly, the body appearing so
swollen or distended with oil as to cause the
insect to look like a ball. On being
handled it suddenly exudes from the joints
of its legs, as well as from some parts of the
body, several small drops of a clear, deep-
yellow oil or fluid is very peculiar and
generally an evidence of a male insect
with difficulty. On being
handled it suddenly exudes from the joints
of its legs, as well as from some parts of the
body, several small drops of a clear, deep-
yellow oil or fluid is very peculiar and
generally an evidence of a male insect

MELON. See Cucumis.

MELONIA, a genus of the mono-
gynia order, in the triandria class of plants,
and in the natural method ranking under the
34th order, cucurbitacae. The calyx is
quinquelocular; the corolla campanulated and
monosperous. There is only one species, viz.
the pendula, a native of Carolina, Virginia,
and also many of the American islands. The
plants strike out roots at every joint, which
fasten themselves into the ground, by which
means its stalks extend to a great distance
each way. The flowers are very small, in
shape like those of the meloe, of a pale sul-
phur-colour. The plant is a native of the West Indies,
grows to the size of a pea, and of an oval figure,
and changes to black when ripe; these are
by the inhabitants sometimes picked when
they are green. In Britain the fruit are much
smaller, and are not so hard to find than them.
The plants are too tender to be reared in this
country without
artificial heat.

MELYRIS, a genus of insects of the order
coleoptera: the generic character is
antennae
entirely perforated; head inflected under the
thorax; thorax margined; lip closed, enarginate; jaw one-toothed, pointed. To ere
the three species. See Plate Nat. Hist. fig. 264.

MEMBRANE. See Anatomy.

MEMECYLON, a genus of the octan-
gynia monogynia class and order. The calyx
is superior; corolla one-petalled; anth.
inserted in the side of the apex of the filament;
berry crowned with cylindrical calyx. There
are three species, trees of the East Indies.

MEMORY, artificial, a method of
writing the name of forming certain
words, the letters of which shall signify
the date or era to be remembered. In
order to this, the following series of vowel, diphi-
thongs, and consonants, together with their
corresponding numbers, must be exactly
learned, so as to be able at pleasure to form
a technical word, that shall stand for any
number, or to resolve such a word already formed.

\[
\begin{array}{cccccccc}
1 & 2 & 3 & 4 & 5 & 6 & 7 & 8 \\
1 & 2 & 3 & 4 & 5 & 6 & 7 & 8 \\
\end{array}
\]

The first five vowels, in order, naturally re-
present 1, 2, 3, 4, 5; the diphthong au = 6, as
being composed somewhat beyond for the like reason, eu = 7, and eu = 9. The
diphthongs ed will easily be remembered for, as
being the initials of the word. In like manner,
where the initial consonants could conveniently
be retained, they are made use of to signify the
number, as for 3, f for 4, s for 6, and s for 9. The rest were assigned without any particular
reason, may be more easily remembered for 7 or septem, f for 8, or k, or moni-
der for 9, or duo; k for 1, as being the first conson-
ant; and l for 5, being the Roman letter for 50:
and among others that could have been put in
their places.

It is farther to be observed, that a and i being
made use of to represent the cophphers, why
certainly the greater number of the
butterflies, than in the case of the earlier
artificial, the numbers assigned begin with 1, instead of a repetition of a and i, e and e,
&c. instead of a repetition of e and s, y and y, &c.
for 100, 300, 500, 900, &c.

Fractions may be set down in the
following manner.
\[
\frac{a}{b} + \frac{c}{d} = \frac{a}{b} + \frac{c}{d}
\]

This is the principal part of the method,
which consists in expressing numbers by
artificial words. The application to history
and chronology is also performed by artificial
words. The art herein consists in making
such a change in the ending of the
name of a place, person, planet, coin, &c.
without altering the beginning of it, as shall
really suggest the thing sought at the
same time that the beginning of the word
being preserved, shall be a leading or
prompting syllable to the ending of it so
changed. Thus, in order to remember the
years in which Cyrus, Alexander, and
Julius Cæsar, founded their respective mo-
carchs, the following words may be form-
ed; for Cyrus, Cyrus; for Alexander, Alex-

MEM.
A mineral, nearly of the same nature with the one just described, has been found in Bavaria. Its specific gravity is only 3.7. According to this fact of Naumann and Hecht, it is composed of 49 oxide of titanium; 33 iron; 2 magnesium; 14 oxide combined with the iron and manganeous; 100.

A specimen of the same ore from Botany Bay has been lately analysed by Mr. Cheeseman.

MENAIS, a genus of the pentadactyla monogynia class and order. The calyx is three-leafed; the corolla salver-shaped; berry four-celled; seeds solitary. There is one species, a herb of South America.

MENDICANTS, or begging friars, several orders of religious in popish countries, who, having no settled revenue, are supported by the charitable contributions they receive from others.

MENISCUS, a genus of the cryptogama siliace. The capsules are helped in crescents interposed between the veins of the pod.

There is one species, a native of the West Indies.

MENISPERM. See OPTICS.

MENISPERMUM, a genus of the dioecia dodecandra class and order. The male petals are four outer, eight inner; stamina sixteen; female corolla, as in the male, stem; eight; barrel; berries two, one-seeded. There are 13 species, herbs of the East Indies.

MENNONITES, a sect of Baptists in Holland, so called from Mennon Simonis of Friesland, who lived in the sixteenth century. This sect believe that the New Testament is the only rule of faith; that the terms person and trinity are not to be used in speaking of the Father, Son, and Holy Ghost; that the first man was not created perfect; that it is unlawful to swear or to wage war upon any occasion; that infants are not the proper subjects of baptism; and that ministers of the gospel ought to receive no salary. They all unite in pleading for toleration in religion, and do not mourn from their assemblies who leave them, and form and own the scriptures for the word of God.

MENSES. See PHYSIOLOGY.

MENSTRUALM, in chemistry, the fluid in which a solid body is dissolvd. Thus water is a menstruum for salts, and gums; and alcohol for resins.

MENTHIA, a genus of the polyandria monogynia class and order. The cal; is five-leafed; cor. five-petalled; cap. inferior; cylindric, many-seeded. There is one species, an annual of South America.

MENYANTHUS, buckbean, a genus of the pentadactyla monogynia class of plants, with a monopetalous funnel-like flower, divided into five deep segments at the limbs; the fruit is an oval capsule with one cell, containing a great many small seeds. There are five species.

Buckbean, called by authors trifolium patens, and pataudium, is greatly recommended as a diuretic in dropsical cases; as also for the cure of intermittent fevers, and disorders of the urinary organs. It is a plant of easy cultivation, and the roots are used, either fresh or by decoction, for culinary purposes, the spermatic is preferred to the other two; but for medicinal use, the peppermint and pennyroyal have almost entirely superseded it. A conserve of the leaves is very grateful; and the distilled waters both simple and spiritual, are universally thought pleasant. Dr. Lewis says, that dry mint digested with rectified spirit, in a ratio of two parts of mints to one part of spirits, when this is strong weed, is useful in convulsive fits; and is also the best remedy for the quinsy, which appears by day-light of a fine dark-green, but by candle-light of a bright red colour. The fact is, that a small quantity of this tincture is green either by day-light or by candle-light, but a large quantity it seems insipuous to common day-light; however, when placed between the eye and a candle, or between the eye and the sun, it appears red.

The virtues of mint are those of a warm stomachic, capable of relieving colicky pains, and the gripes, to which children are subject. It likewise proves a useful cordial in languors and faintness. When prepared with rectified spirit, the whole virtues of the mint are extracted. The expressed juice contains only the astringent and bitter parts, together with the mucilaginous substance common to all vegetables. The peppermint is much more pungent than the others.

Pennroyal has the same general characters with the mint, but is more acrid and less agreeable when taken into the stomach. It was long held in great esteem in hysteric complaints, and supposed to have virtues more peculiar than any other plant, but its effects are trifling. It is observable, that both water and rectified spirit extract the virtues of this herb by infusion, and likewise elevate the greatest part of them by distillation.

MENZELIA, a genus of the polyandria monogynia class and order. The cal; is five-leafed; cor. five-petalled; cap. inferior, cylandric, many-seeded. There is one species, an annual of South America.

MERCATON's projection of maps. See MAP.
It is evident that the close connection of this subject with the affairs of men would be of very early recommendation, and accordingly the greatest among them have paid the utmost attention to it; and the chief and most essential discoveries in geometry in all ages have been made in consequence of their practical relations. Socrates thought that the prime use of geometry was to measure the ground, and indeed this business gave name to the subject; and most of the ancients seem to have had no other end in view; and besides measurement, he laid all their geometrical disquisitions. Euclid's Elements are almost entirely devoted to it; and although there are contained in them many properties of geometrical figures, which may be applied to other purposes, and indeed of which the modellers have made the most material uses in various disquisitions of exceedingly different kinds; notwithstanding this, Euclid himself seems to have adapted them cutely to his end, all is considered that his Elements contain a continued chain of reasoning, and of truths, of which the former are successively applied to the discovery of the latter, one proposition depending on and leading to the other. Euclid's propositions still approximating towards some particular object near the end of each book; and when at the last we find that object to be the quality, proportion, or relation between figures, the square, rectangular plane, and solid; it is scarcely possible to avoid allowing this to have been Euclid's grand object: Accordingly he determined the chief properties in the mensuration of rectilinear plane and solid figures, and arranged all such planes, and cubed all such solids. The only curve figures which he attempted besides are the circle and sphere; and when he could not accurately determine their measures, he gave an excellent method of approximating to them, by showing how in a circle to inscribe a regular polygon which should not touch another circle, concentric with the former, although their circumferences should be ever so near to each other; for lying between any two concentric spheres to describe a polyhedron which should not any where touch the inner one: and approximations to this aim have been given to the ancient and modern authors. He always considered that the determination of the circumference of a circle is the chief aim of geometry. He also reduced the circumference of the circle to the diameter of the circle; and so reduced the quadrature of the circle to the determination of the ratio of the diameter to the circumference; which until the times of Archimedes had not yet been found. Being disappointed of the exact quadrature of the circle, for want of the rectification of its circumference, which all his methods would not effect, he proceeded to assign an useful approximation to it; this he effected by the numerical calculation of the perimeters of the inscribed and circumscribed polygons; from which calculations he appears that the perimeter of the circumscribed regular polygon of 192 sides is to the diameter, in a less ratio than that of 3.1415926535897932 (says Mr. Lightfoot) to 1, and that the inscribed polygon of 96 sides is to the diameter in a greater ratio than that of 3.1415926535897932 to 1; and consequently that much more than the circumference of the circle is to the diameter in a less ratio than that of 3.1415926535897932 to 1, but greater than that of 3.1415926535897932 to 1: the first ratio of 3.1415926535897932 to 1, reduced to whole numbers, gives that of 22 to 7, for 3.1415926535897932: 1; 22: 7, which ratio therefore will be a good approximation to the circumference of the diameter. From this ratio of the circumference to the diameter he computed the approximate area of the circle, and found it to be the square of the diameter as 11 to 14. He likewise determined the relation between the circle and ellipse, with that of their similar parts. The hyperbola too, in all probability, he attempt ed: but it is not to be hoped, that he met with any success, since approximation to its area are all that can be given by all the methods that have since been invented.

Besides these figures, he has left us a treatise on the spiral described by a point moving uniformly along a right line, which at the same time moves with an uniform angular motion; and determined the proportion of its area to that of its inscribed circle, as also the proportion of their sectors.

Throughout the whole works of this great man, which are chiefly on mensuration, he everywhere discovers the deepest design, the most beneficial inventions (with Euclid exceedingly careful of admitting into his demonstrations nothing but principles perfectly geometrical and unquestionable) and although his most general method of demonstrating the relations of curved figures to straight ones, is by inscribing polygons in them, yet to determine those relations, he does not increase the number and diminish the magnitude of the sides ad infinitum; but from the plain fundamental principle, allowed in Euclid's Elements, viz. that any quantity may be so often multiplied, or added to itself, as that result shall exceed any fixed quantity of the same kind, he proves that to deny his figures to have the proposed relations, would involve an absurdity. He demonstrated also many properties, particularly in the parabola, by means of the regular paravola which are similar to the inscribed figures; but without considering such series to be continued ad infinitum, and then summing up the terms of such infinite series.

He had another very curious and singular contrivance for determining the measures of figures, in which he proceeds as it were mechanically by weighing them.

Several other eminent men among the ancients who have dealt in this subject, held no small credit and after Euclid and Archimedes: but their attempts were usually upon particular parts of it, and according to methods not essentially different from theirs. Among these are to be reckoned Thales, Anaxagoras, Pythagoras, Bryson, Antiphon, Hippocrates of Chios, Plato, Apollonius, Philo, and Rhetor: most of whom wrote of the quadrature of the circle; and those after Archimedes, by his method, usually reduced the approximation to a greater degree of accuracy.

Many of the moderns have also prosecuted the same problem of the quadrature of the circle, after the same methods, to greater lengths: such are Vieta and Mersenne, whose proportion between the diameter and circumference is that of 113 to 355, which is within about \( \frac{1}{7000} \) of the true ratio; but above all Leibniz, with a still more amazing degree of accuracy, he determined the ratio of the circumference to the diameter to be \( \frac{3.1415926535897932}{4} \cdot \), making it that of \( 3.1415926535897932 \) to 4. See Circle.

Hence it appears, that all or most of the material improvements in the principles or methods of treating of geometry, have been made especially for the improvement of this chief part of it, measurement, which abundantly shews the dignity of the subject; subject success, and therefore, we may say, after mentioning some other things, deserves to be more curiously weighed, because from hence a name is imposed upon that mother and mistress of the rest of the mathematical sciences, which is employed about proportions, and which is wont to be called geometry (a word taken from ancient use, because it was first applied only to measuring the earth, and fixing the limits of possession); though the name seemed very ridiculous to Plato, who substitutes in its place the more extensive name of metrics or mensuration; and others after him give it the title of gnomometry, because it teaches the method of measuring the kinds of phenomena and phenomena of the earth. See Heights, Surveys, Leveling, Geometry, and Gauging.

MERCURIALIS, mercury, a genus of the former order, in the daisy class of plants, and in the natural system under the 38th order, triticaceae. The calyx of the male is tripartite; there is no corolla, but 9 or 12 stamina; the anther is globular and twined. The female calyx is tripartite; there is no corolla, but two styles; the capsule is bicoccous, bilocular, and monospermous. There are six species.

Of these, the perennis, according to Mr. Lightfoot, is of a soporific and delirious nature, noxious both to man and beast. There are instances of those who have eaten it by mistake, instead of the chenopodium bonusHenricus, or English mercury, and have thereby lost their lives, or inventions in plain words, that the French make a syrup of the juice of the annua, another species, two ounces of which are given as a purgative; and that they use it in pessaries and plasters, mixing one part of house to one and a half of the juice. Dr. Withering differs greatly from Lightfoot concerning the qualities of the perennis. "This plant, (says he), dressed like spinach, is very good eating early in the
Mercury.

spring, and is frequently gathered for that purpose. It is said to be beneficial to sheep. Mr. Macnab relates the ease of a man, his wife, and three children, who experienced highly deleterious effects from eating it fried with bacon; but this was probably when the spring was more advanced, since that plant had become acrimonious. When steeped in water, it affords a fine deep-blue colour. Sheep and goats eat it; but cows and horses refuse it.

Mercury, called also quicksilver, was known in the remotest ages, and seems to have been employed by the ancients in gliding and in separating gold from other bodies, just as it is by the indians. Its colour is white, and similar to that of silver; hence the names hydrargyrus, argentum vivum, quicksilver, by which it has been known in all ages. It has no taste nor smell. It possesses a good deal of brilliancy; and when its surface is not tarnished, makes a very good mirror. Its specific gravity is 13.638. At the common temperature of the atmosphere, it is always in a state of fluidity. In this respect it differs from all other metals. But this metal solid when exposed to a sufficient degree of cold. The temperature necessary for freezing this metal is—39°, as was ascertained by the experiments of Mr. Macnab at Hinde's-day. The congelation of mercury was accidentally discovered by the Petersburgh academicians in 1739. Taking the advantage of a very severe frost, they plunged a thermometer into a mixture of snow and salt, in order to ascertain the degree of cold. Observing the mercury stationery, even after it was removed from the mixture, they broke the ball of the thermometer, and found the metal frozen into a solid mass. This experiment has been repeated very often since, especially in Britain. Mercury contracts considerably at the instant of freezing; a circumstance which misled the philosophers who first witnessed its congelation. They supposed that in its thermometer it stuck so much before it froze, that they thought the cold to which it had been exposed, much greater than it really was. It was in consequence of the rules laid down by Pardies, and by dry, but Mr. Macnab was enabled to ascertain the real freezing point of the metal.

Solid mercury may be subjected to the blows of a hammer, and may be extended without breaking. It is therefore malleable; but neither the degree of its malleability, nor its ductility, nor its tenacity, has been ascertained.

Mercury boils when heated to 609°. It may therefore be totally evaporated, or distilled from one vessel into another. It is by distillation that mercury is purified from various metallic bodies, with which it is often contaminated. The vapour of mercury is invariable and elastic like common air; like air, too, its elasticity is indefinitely increased by heat, so that it breaks through the strongest vessel. Gothic, at the desire of an alchemist, once placed a quantity of it in an iron globe, strongly secured by iron hoops, and put the apparatus into a furnace. Soon after the globe became red-hot, it burst with all the violence of a bomb, and the whole of the air was disappared.

Mercury is not altered by being kept under water. When exposed to the air, its surface is gradually tarnished, and covered with a black powder, owing to its combining with the oxygen of the atmosphere. But this change goes on very slowly, unless the mercury is either heated or agitated, by shaking it, for instance, in a large bottle full of air. By either of these processes, the metal is converted into oxide; by the first, into a black-coloured oxide; and by the first, into a red-coloured oxide. This metal does not seem to be capable of combustion.

The oxides of mercury at present known are four in number, viz.

1. The protoxide was first described with accuracy by Boerhaave. He formed it by putting a little mercury into a bottle, and tying it to the spoke of a mill-wheel. By the constant agitation which it thus underwent, it was converted into a black powder, to which he gave the name of ethiops per ye. This oxide is readily formed by agitating impure mercury in a vessel. If it be a black powder, it is without any of the black laster, has no taste, and is insoluble in water. According to the experiments of Fourcroy, it is composed of 90 parts of mercury and 4 of oxygen, and is thus exposed to a strong heat, oxygen gas is emitted, and the mercury reduced to the metallic state. In a more moderate heat it combines with an additional dose of oxygen, and assumes a red colour.

2. When mercury is dissolved in nitric acid without the assistance of heat, and the acid is made to take up as much mercury as possible, it has been demonstrated, by the experiments of Mr. Macnab, that the proportions of mercury and nitric acid are at most 97.6 per cent. of oxygen. Of course an oxide is formed, composed of 89.3 parts of mercury and 10.7 parts of oxygen. This is the dextro-oxide of mercury. This oxide of mercury, or its protioxide, is exposed to a heat of about 609°, it combines with additional oxygen, assumes a red colour, and is converted into an oxide which, in the present state of our knowledge, we must consider as a tritioxide. This oxide may be formed two different ways: 1. By putting a little mercury into a flat-bottomed glass bottle or matras, the neck of which is drawn out into a very narrow tube, putting the matras into a sandbath, and keeping it constantly at the boiling point. The height of the matras, and the smallness of its mouth, prevent the mercury from making its escape, while it affords freeness to the air. The matras contains the protoxide, and becomes black, and then red, by combining with the oxygen of the air: and at the end of several months the whole is converted into a red powder, or rather into small crystals, of a very deep red colour. Thence, when thus obtained, was formerly called precipitate per se. 2. When mercury is dissolved in nitric acid, evaporated to dryness, and then exposed to a pretty strong heat in a porcelain cup, it assumes, when triturated, a brilliant red colour. The powder thus obtained was formerly called red precipitate, and possesses the properties of the oxide obtained by the former process.

This oxide has an acrid and disagreeable taste, possessing poisonous qualities, and acts as an escharotic when applied to any part of the skin. It is somewhat soluble in water. When triturated with mercury it gives out part of its oxygen; and the mixture is converted into protioxide or black oxide of mercury. When heated along with zinc, or tin filings, it sets these metals on fire. According to Fourcroy, it is composed of 92 parts of mercury and 8 of oxygen. But the analysis of Mr. Chevrix, to be described hereafter, gives, for the proportion of its component parts, 85 parts of mercury and 15 parts of oxygen.

The red oxide of mercury, prepared in the usual way, is not pure, but always contains a portion of nitric acid. If we dissolve it in muriatic acid, and precipitate it again, it finds the same when we consider, and retains a portion of muriatic acid. It was in this state that it was examined by Chevrix.

The difficulty of procuring this oxide in a state of purity, and the uncertainty respecting it, may, in some measure, account for the different results obtained by different chemists in their attempts to ascertain its proportions.

Fourcroy has observed, that when oxygen is introduced through the red oxide of mercury, it combines with an additional dose of oxygen, and is converted into a peroxide; but as this peroxide cannot be procured in a separate state, we are ignorant of its composition.

Mercury does not combine with carbon or hydrogen; but it unites readily with sulphur and with phosphorus.

When two parts of sulphur and one of mercury are triturated together in a mortar, the mercury graduall y disappears, and the whole assumes the form of a black powder, formerly called ethiops mineral. This scarcely possible by any process to combine the sulphur and mercury so small globules of the metal may not be detected by a microscope. When mercury is added slowly to its own weight of melted sulphur, and the whole is stirred, the same black compound is formed.

Fourcroy had suggested, that in this compound the mercury is in the state of black oxide, absorbing the necessary portion of oxygen from the atmosphere during its combination with the sulphur. But the late experiments of Front have shown that this is not the case. Berthollet has made it probable that ethiops mineral contains sulphuretted mercury. Hence we must consider it to be composed of three ingredients, namely, mercury, sulphur, and sulphuretted hydrogen. Such compounds are at present denominated by chemists hydrogenous sulphurates. Ethiops mineral is therefore called hydrogenous mercury. When this substance is heated, part of the sulphur is disappared, and the compound assumes a deep violet colour.

When heated red-hot, it sublimes; and if a proper vessel is placed to receive it, a cake is obtained of a fine red colour. This cake was formerly called cinnabar; and when reduced to a fine powder, is well known in medicine under the name of vermilion. It has been hitherto supposed a compound of
the oxide of mercury and sulphur. But the experiments of Priest have demonstrated that the amalgam contains is in the metallic state. According to that very accurate chemist, it is composed of 83 parts of mercury and 13 of sulphur. It is therefore sulphuret of mercury.

The amalgam of mercury has a scarlet colour, more or less beautiful, according to the mode of preparing it. Its specific gravity is about 10. It is tasteless, insoluble in water, and in muriatic acid, and not altered by exposure to the air. When heated sufficiently, it takes fire, and burns with a blue flame. When mixed with half its weight of iron filings, and distilled in a stoneware retort, the sulphur combines with the iron, and the mercury passes into the receiver, which ought to contain water. By this process mercury may be obtained in a state of purity. The use of sulphuret of mercury as a paint is well known.

Mr. Pelletier, after several unsuccessful attempts to combine phosphorus and mercury, at last succeeded by distilling a mixture of red oxide of mercury and phosphorus. Part of the phosphorus combined with the oxide, some of it was converted into an acid; the rest combined with the mercury. He observed that the mercury was converted into a black powder before it combined with the phosphorus. As Pelletier could not succeed in combining phosphorus with mercury in its metallic state, we must conclude that it is not with mercury, but with the black oxide of mercury, that the phosphorus combines. The compound, therefore, is not amalgam of mercury, but black phosphuret of oxide of mercury.

It is of a black colour, of a pretty solid consistence, and capable of being cut with a knife. When exposed to the air, it exhales vapours of phosphorus. Mercury does not combine with the simple incombustibles.

Mercury combines with the greater number of metals. These combinations are known in chemistry as amalgams or amalgamation.

The amalgam of gold is formed more readily, because there is a very strong affinity between the two metals. If a bit of gold is dipped into mercury, its surface, by combining with the mercury, becomes almost as silver. The easiest way of forming this amalgam is to throw small pieces of red-hot gold into mercury. The proportions of the ingredients are not determinable, because the amalgam has an affinity both for the gold and the mercury; in consequence of which they combine in any proportion. This amalgam is white, with a shade of yellow; and when composed of six parts of mercury and one of gold, it may be obtained crystallized in four-sided prisms. It melts at a moderate temperature; and when heated sufficiently, the mercury evaporates, and leaves the gold in a state of purity. It is much used in gilding.

The amalgam composed of ten parts of mercury and one of gold, is spread upon the metal which is to be gilt; and then, by the application of a gentle and equal heat, the mercury is driven off, and the gold left adhering to the metallic surface; this surface is then rubbed with a burnish under water, and afterwards burnished.

Dr. Lewis attempted to form an amalgam of platinum, but hardly succeeded alter a

labor which lasted for several weeks. Guy- ton Morveau succeeded by means of heat. He fixed a small cylinder of platinum at the bottom of a tall glass tube and covered it with mercury. The vessel was then placed in a sand-bath, and the mercury kept constantly boiling. The mercury gradually combined with the platinum; the weight of the cylinder was increased, and it became brittle. When heated strongly, it evaporated, and left the platinum partly oxidized. It is remarkable, that the platinum, notwithstanding its superior specific gravity, always swam upon the top of the mercury, so that Morveau was under the necessity of fixing it down. The amalgam of silver is made in the same manner as that of gold, and with equal ease. It forms dentritic crystals, which, according to the Dion academicians, contain eight parts of mercury and one of silver. It is of a white colour, and is always of a soft consistence. Its specific gravity is greater than the mean of the two elements. Gellert has ever remarked that, when thrown into pure mercury, it sinks to the bottom of that liquid. When heated sufficiently, the mercury is volatilized, and the silver remains behind pure.

The affinities of mercury as ascertained by Morveau, and of its oxides as exhibited by Bergman, are in the following order:

**Mercury. Oxide of Mercury.**

<table>
<thead>
<tr>
<th>Gold</th>
<th>Muriatic acid</th>
</tr>
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<tbody>
<tr>
<td>Silver</td>
<td>Oxalic</td>
</tr>
<tr>
<td>Tin</td>
<td>Succinic</td>
</tr>
<tr>
<td>Lead</td>
<td>Arsenic</td>
</tr>
<tr>
<td>Bismuth</td>
<td>Phosphoric</td>
</tr>
<tr>
<td>Platinum</td>
<td>Sulphuric</td>
</tr>
<tr>
<td>Zinc</td>
<td>Saccatic</td>
</tr>
<tr>
<td>Copper</td>
<td>Tartaric</td>
</tr>
<tr>
<td>Antimony</td>
<td>Citric</td>
</tr>
<tr>
<td>Arsenic</td>
<td>Sulphurous</td>
</tr>
<tr>
<td>Iron</td>
<td>Nitric</td>
</tr>
<tr>
<td>Fluoric</td>
<td>Acetic</td>
</tr>
<tr>
<td>Boracic</td>
<td>Hydrogen</td>
</tr>
<tr>
<td>Carbolic</td>
<td>Carbonic</td>
</tr>
</tbody>
</table>

**Mercury, in astronomy, the smallest of the planets, and the nearest the sun. See Astronomy.**

**Mercury, in ethnology, a genus of birds of the order of auresae; distinguished by having the beak of a cylindrical figure, and hooked at the extremities, and its dentitions of a subulated form.**

1. The cucullatus, or crested diver of Canada, has a globular crest, white on each side; and the body is brown above, and white below. This elegant species inhabits North America. It appears at Hudson’s-bay the end of May, and builds close to the lakes. The nest is composed of grass, lined with feathers from the breast; the number of eggs from four to six. The young are yellow, and are fit to fly in July. They all depart from thence in autumn. They appear at New York, and other parts, as low as Virginia and Carolina, in November, where they frequent fresh waters. They return to the north in March, and are called at Hudson’s bay, the comika sheep. See Plate Nat. Hist. fig. 265.

2. The merganser, or goosander, weighs four pounds; its length is two feet four inches; the breadth three feet four. The dun-diver, or female, is less than the male; the head and neck are white; the tips of the plumage are white; the breast and middle of the belly are white, tinged with yellow. The goosander seems to prefer the more northern situations to those of the south, not being seen in the last except in very severe weather. It continues the whole year in the Orkneys; and has been shot in the Hebrides in summer. It is common on the continent of Europe and Asia, but most so towards the north.

3. The alidus, or smew, weighs about 34 ounces; the length is 18 inches, the breadth 26; the bill is narrower at the end, and of a lead-colour; the head is adorned with a long crest, white above and black beneath; the head, neck, and whole under part of the body, are of a pure white; the tail is of a deep gold, the legs a white. The male, or loach, diver, is less than the male; the back, the scapulars, and the tail, are dusky; the belly is white. The smew is seen in England only in winter, at which season it sometimes breeds. It is found on some parts of it; as also in France, in the neighborhood of Picardy, where it is called la piette; similar to this, we have heard it called in Kent by the name of magpie diver.

There are three other species. See Astronomy, and Geography.

**Meridian.** See Astronomy, and Geography.

**Meridional Parts, Miles, or Minutes.** In navigation, are the parts by which the meridians in Mr. Wright’s chart (commonly though falsely called Mercator’s) increase as the parallels of latitude decreas; and as the distances of the latitude of any place is equal to the radius or semi-diameter of that parallel, therefore, in the true sea chart, or nautical planisphere, this radius being the radius of the equinoctial, or whole sine of 90°, the meridional parts are the degree of latitude must increase, as the seconds of the arch, contained between that latitude and the equinoctial, do decrease. The tables therefore of meridional parts, which we have in books of navigation, are made by a continual addition of seconds; they are calculated in some books for every degree and minute of latitude; and they will serve either to make or graduate a Mercator’s chart, or to work the Mercator’s sailing. To use them, you must enter the table with the degree of latitude at the head, and the minute on the first column towards the left hand, and in the angle of meeting you will have the meridional parts of both the place you are in; if you use the meridional difference of latitude is found by subtracting the meridional parts answering to the least latitude, from those answering to the
To find the Meridional Parts to any Spheroid, with the same eccentricities as a Sphere. Let the semi-diameter of the equator be to the distance of the centre from the focus of the generating ellipses, as \( m \) to 1. Let \( A \) represent the latitude for which the meridional parts are required, \( x \) the sine of the latitude, to the radius 1. Find the arc \( B \), whose sine is \( -\frac{1}{x} \), take the logarithmic tangent of half the complement of \( B \), from the common tables. Subtract the log. tangent from 10.000000, or the log. tangent of \( 90^\circ \); multiply the remainder by the number \( 785.7044679 \), and divide the product by \( m \); then the quotient subtracted from the meridional parts in the sphere, computed in the usual manner for the latitude \( A \), will give the meridional parts, expressed in minutes, for the same latitude in the spheroid, when it is the oblate one.

Example: If \( m = 1 \), \( 1000 \) to 29, then the greatest difference of the meridional parts in the sphere and spheroid is 760.299 minutes. In other cases it is found by multiplying the remainder above-mentioned by the number 1174.078.

When the spheroid is oblate, the difference in the meridional parts between the sphere and spheroid, for the same latitude, is then determined by a circular arc.

We shall here add a table of meridional parts, calculated by Mr. Mungo, in his new and learned Treatise of Mercator’s Sailing applied to the true Figure of the Earth. By this table may be projected a true chart for any part of the earth’s surface, and the several problems of sailing may be solved by it. Maps of countries may be delineated and applied to the various purposes of navigation, geometry, and astronomy. Nor are the errors of the common spherical projections so very small in many cases, as to be inconsiderable and not dangerous. For instance, if a ship sails from south latitude \( 25^\circ \), to north latitude \( 90^\circ \), and the angle of the course be \( 45^\circ \); then the difference of longitude of the common table would be \( 320^\circ \), exceeding the true difference \( 314^\circ \) by \( 6^\circ \), or rules. Also the distance sailed would be \( 4512 \), exceeding the true distance, \( 4425 \), by \( 87 \), or miles, which errors are too great to be neglected. For other instances of such a correction of the charts, we refer to the author’s admirable book above-mentioned.

A Table of Meridional Parts to the Spheroid and Sphere, with their Differences.

<table>
<thead>
<tr>
<th>D.</th>
<th>Spheroid</th>
<th>Sphere</th>
<th>Diff.</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>53.7</td>
<td>60.0</td>
<td>6.3</td>
</tr>
<tr>
<td>2</td>
<td>117.3</td>
<td>120.0</td>
<td>2.7</td>
</tr>
<tr>
<td>3</td>
<td>175.3</td>
<td>180.1</td>
<td>4.8</td>
</tr>
<tr>
<td>4</td>
<td>231.9</td>
<td>240.0</td>
<td>8.1</td>
</tr>
<tr>
<td>5</td>
<td>293.8</td>
<td>300.0</td>
<td>6.2</td>
</tr>
<tr>
<td>6</td>
<td>352.7</td>
<td>360.0</td>
<td>7.3</td>
</tr>
<tr>
<td>7</td>
<td>411.8</td>
<td>420.0</td>
<td>8.2</td>
</tr>
<tr>
<td>8</td>
<td>471.0</td>
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<tr>
<td>9</td>
<td>530.4</td>
<td>542.0</td>
<td>11.6</td>
</tr>
<tr>
<td>10</td>
<td>589.3</td>
<td>605.0</td>
<td>15.7</td>
</tr>
<tr>
<td>11</td>
<td>649.7</td>
<td>664.1</td>
<td>14.4</td>
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<td>709.6</td>
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</tr>
<tr>
<td>13</td>
<td>768.8</td>
<td>785.8</td>
<td>17.0</td>
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<tr>
<td>14</td>
<td>828.0</td>
<td>846.5</td>
<td>18.5</td>
</tr>
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<td>15</td>
<td>889.0</td>
<td>910.5</td>
<td>21.5</td>
</tr>
<tr>
<td>16</td>
<td>951.8</td>
<td>975.7</td>
<td>23.9</td>
</tr>
</tbody>
</table>

MERLIN. See Falcon.

MERLIN, in fortification, is that part of a parapet which is terminated by two embrasures, or the thick part of a lantern or cistern. These are the same with those of the parapet; but its breadth is generally nine feet on the inside, and six on the outside. It serves to cover those on the battery from the enemy; and is better when made of earth well beaten and close, than when built with stones; because the latter are round and would should defend.

MEROPS, in ornithology, a genus belonging to the order of pica. The bill is crooked, fat, and carinated; the tongue is jagged at the point, and the feet are of the walking kind.

The principal species are: 1. The apalier, or bee-catcher, which has an iron-colored back; the belly and tail are of a blueish green; and the throat yellow. This bird inhabits various parts of Europe, on the continent, though not in England. It is said to have been seen in Sweden, and blocks of them have been seen at Annapah in Germany in the month of June. It takes the name of bee-catcher from its being very fond of those insects; but, besides these, it will catch gnats, flies, cicadae, and other insects, on the wing, like swallows.

These birds make their nests in the holes in the banks of rivers, of the sand martin and kingfisher: at the end of which the female lays five to seven white eggs, rather less than those of a blackbird. The nest itself is composed of moss.

2. The virdilis, or Indian bee-eater, is given with black belly, black breast, and the throat and tail black. It is a large bird.

3. The erythropeter, or red-winged beecatcher, is in length six inches; the bill is one inch, and black; the upper parts of the head, body, and wings, the spheroid, or crests, are green brown, on the rump and the tail-coverts; behind the eye is a spot of the same, but of a very deep color; the quills and tail are red, tupp’d with black; the last two inches in length; the throat is yellow; the under parts of the body are a dirty white; and the legs black. There are more than 20 other species.

MESEMBRYANTHEMUM, Figmar--gold, a genus of the pentagynia order, in the icosandra class of plants, the natural method ranking under the 13th order, succulent. The calyx is quinquepart; the petals are numerous and linear; the capsule is fleshy, four-seeded and indehiscent: there are seventy-five species, all African plants, from the Cape of Good Hope, near 40 of which are retained in our gardens for variety. Of these only one is annual, and the most remarkable of them all is called the crystal--lumin, diamond, ficodes, or ice-plant. This singular and curious plant, being closely covered with large pellucid pimples, full of moisture, shining brilliantly like diamonds, is in great esteem. It is a very tender plant when young, and is raised usually from seed by means of cuts. In June it will endure the open air till October, when it perishes; but if placed in a hot-house in autumn it will often live all winter.

The other species are most durable in stem and foliage. Some are shrubby; others pendent, with loose straggling stems, and branches inclining to the ground; while others have no stalks at all; the leaves are universally very thick, succulent, and fleshy, and of various shapes, situations, and directions; while some are punctured, or dotted with transparent points; and some have pellicle. Its use has not been much noticed, as it has not been much mentioned. They afford a very agreeable variety at all times of the year, and merit a place in every collec-
tion. They are greenhouse plants, and are propagated by cuttings of their stalks and branches.

**MESENTERY. See Anatomy.**

**MESNE, he who is lord of a man, and so lastentants of him, yet himself sheds of a superior lord 15 Vin. Alc.**

**MESNE PROCESS, is an intermediate process, and is said to be pending the suit, upon some collateral interlocutory matter, as to summon jurors, witnesses, and the like; sometimes it is put in contradistinction to final process, or process of execution, and then it signifies all such process as intervenes between the beginning and end of a suit. 3 Black. 279.**

**MESPLISUS, the medlar; a genus of the pentagaomy order, in the Rosacea class of plants; and in the natural method ranking under the 30th order, pomaceae. The calyx is quinquelobate; the petals are five; the berry is inferior and pentapetalous.**

There are nine species, the principal of which are, 1. The Germanica, German mespilus, or common medlar, rises with a de- formed button, branching irregularly 15 or 20 feet high; sparse-leaved, yellow, and brown fruit, the size of middling apples, which ripen in October, but are not edible till beginning to decay. The varieties are, common great German medlar; smaller Nottingham medlar; spear-shaped Italian medlar. 2. The arbutus, arbutus-leaved mespilus, has a small, roundish, purple fruit, like haws. 3. The amethyst, or shrubbery medlar, or dwarf medlar. 4. The chamæ- mespilus, or dwarf medlar, commonly called bastard quince, has small red fruit. 5. The cotonéaster, commonly called dwarf quince, with small roundish bright-red fruit. 6. The Cnidosperma, Canada snowy mespilus, with small, purpleish fruit, like haws. 7. The pyracantha, or evergreen thorn, rises with a shrublike, spiny stem, branching diffusely 12 or 14 feet high, all the shoots terminated by much branching white flowers; succeeded by large bunches of beautiful red berries, remaining all winter, and exhibiting a very ornamental appearance.

**MESSENGERS, are certain officers chiefly employed under the direction of the secretary; the secretaries always in readiness to be sent with all kinds of dispatches foreign and domestic. They also, by virtue of the secretaries' warrants, take up persons for high treason, or other offences against the state. The prisoners they apprehend are usually kept at their own houses, for each of which they are allowed 6s. 8d. per day, by the govern-ment; and when they are sent abroad, they have a stated allowance for their jour-ney.**

**METALS may be considered as the great instruments of all our improvements; without them, many of the arts and sciences could hardly have existed. So sensible were the ancients of the great importance, that they raised those persons who first dis- covered the art of working them to the rank of deities. In chemistry, they have always filled a conspicuous station; at one period the whole science was founded upon them; and it may be said to have owed its very existence to a rage for making and transmuting metals. 1. One of the most conspicuous properties of the metals is a particular brilliancy which they possess, and which has been called the metallic lustre. If a piece of any of the metals is rubbed on a cloth and then placed in direct contact with the eyes, and the surface of the skin, it will be found that the rays from the surface of the metal enter the eye, and produce in it a sense of brightness, and this while a piece of the metal is held up to the eye. 2. They are transparent, or impervious to light, even after they have been reduced to very thin plates. Silver leaf, for instance, is so thin that it does not permit the smallest ray of light to pass through it. Gold, however, when very thin, is not absolutely opaque: for gold leaf is so thin that it appears to the eye, and the light, of a lively green; and must therefore, as Newton first remarked, transmit the green-coloured rays. 3. There are a number of metals, as the same as gold, and which transmit a trivial degree of light; if they could be reduced to a proper degree of thinness. 4. There is a part of the excellence of the metals, as copper, which is, owing; their brilliancy alone would not equalize them for that purpose. 5. They may be melted by the application of heat, and then still retain their opacity. This property enables us to cast them in moulds, and then to give any shape we please. In this manner many ele- gant iron utensils are formed. Different met- als differ exceedingly from each other in fusibility. Mercury is so very fusible, that it is always fluid at the ordinary temperature of the atmosphere; while other metals, as platinum, cannot be melted except by the most violent heat which it is possible to pro- duce. 6. Their specific gravity is much greater than that of any other body that is known in anatomy. That the lightest of them, is more than six times heavier than water; and the specific gravity of platinum, the heaviest of all the metals, is 23. This great density, no doubt, contributes con- siderably to the value and utility of that great quantity of light which constitutes the metallic lustre. 7. They are the best conductors of elec- tricity of all the bodies hitherto tried. 8. None of the metals are very hard; but some of them may be hardened by art to such a degree as to exceed the hardness of almost all other bodies. Hence the nume- rous cutting instruments, and the modern make of steel, and which the ancients made of a combination of copper and tin. 9. The elasticity of the metals depends upon their hardness, and it may be increased by the same process by which their hardness is increased. Thus the steel of which the balance-springs of watches are made, is almost perfectly elastic, though iron in its natural state possesses little elasticity. 10. One of their most important properties is malleability, by which they present the capacity of being pounded and flattened when struck with a hammer. This property, which is peculiar to metals, enables us to give the metallic bodies any form we think proper, and thus renders it easy for us to convert them into the various instruments for which we have occasion. All metals do not possess all these qualities; but it is remark- able that almost all those which were known to the ancients have it. Heat increases this property considerably. Metals become harder and denser by being hammered for a long time; this property, which is also wanting in many of the metals, is ductility; by which we mean the capacity of being drawn out into wire, by being forced through holes of various diameters. 11. Ductility depends, in some measure, on another property which metals possess, namely, tenacity; by which is meant the power which a metallic wire of a given diame- ter has of resisting, without breaking, the action of a weight suspended from its extremity. Metals differ exceedingly from each other in their tenacity. An iron wire, for instance, 1/4 of an inch in diameter, will support, without breaking, about 500l. weight; whereas a lead wire, of the same diame- ter, will not support more than 15l.

11. When exposed to the action of heat and air, most of the metals lose their lustre, and are converted into earthy-like powders of different colours and properties, according to the metal and the degree of heat employed.

12. If any of these calxes, as they are called, is mixed with charcoal, and exposed to a strong heat in a proper vessel, it is changed again to the metal from which it was produced. This fact is easily ex- plained on the principles of modern chemist- ry; the calx is the metal combined with ox- ygen, or an oxide, in modern language, and by heating it with charcoal, which has a stronger attraction for oxygen, than substance is taken from the metal, and it is brought back again to the metallic state. This process, uniting with the charcoal, forms carbonic acid gas.

The words calx and calculation, then, are evidently improper, as they convey false ideas; philosophers therefore now employ, instead of them, the words oxide and oxida- tion, which were invented by the French chemists. A metallic oxide signifies a metal united with oxygen; and oxidation implies the act of that union.

13. Metals, then, are all capable of combi- ning with oxygen; and this combination is sometimes accompanied by combustion, and sometimes not. The new compounds formed are called metallic oxides, and in some cases metallic acids. These were formerly distin- guished from each other by their colour. One of the oxides, for instance, was called black oxide, another was termed red oxide; but it is now known that the same oxide is capable of being converted according to circumstances. The mode of naming them from their colour, therefore, wants precision, and is apt to mislead; es- pecially as there occur different examples of the same metal having the same colour.

As it is absolut-ly necessary to be able to dis-tinguish the different oxides of the same
metal from each other with perfect precision, and as the present chemical nomenclature is defective in this respect, we may, till some better system is adopted, distinguish them from each other, by prefixing to the word oxide the first syllable of the Greek ordinal numerals. Thus the protoxide of a metal will denote the metal combined with a minimum of oxygen, or, the first oxide which the metal is capable of forming: deuteroxide will denote the second oxide of a metal, or the metal combined with two doses of oxygen. When a metal has combined with as much oxygen as possible, the compound formed is denoted by the term peroxide; indicating by it, that the metal is thoroughly oxidized.

Thus we have the term oxide to denote the combination of metals with oxygen in general; the term protoxide and peroxide to denote the minimum and maximum of oxidation; and the terms deuteroxide, triroxide, &c., to denote all the intermediate states which are capable of being formed.

14. Metals may be also of combining with the simple combustibles. The compounds thus formed are denoted by the simple combustible which enters into the combination, with the termination uret added to it. Thus the combination of a metal with sulphur, phosphorus, or carbon, is called the sulphuret, phosphuret, or carburat of the metal. Hydrogen has not been proved capable of entering into similar combinations; neither have the simple metals, oxygen.

15. The metals are capable likewise of combining with each other, and of forming compounds, some of which are extremely useful in the manufacture of instruments and utensils. Thus pewter is a compound of lead and tin; brass, a compound of copper and zinc; bell-metal, a compound of copper and tin. These metallic compounds are called by chemists alloys, except when one of the combining metals is mercury. In that case the compound is called an amalgam. Thus the compound of mercury and gold is called the amalgam of gold.

16. The metals at present amount to 23; only 11 of which were known before the year 1750. They may be very conveniently arranged into the following classes: namely, 1. Malleable metals; 2. Brittle and easily fusible metals; 3. Brittle and difficultly fusible metals. The metals belonging to each of these classes will be seen from the following Table:

<table>
<thead>
<tr>
<th>Metal</th>
<th>( \alpha )</th>
<th>( \beta )</th>
<th>( \gamma )</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gold</td>
<td>Sun</td>
<td>Moon</td>
<td>Mercury</td>
</tr>
<tr>
<td>Silver</td>
<td>Moon</td>
<td>Mercury</td>
<td>Mercury</td>
</tr>
<tr>
<td>Mercury</td>
<td>Mercury</td>
<td>( \alpha )</td>
<td>( \beta )</td>
</tr>
<tr>
<td>Copper</td>
<td>( \alpha )</td>
<td>( \beta )</td>
<td>( \gamma )</td>
</tr>
<tr>
<td>Tin</td>
<td>Jupiter</td>
<td>Saturn</td>
<td>Mars</td>
</tr>
</tbody>
</table>

It seems most probable that these names were first given to the planets; and that the seven metals, the only ones then known, were considered as having some relation to the deities of the planets or to the Gods that inhabited them, as the number of both happened to be the same. It appears from a passage in Origen, that these names first arose among the Persians. Why each particular metal was denominated by a particular planet, it is not easy to say. Many conjectures have been made, but scarcely any of them are satisfactory.

As to the characters by which these metals were expressed, astrologers seem to have considered them under the attributes of the deities of the same nature. The circle, in the earliest periods among the Egyptians, was the symbol of divinity and perfection; and seems with great propriety to have been adopted as the character of the earth, especially as, when surrounded by small strokes projecting from its circumference, it may form some representation of the emblem of rays. The semicircle is, in like manner, the image of the moon; the only one of the heavenly bodies that appears under that form to the naked eye. The character \( \alpha \) is supposed to represent the scythe of Saturn; \( \beta \) the thunderbolt of Jupiter; \( \gamma \) the crescent of Mars, together with his shield; \( \alpha \) the looking-glass of Venus; and \( \delta \) the caduceus or wand of Mercury.

Professor Beckmann, however, who has examined this subject with much attention, thinks that these characters are merely abbreviations of the old names of the planets. "The character of Mars (he observes), according to the oldest mode of representing it, is evidently an abbreviation of the word Espur, in the Greek manuscripts understood to signify; or, in other words, the first letter \( \alpha \), with the last letter \( \alpha \) placed above it. The character of Jupiter was originally the initial letter of \( \zeta \) and \( \gamma \); and the two last letters of the name of the planet, or its mathematical and astrological works of Julius Firmicus, the capital \( Z \) only is used, to which the last letter \( \alpha \) was afterwards added at the bottom, to render the abbreviation more distinct. The supposed looking-glass of Venus is nothing else than the initial letter distorted a little of the word \( \varphi \\\alpha\rho\upsilon\omicron\upsilon \), which was the name of that god. The imaginary scythe of Saturn has been gradually formed from the two first letters of his name \( \Sigma\alpha\rho\upsilon\omicron\upsilon \); and, during the invention of the signs used by the Greek philosophers for the sake of dispatch, made always more convenient for use, but at the same time less perceptible. To discover in the pretended caduceus of Mercury the initial letter of his Greek name \( \Sigma\alpha\omicron\omicron\nu \), one needs only look at the abbreviations in the oldest manuscripts, where he will find that the \( \Sigma \) was once written as \( \zeta \); they will remark, also that transcribers, to distinguish this abbreviation from the first still preserved, placed the \( C \) thus \( \delta \), and added under it the next letter \( \alpha \). If those to whom this deduction appears improbable will only take the trouble to look at other Greek abbreviations, they will find many that differ still farther from the original letters they express than those of \( \zeta \) and \( \alpha \) united. It is possible also that later transcribers, to whom the origin of this abbreviation was not known, may have endeavored to give it a greater resemblance to the caduceus of Mercury. In short, it cannot be denied that many other astronomical characters are real symbols, or a kind of proper hieroglyphics, that represent certain attributes of circumstances, like the characters of Aries, Leo, and Taurus, explained by Sammasa."
The destructive elastic fluids, which so frequently are disseipated in the cavities of mines, and particularly the carbonic acid gas, and different species of mixed hydrogen gases, may be less prejudicially injurious, among the most formidable enemies of miners. Galleries, fires, ventilators, inflammations by means of torches held at a great distance in those parts of the mines which are unpurposed, and theivable strong door, or barricado, which the workmen place at the moment when they find by the particular sound of the rock, that the waters are coming in upon them, which barricado, by separating them from the liquid, gives them time to save themselves.

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have agreed in calling metaphysical: such were the discussions between Clarke and Leibnitz concerning the free agency of man; such were the disputes concerning identity and diversity, which formerly agitated the schools, and which the great philosophers have laid to rest, and if we were called upon to point out a most able and rational work, into which metaphysics are introduced with propriety and ability, we should name Cutworth's Intellectual System.

METEORIS. See Anatomy.

METEOR. This term is by some writers made to comprehend all the visible phenomena of meteorology, but it is more generally confined to luminous bodies appearing suddenly at uncertain times, and with more or less of motion in the atmosphere. These may be reduced under three classes, viz. fire-balls, falling or shooting stars, and ignes fatui.

Those phenomena which are classed together under the general appellation of fire-balls, were divided by the ancients into several branches, according to the external form or appearance of the bodies. They were also regarded by them in a much more formidable light than by us; as being the certain prognostics of great and awful events in the civil and political world. Even the philosophic Cicero distinguished the "ignea facies," as the certain harbingers or indications of those bloody scenes which in his time convulsed and desolated the Roman commonwealth.

Under the general name of comets, Pliny enumerates a variety of these phenomena. If the fire commences at one extremity of the meteor, and burns by degrees, he terms it, from its form and appearance, a lamp or torch; if an extended mass of fire passes longitudinally through the atmosphere, he calls it a dart; and if its length and magnitude are considerable, and it maintains its station for any space of time, it is a bomb; and if the clouds seem to be brought, and exist a quantity of time, it is a tempest; but the last appears to be, strictly speaking, an electrical phenomenon, indeed only a strong and vivid display of lightning.

Several instances of these meteors are recorded by the same author. During the spectacle of gladiators exhibited by Germanicus, one of them passed rapidly by the faces of the spectators at noon-day. A meteor of that species which he calls a beam, he adds, was seen when the Lacedemonians were defeated at sea, in that memorable engagement which lost them the empire at sea. He also mentions a singularly keen meteor, a flame as red as blood, which fell from heaven about the 107th Olympiad, when Philip of Macedon wasconcerting his wicked plan for enslaving the republics of Greece. He relates, that when he was himself on the watch during the night in the Roman camp, he was a spectator of a similar appearance—a number of re-plented fires fixed upon the pickets of the camp, similar, he says, to those which mariners speak of as attaching themselves to the masts and yards of a ship.

In tropical climates these meteors are more common and more stupendous than in these more temperate regions. "As I was riding in Jamaica," says Mr. Barbraham, "one morning past the camp, situated about three miles south-west from St. Jago de la Vega, I saw a ball of fire, appearing to me about the bigness of a bomb, swiftly flying down with a great blaze. At first I thought it fell into the town; but when I came nearer, I saw many people gathered together, a little to the northward, in the savannah, to whom I rode up, because of their meeting: they were admiring, as I found, the ground's being strangely broken up and ploughed by a ball of fire, which, as they said, fell down there. I observed there were many holes in the ground, one in the middle of the bigness of a man's head, and five or six smaller round about it, of the bigness of one's fist, and so deep as not to be fathomed by such implements as were at hand. It was observed also, that all the green herbage was burnt up near the holes; and there continued a strong smell of sulphur near the place for some time after." 

Ulysses gives an account of one of a similar kind at Quito. "About nine at night," says he, "a globe of fire appeared to rise from the side of the mountain Pichincha, and so large, that it spread a light over all the part of the earth facing that mountain. The house where I happened to be at that very time, I was surprised with an extraordinary light darting through the crevices of the window-shutters. On this appearance, and the bustle of the people in the street, I hastened to the window, and could not but take occasion to see it, in the middle of its career, which continued from the west to south, till I lost sight of it, being intercepted by a mountain that lay between me and it. It was round, and its apparent diameter about a foot; it was observed to rise from the sides of Pichincha, although, to judge from its course, it was beyond that mountain where this concrescences of inflammable matter had appeared. In the first half of its visible course it emitted a prodigious effulgence, then it began gradually to grow dim; so that, upon its disappearing behind the intervening mountain, its light was very faint." 

But this kind are very frequently seen between the tropics, and to the northward of 30 degrees latitude; but they sometimes also visit the more temperate regions of Europe. We have the description of a very extraordinary one, given us by Monta- nari, that he was shown to what great heights, in our atmosphere, these vapours are found to ascend. In the year 1670, a great globe of fire was seen at Bononia, in Italy, about three quarters of an hour after sunset. It passed westward, with a most rapid course, and at the rate of not less than 60 miles in a minute, which is much swifter than the force of a cannon-ball, and at last stood over the Adriatic sea. In its course it crossed over all Italy; and, by computation, it could not have been less than 80 miles above the surface of the earth. In the whole line of its course, wherever it approached, the inhabitants below could distinctly hear it, with a hissing noise, resembling that of a fire-work. Having passed away to sea, towards Corfu, it was heard at last to go off with a most violent explosion, much louder than that of a cannon; and immediately after, another noise was heard, like the rattling of a great cart upon a stony road. This sound, which was probably nothing more than the echo of the former sound. Its magnitude, when at Bononia, appeared twice as long as the moon one way, and as broad the other; so that, considering its height, it could not have been less than a mile long, and half a mile broad. From the height at which this was seen, and the relations to that quarter of the world whence it came, it is not improbable that this terrible globe was kindled on some part of the contrary side of the globe; and thus, rising above the air, and passing in a course opposite to that of the earth's motion, in this manner it acquired its amazing rapidity.

Two of these meteors appeared in this country in the year 1783, of which a most particular and truly philosophical account and ingenious solution may be found in the Philosophical Transactions of the following year; and as his account will apply to many phenomena of the kind, we cannot take any better method to elucidate this part of the subject, than by presenting our readers with a short abstract of this very curious and learned memoir.

The first of the two meteors in question was seen on the 18th of August, and was, in appearance, a luminous globe which rose in the N. N. W. nearly round: it, however, soon became elliptical, and gradually assumed a tall as it ascended, and, in a certain part of its course, underwent a remarkable change, compared to the latter by which it proceeded no longer as an entire mass, but was apparently divided into a cluster of balls of different magnitudes, and all carrying a fiery light behind them, till, having passed the east, and turning consideraby to the south, it gradually descended, and was lost out of sight. The time of its appearance was about sixteen minutes past nine in the morning, and visible about half a minute. It was seen in all parts of Great Britain, at Paris, at Nuits in Burgundy, and even at Rome; and is supposed to have described a tract of 1000 miles at least over the surface of the earth. It appears to have burst and re-united several times; and the first bursting of it which was noticed seems to have been somewhere over Lincolnshire, or perhaps near the commencement of the fens.

This change of color corresponds with the period in which it underwent a change of elevation from its course. If, indeed, the explosion was any kind of effort, we cannot wonder that the body should be deviated by it from its direct line; and on the other hand, it seems equally probable, that it was forced by any cause to change its direction, the consequence would naturally be a separation of its parts along the line of the explosion.

The illumination of these meteors is often so great as totally to obliterate the stars, to make the moon look dull, and even to affect the spectators like the sun itself. When this meteor was observed at Brussels, the moon appeared quite red, and even then it was passed, recovered its natural light. This effect, the doctor remarks, must have depended on the contrast of colour, and shows how large a proportion of the blue rays enters into that light which could even on the silver moon appear to have an excess of red. The body of the fire-ball, even before it burst, did not appear of an uniform brightness, but consisted of such light and dull parts, which were constantly changing their relative positions, so that the whole effect was of the kind as if an intermittent illumination or obliquity of the matter. By the best accounts that could be procured concerning the height of the meteor, it seems...
to have varied from 55 to 60 miles. In these two last particulars it seems to have wonderfully corresponded with some other phenomena of the same kind.

A report was heard at some time after the meteor disappeared, and this report was loudest in Lincolnshire and the adjacent parts, and again in the eastern parts of Kent: the report we may therefore suppose to be the effect of the two explosions; for it is singular that, after it entered the continent: a hissing sound was said also to have accompanied the progress of the meteor. Judging from the height of the meteor, its bulk is conjectured to have been not less than half a mile in diameter; and when we consider this bulk, its velocity cannot fail to astonish us, which is supposed to be at the rate of more than 40 miles in a second.

The other meteor, which appeared on the 4th of October, 1783, at 43 minutes past six in the evening, was much smaller than the former, and of a much shorter duration. It was first perceived to the northward, as a stream of fire, like the common aurora borealis, yelling so violently out into that intensely bright bluish flame, which is peculiar to such meteors. It left behind it a dusky-red streak of fire, and, except this, had no tail, but was nearly globular. After moving for not less than 10 degrees in this bright state, it became suddenly extinct without any explosion. The height of the meteor must have been between 40 and 50 miles; and its duration was not more than four seconds.

The doctor is of opinion, that the general cause of these phenomena is electricity, which opinion liegrounds upon the following circumstances: 1st, The velocity of these meteors, in which they correspond with no other body in nature but the electrical fluid. 2dly, The electrical phenomena attending meteors, the lightning flames, and the sparks proceeding from them, which have sometimes damaged ships and houses in the manner of lightning; and, thirdly, the report or sound, which is the effect of electricity passing from a conductor. As a third argument in favour of this hypothesis, the doctor remarks the connection of meteors with the northern lights. Instances are on record of electric lights seen to join, and form luminous balls, darting about with great velocity, and even leaving a train like fire-balls. The aurora borealis appears to occupy as high, if not a higher, region above the surface of the earth, as may be concluded from the very distant countries to which it has been visible at the same time. 3dly, The most remarkable analogy, the doctor thinks, is the course of at least all the larger meteors, which seems to be constantly from or towards the north or north-west quarter of the heavens. Of above forty different fire-balls described in the Philosophical Transactions, twenty are so described, that it is certain their course was in that direction: only three or four seem to have moved the contrary way; and with respect to the remainder, it is felt doubtful, from the imperfect state of the relations.

Notwithstanding the doctor's ingenious arguments, we cannot subscribe to the opinion, that these phenomena are altogether electrical. The duration of the fire-ball, the unequal consistency of the mass, and several other points in the narration, seem to indicate that the ball consisting of three and four separate masses of an evanescent nature than the electric fire.

The following probably was electrical.

On board the Montague, under the command of admiral Chambers, in lat. 42° 49', on the 1st of November, 1783, about ten minutes before twelve, as the author, Mr. Chambers, was taking an observation, one of the quarter-masters desired he would look to the windward. On directing his eye that way, he observed a large ball of blue fire about three miles distance from them. They immediately lowered the topsails, but it came so fast upon them, that before they could raise the main-tack, they observed the ball rise almost perpendicularly, and not above 40 or 50 yards from the main-children, when it went off with an explosion as great as if hundreds of cannon had been discharged at the same time, leaving behind it a bright red flame; and the main-mast rent quite down to the keel. Five men were knocked down, and one of them was greatly bruised, and the other so severely wounded, as to be done to the ship. Just before the explosion, the ball seemed to be of the size of a large hill-stone.

The shooting or falling star is a common phenomenon, but there is so frequently observed, the great distance and transient nature of these meteors have hitherto frustrated every attempt to ascertain their cause. The connection of these with an active state of the atmosphere or a preternatural cause is certain from observation, and we have more reason to consider them as electric scintillations than as solid or fluid matter in the act of combustion. They precede a change of wind.

Concerning the nature and composition of the ignis fatua, or Will-with-a-wisp, there is less dispute; the generality of philosophers being agreed, that it is caused by some volatile vapour of the phosphoric kind, probably the phosphoric acid, emitted from putrid substances, particularly putrid fish, and those sparks emitted from the sea, or sea-water when agitated, in the dark, correspond in appearance with this meteor. Whitehorses, white swans, and other fictions to be "a vapour shining without heat," and it is usually visible in damp places, about dunghills, burying-grounds, and other situations which are likely to abound with phosphoric matter.

A remarkable ignis fatua was observed by Mr. Derham, in some boggy ground, between two rocky hills. He was so fortunate as to be able to approach it within two or three yards. It moved as he stood; and the natural notion about a dead thistle, till a slight agitation of the air, occasioned, as he supposed, by his near approach to it, caused it to jump to another place; and as he approached, it kept flying before him. He was near enough to satisfy himself that it could not be the shining of glow-worms or other insects: it was one uniform body of light.

M. Becaria mentions two of these luminous apparitions, commonly observed in the neighbourhood of Bologna, and which emitted a light equal to that of an ordinary faggot. Their motions were unequal, sometimes rising, and sometimes sinking towards the earth; sometimes totally disappearing, though in general they subsided about six feet above the ground. They clutured in size and figure: and, indeed, the form of each was fluctuating, sometimes floating like waves, and dropping sparks of fire. He was at Cremona, in a dark night in the whole year in which they did not appear; nor was their appearance at all affected by the weather, whether cold or hot, snow or rain. They have been known to change their colour in order to allure men and generalize greater terrors as any person approached, vanishing entirely when the observer came very near to them, and appearing again at some distance. Dr. Shaw also describes a regular ignis fatua, which he saw in the Holy Land. It was sometimes globular, or in the form of the flame of a candle; and immediately afterwards spread itself so much, as to involve the whole company in a pale nodding-light; and then was observed to contract itself again, and suddenly disappear. In less than a minute; however, it would become visible as before, and run along from one place to another; or would expand itself over more than the space of an acre, and then retire. The atmosphere at this time, he adds, was thick and hazy.

In a supersitious age we cannot wonder that these phenomena have all been attributed to supernatural agency: it is one of the noblest purposes of philosophy to release the mind from the bondage of imaginary errors; and by explaining the modes in which the Divine Providence disposes the different powers of nature, to establish the One First Cause; to teach us to see "God in all, and all in God."

METORIC STONES. Almost all the larger fire-balls have been observed to disappear with a loud explosion; and it was almost constantly affirmed that heavy stonebodies fell from them. But though several well-authenticated accounts of the fall of such stones had been from time to time published, it was not till recently that they did indeed attract the attention of philosophers, till Dr. Chladni published a dissertation on the subject in 1794. Two years after, Mr. King published a still more complete account of examples, both ancient and modern; many of them supported by such evidence that it was impossible to reject it. These two dissertations excited considerable attention: but the opinion that stones had really fallen from the atmosphere was considered as so extraordinary, and so contrary to what we know of the constitution of the air, that most people hesitated, or refused to admit it. Meanwhile Mr. Howard took a different method of investigating the subject. He not only collected all the recent and well-authenticated accounts of the fall of stone bodies, and examined the evidence of their truth, but procured specimens of the stones which were said to have fallen in different places, compared them together, and subjected them to a chemical analysis. The result was, that all these stone bodies differed completely from every other known stone: they all contained a superstitious kind of stone; and that they are all composed of the same ingredients. His dissertation on the subject was published in the Philosophical Transactions for 1802. The proofs which this ascri-
Meteoric Stones.

The stony bodies when found are always hot. They commonly bury themselves some distance under the ground. Their size differs from a few ounces to several tons. They are usually roundish, and always covered with a black crust. In many cases they smell strongly of sulphur. The black crust, from the analysis of Howard, consists chiefly of oxide of iron.

The outer surface of these stones is rough. When broken, they appear of an ash-grey colour, and of a granular texture like a coarse sandstone. When examined with a microscope, four different substances may be discovered, of which the stone is composed: 1st. A number of spherical bodies, varying in size from a pin's head to a pea, of a greyish-brown colour, opaque, breaking easily in every direction, of a compact texture, capable of scratching glass, and of giving a few feeble sparks with steel. 2d. Fragments of pyrites of an indeterminate shape, of red, yellow, dull, or yellowish, and quite easily reduced to powder. The powder has a black colour. 3d. Grains of iron in the metallic state, scattered like the pyrites through the stone. 4th. The three substances just mentioned are cemented together by a fourth of an earthy consistence, and so soft that all the other substances may be easily separated by the point of a knife or the nail, and the stone itself crumbling to pieces between the fingers. This cement is of a grey colour. The proportion and size of these different constituents vary considerably in different specimens; but all of them bear a striking resemblance to each other. Their specific gravity varies from 3.3376 to 4.281.

From the analysis of Howard, which was conducted with much precision and address, and which has been fully confirmed by Vanquelin and Klaproth, we learn, that the black crust consists of a compound of iron and nickel, partly metallic and partly oxidized. The pyrites consist of iron, nickel, and sulphur. The metallic grains consist of iron, combined with about one-third of its weight of nickel, and the yellow globules are composed of silica, magnesia, iron, and nickel. The count Bournon observes, that these globules resemble the clays of Werner, and that their chemical analysis corresponds exactly with Klaproth's analysis of this mineral. The earthy cement consists of the various substances, and nearly in the same proportions, as the globular substances. But it will be necessary to exhibit a specimen of some of the analyses, as published by the philosophers to whom we are indebted for them. A stone which fell at Benares in India, was analyzed by Howard. The pyrites consisted of:

<table>
<thead>
<tr>
<th>Substance</th>
<th>Place where they fell</th>
<th>Period of their Fall</th>
<th>Testimony</th>
</tr>
</thead>
<tbody>
<tr>
<td>Shower of stones</td>
<td>At Rome</td>
<td>Under Tullus Hostilius</td>
<td>Livy</td>
</tr>
<tr>
<td>Shower of stones</td>
<td>At Rome</td>
<td>Comites C. Marius &amp; M. Torquatius</td>
<td>J. Obsequens</td>
</tr>
<tr>
<td>Shower of stones</td>
<td>in Lucania</td>
<td>Year before the Rehearsal of Crises</td>
<td>Dio</td>
</tr>
<tr>
<td>Shower of stones</td>
<td>in Italy</td>
<td>Second year of the 78th Olympiad</td>
<td>Pliny</td>
</tr>
<tr>
<td>Shower of sulphur</td>
<td>near the river Negus, Thrace</td>
<td>Year before J. C. 422</td>
<td>Ch. of Count Marcellar, Geoffroy le Cadet</td>
</tr>
<tr>
<td>Shower of sulphur</td>
<td>at Tassy</td>
<td>January 5th, 1717</td>
<td>Paul Lucas</td>
</tr>
<tr>
<td>Shower of sulphur</td>
<td>near Larissa, Macedonia</td>
<td>January 1768</td>
<td>Carden, Varicci</td>
</tr>
<tr>
<td>Shower of sulphur</td>
<td>near Padua in Italy</td>
<td>in 1510</td>
<td>Mussedoni</td>
</tr>
<tr>
<td>Any two stones weighing 20 lbs.</td>
<td>On Mount Vaisser, Provence</td>
<td>November 27th, 1697</td>
<td>Père la Feuille</td>
</tr>
<tr>
<td>Any stone</td>
<td>In the Atlantic</td>
<td>April 6th, 1719</td>
<td>Moses</td>
</tr>
<tr>
<td>Any stone</td>
<td>In the Baltic</td>
<td>in 1658</td>
<td>Saxonberg</td>
</tr>
<tr>
<td>Any stone</td>
<td>In the Adriatic</td>
<td>in 1643</td>
<td>Obin a Worniis</td>
</tr>
<tr>
<td>Any stone</td>
<td>In Danzig</td>
<td>October 1721</td>
<td>Siegesber</td>
</tr>
<tr>
<td>Any stone</td>
<td>In the Adriatic</td>
<td>in 1693</td>
<td>Mischenbueck</td>
</tr>
<tr>
<td>Any stone</td>
<td>In the Adriatic</td>
<td>in 1750</td>
<td>Delalande</td>
</tr>
<tr>
<td>Any stone</td>
<td>near Ville-Franche</td>
<td>September 17th, 1768</td>
<td>Delalande</td>
</tr>
<tr>
<td>Any stone</td>
<td>at Alre in Artois</td>
<td>in 1772</td>
<td>Bachelor</td>
</tr>
<tr>
<td>Any stone</td>
<td>in Le Cotentin</td>
<td>in 1768</td>
<td>Gunson de Boyaval</td>
</tr>
<tr>
<td>Any stone</td>
<td>at Luce in Le Maine</td>
<td>July 4th, 1790</td>
<td>Morand</td>
</tr>
<tr>
<td>Any stone</td>
<td>at Flage in Normandy</td>
<td>July 1794</td>
<td>St. Amand, Bandin, &amp;c.</td>
</tr>
<tr>
<td>Any stone</td>
<td>at Alre in Artois</td>
<td>December 18th, 1795</td>
<td>Earl of Bristol</td>
</tr>
<tr>
<td>Any stone</td>
<td>at Alre in Artois</td>
<td>March 17th, 1793</td>
<td>Captain Topham</td>
</tr>
<tr>
<td>Any stone</td>
<td>at Alre in Artois</td>
<td>February 19th, 1796</td>
<td>Lefebvre and De Dree</td>
</tr>
<tr>
<td>Any stone</td>
<td>at Alre in Artois</td>
<td>December 19th, 1796</td>
<td>Southey</td>
</tr>
<tr>
<td>Any stone</td>
<td>at Alre in Artois</td>
<td>July 28th, 1798</td>
<td>J. Lloyd Williams, Esq.</td>
</tr>
<tr>
<td>Any stone</td>
<td>at Alre in Artois</td>
<td>April 28th, 1800</td>
<td>B. de Born</td>
</tr>
<tr>
<td>Any stone</td>
<td>at Alre in Artois</td>
<td>Very old</td>
<td>Philosophical Magazine</td>
</tr>
<tr>
<td>Any stone</td>
<td>at Alre in Artois</td>
<td>July 1789</td>
<td>Pallis, Chladhi, &amp;c.</td>
</tr>
<tr>
<td>Any stone</td>
<td>at Alre in Artois</td>
<td>November 7th, 1792</td>
<td>Direct, jun. Lomel, &amp;c.</td>
</tr>
<tr>
<td>Any stone</td>
<td>at Alre in Artois</td>
<td>in 1782</td>
<td>Azad de Bourd</td>
</tr>
<tr>
<td>Any stone</td>
<td>at Alre in Artois</td>
<td>March 12th, 1798</td>
<td>De Dree</td>
</tr>
<tr>
<td>Any stone</td>
<td>at Alre in Artois</td>
<td>April 26th, 1803</td>
<td>Fourcroy.</td>
</tr>
</tbody>
</table>

2.0 sulphur
10.5 iron
1.0 nickel
2.0 earths and foreign bodies.

13.5

The spherical bodies,
50.0 silica
15.0 magnesia
34.0 oxide of iron
2.5 oxide of nickel.

101.5

The earthy cement,
48.0 silica
18.0 magnesia
34.0 oxide of iron
2.5 oxide of nickel.

102.5

A stone which fell in Yorkshire, deprived as much as possible of its metallic particles, gave Mr. Howard from 150 grains,
then the same original; and this accordingly is almost the uniform opinion of philosophers. Klaproth has shown, that real native iron

upon the whole, we may consider these stony and metallic masses as fragments of fire-balls which have burst in the atmosphere; but the origin of the fire-balls will perhaps for ages baffle all the attempts of philosophers to explain them.

meteorology, the doctrine of meteors, or the study of the variable phenomena of the atmosphere, in which also is commonly included the art of deducing probable conjectures on the future state of the weather.

the latter branch of this science was successfully cultivated by the ancients; and it subsists at this day among those whom necessity, arising from the nature of their occupations, renders diligent in comparing the present appearances of the atmosphere, and circumstances depending on its present state, with the changes which succeed. The apohysms of Virgil, in his Georgics, are beautiful examples of this kind of skill, and possess authority, in an equal degree with poetical merit.

the atmosphere may be considered in respect of the direction of its currents or winds; of the variations in its gravity or pressure; of the change in its temperature; of the state of the electricity which it exhibits; and lastly, as to the visible phenomena which are supposed to depend on the foregoing; and the regular notation of which, together with the other indications, forms the only successful way of prosecuting this study. Since the invention of philosophical instruments, an attention to these has too much superseded the ancients, and, singly considered, the more rational, way of deducing pro-

winds, though proverbially uncertain in some climates, are yet not without a striking degree of regularity and system, if we consider the whole atmosphere; and there is a wind that goes on so constantly in one quarter, that windward, in common speech, stands for eastern, and leeward for western. We want only a more extensive set of observations to render exceedingly probable the following hypothesis: That a large portion of the whole atmosphere moves constantly from east to west round the earth, on and near the equator; that this is supplied and impelled by air from the temperate zones, which bounds the cold air in the polar regions; the heat and moisture which arise in the tropics, and the greater density of the air near the earth's surface, giving an ascending current, and the heat of the sun, as well as the inequality in the atmosphere, producing a descending current.

this case all the water moves indeed towards the gate; but the successive times of beginning the current are very different from the gate back to the head of the canal. Thus, to produce a north-east storm, I suppose some great rarefraction of the air in or near the Gulf of Mexico; the air rising thence has its place supplied by the next more northern, cooler, and therefore denser and heavier air; a successive current is formed, to which our coast and islands give a north-eastern direction.

one storm was observed by Dr. Mitchell in 1802. It began at Charleston on the 21st February, at two o'clock in the afternoon; at Washington, which lies several hundred miles to the north-east, it was not observed till five o'clock; at New York it began at ten in the evening; and at Albany not till day-break of the 22d. Its motion, from this statement, was 1100 miles in 11 hours, or 100 miles in the hour.

a remarkable storm of the same kind, and accompanied by an easterly wind, was observed in Scotland on the 8th of February 1799. It was attended by a very heavy fall of snow, and the motion of the wind was
Meteorology.

The range of the barometer is greater in winter than in summer. Thus at York the mean range of the barometer, during October, November, December, January, February, March, of the year 1774, was 1.42, and for the six summer months, 1.06.

It is probable that the variations of the barometer, as well as those of the thermometer, are susceptible of what we may term a local character for each tract or country differing in climate. This will be most readily discovered by the following mode of investigation: Prepare a sheet of paper ruled in inches and vertical divisions on it, the horizontal ones agreeing with the inches and decimal divisions of the scale of the barometer; the perpendicular, which may be about twice as distant, representing divisions of time. It will thus be evident when each line of observation is at the de-termining midnight, and to mark the days of the month at the top of the column thus placed. On this scale let the several notations of any register of the barometer be set down by means of a dot for each, placed in the part of the scale where it may point out the time and the elevation. The desired number of such dots as may be, drawn through the series of dots, which will represent its mean value, the course of the barometer for the time. It will be found, on comparing a number of these curves, that they characterize, in a certain degree, not only the latitude and season, but the locality of the observations. So that although the most obvious resemblances may be traced in different years of the same register, yet the general appearance of registers from different climates, will be found to differ in all respects. In this way we may be seen at one view both the correspondence between the latitude or elevation above the sea of any place, and the range at that place; and the coincidence between the movements of the barometer, and the other phenomena of the weather. It is obvious that the same mode, and even the various elevations, must be used to serve for temperature also, by marking degrees upon the horizonal lines, and changing the line of the appearance representing tempera-ture, so as to make it readily distinguishable from the other. There is a correspon-dence in this climate between the two instruments, which will thus often become conspicuous. It consists in an elevation of temperature after a rise of the barometer, and even the very same elevation takes place at two o'clock. The following is a part of the table on which these observations are founded, reduced to the English standard.

<table>
<thead>
<tr>
<th>Places</th>
<th>Years of observation</th>
<th>Morning</th>
<th>Noon</th>
<th>Evening</th>
<th>Year</th>
</tr>
</thead>
<tbody>
<tr>
<td>Arles</td>
<td>8</td>
<td>29.847</td>
<td>29.847</td>
<td>29.843</td>
<td>29.847</td>
</tr>
<tr>
<td>Arras</td>
<td>6</td>
<td>29.803</td>
<td>29.803</td>
<td>29.801</td>
<td>29.807</td>
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<tr>
<td>Bourdeaux</td>
<td>11</td>
<td>29.712</td>
<td>29.835</td>
<td>29.835</td>
<td>29.835</td>
</tr>
<tr>
<td>Cambray</td>
<td>13</td>
<td>29.765</td>
<td>29.875</td>
<td>29.875</td>
<td>29.875</td>
</tr>
<tr>
<td>Chinon</td>
<td>12</td>
<td>29.770</td>
<td>29.875</td>
<td>29.875</td>
<td>29.875</td>
</tr>
<tr>
<td>Dunkirk</td>
<td>8</td>
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<td>29.735</td>
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<tr>
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<tr>
<td>Montpelier</td>
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<tr>
<td>Oberhern</td>
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<td>29.745</td>
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<tr>
<td>Paris</td>
<td>67</td>
<td>29.691</td>
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<td>Poitiers</td>
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<td>29.665</td>
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</tr>
<tr>
<td>Rm. Maurice le Gerard</td>
<td>10</td>
<td>29.649</td>
<td>29.707</td>
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</tr>
<tr>
<td>Troyes</td>
<td>10</td>
<td>29.682</td>
<td>29.741</td>
<td>29.741</td>
<td>29.741</td>
</tr>
</tbody>
</table>

The mean height of the barometer.
METEOROLOGY.

Which the original movement commenced. After a continued gradual rise on the other hand, there usually occurs a similar depression. Experiments prove that the rising movement is the more rapid of the two. The undulations which are to be found in the curve corresponding to the interval between the phases of the moon, are often accompanied by the appearance of some smaller ones, which appear to be due to occasional and less extensive causes.

It happens also from some principle of the kind above stated, that these movements, which in fair and moderate weather proceed with considerable regularity, on being disturbed by storms, e a not resumed suddenly but by degrees, and the interruption is perceptible for a considerable space afterwards.

In long periods of wet weather, the barometer usually keeps about the mean altitude, rising and falling through a short space with little regularity.

In serene and settled weather it is generally high; and in low calm weather, when the air is inclined to rain, it sinks on high winds, rises highest on easterly and northerly winds, and sinks at the wind from the south. At Calcutta, it is always highest when the wind blows from the north-west and north, and lowest when it blows from the south-east.

Such are the phenomena respecting the variations of the barometer, as far as they can be reduced under general heads. Various attempts have been made to explain them, but hitherto without any great degree of success. The theory of Mr. Laplace appears by far the most plausible, though it is not sufficient to explain all the facts. The following observations may be considered as a kind of abstractive of his theory, except in one or two instances.

It is evident, that the density of the atmosphere is least at the equator, and greatest at the poles; for at the equator, the centrifugal force, the distance from the centre of the earth, and the height of the barometer, are at their maximum, while at the pole they are at their minimum. The mean height of the barometer at the level of the sea, all over the globe, is about 77 inches; and on that account, the density of the atmosphere is the same all over the globe. The weight of the atmosphere depends on its density and height; where the density of the atmosphere is greatest, its height must be least; and, on the contrary, where its density is least, its height must be the greatest. The height of the atmosphere, therefore, must be greatest at the equator, and least at the poles; and it must decrease gradually between the equator and the poles, so that its upper surface will resemble two inclined planes, meeting above the equator in their highest part.

During summer, when the sun is in our hemisphere, the mean heat between the equator and the pole does not differ so much as in winter. Indeed, the heat of northern countries at that time equals the heat of the torrid zone; thus in Russia, during July and August, the thermometer rises to 83°. Hence the early of the atmosphere at the pole, and consequently its height, will be increased.

The upper surface of the atmosphere, therefore, in the northern hemisphere, will be less inclined, while that of the southern hemisphere, from contrary causes, will be much more inclined. The very reverse will take place during our winter.

The density of the atmosphere depends in a great measure on the pressure of the superincumbent column; and therefore decreases, according to the height, as the pressure of the superincumbent column continually decreases. But the density of the atmosphere in the torrid zone will not decrease so fast as in the temperate and frigid zones; because its column is longer, and therefore there is a greater proportion of air in the higher part of this column. This accounts for the observation of Mr. Cassini, that the barometer only sinks half as much for every 200 feet of elevation in the torrid as in the temperate and frigid zones.

The density of the atmosphere at the equator, therefore, though at the surface of the earth it is less, must at a certain height equal, and at a still greater distance, the density of the atmosphere in the temperate zones and at the poles.

A current of air is constantly ascending at the equator, and part of it at least reaches and continues in the higher parts of the atmosphere. From this, we may conclude, it is evident, that it cannot accumulate above the equator, but must roll down the inclined plane which the upper surface of the atmosphere assumes towards the poles. As the superincumbent column of the northern hemisphere is more inclined during our winter than that of the southern hemisphere, a greater quantity of the equatorial current of air must flow over upon the northern than upon the southern hemisphere; and the density of our atmosphere will be greater during winter than that of the southern hemisphere: but during summer the very reverse will take place. Hence the greatest mercurial heights take place during winter, and the range of the barometer is less in summer than in winter.

At the heat in the torrid zone never differs much, the density, and consequently the pressure and the weight of the atmosphere, are about the same all over the globe. Hence the range of the barometer within the tropics is comparatively small; and it increases gradually as we approach the poles, because the difference of the temperature and the density of the atmosphere, increases with the latitude.

The diurnal elevation of the barometer in the torrid zone corresponding to the tides, observed by Mr. Cassini and others, must be owing to the influence of the moon on the atmosphere. This influence, notwithstanding the ingenious attempts of D'Alembert and several other philosophers, seems altogether inadequate to account for the various phenomena of the wind. It is not so easy to account for the tendency which the barometer has to rise as the day advances, which seems to be established by Mr. Cotte's table. Perhaps it may be accounted for by the additional quantity of vapour added to the atmosphere, which, by increasing the quantity of the atmosphere, may possibly be adequate to produce the effect.

The falls of the barometer which precede and follow the great oscillations which accompany, the recent storms and hurricanes, show us, that these phenomena are produced by very great rarefactions, or perhaps destruction of air, in particular parts of the atmosphere. The falls of the barometer, too, that accompany winds, proceed from the same cause.

That the temperature of the air varies considerably, not only in different climates and in different seasons, but even in the same place and in the same season, must be obvious to the most careless observer. This terrestrial variation cannot be ascribed to the direct heat of the sun; for the rays of that luminary seem to produce no effect whatever upon air, though ever so much concentrated; but they warm the surface of the earth, which communicates its heat to the surrounding atmosphere. Hence it happens, that the temperature of the air is highest in those places which are situated to be most warmed by the sun's rays, and that it varies in every region with the season of the year. Hence too the reason why it diminishes according to the height of the air above the surface of the earth. That portion of the earth which lies at the equator, is exposed to the most perpendicular rays of the sun. Of course it is hottest, and the heat of the earth diminishes gradually from the equator to the poles.

The temperature of the air must follow the same order. The air, then, is hottest at the equator, and becomes progressively cooler as it increases from the equator, and its height, according to its height above that portion of the earth which lies at the equator, for the two diminishing progressions of temperature.

1. Though the temperature of the air is highest at the equator, and gradually sinks as we ascend towards the poles, it must not vary much. Hence the range of the barometer within the tropics is comparatively small, and it increases gradually as we approach the poles, because the difference of the temperature and the density of the atmosphere, increases with the latitude.

Hence the mean annual temperature of any degree of latitude, must be greater at the equator than at the poles, the same being true of every other portion of the earth. Hence the mean annual temperature of every degree of latitude, must be greater at the equator than at the poles, the same being true of every other portion of the earth.

This first discovered by Mr. Mayer; and by means of an equation which he founded on it, but rendered considerably plainer and simpler, Mr. Kirwan has calculated the mean annual temperature of every degree of latitude between the equator and the pole. He proceeded on the following principle: Let the mean annual heat at the equator be \( m \), and at the pole \( n \); and for any other latitude, the mean annual temperature of that latitude will be \( m - n \times \sin^2 \theta \). If the temperature of any two latitudes is known, the value of \( m \) and \( n \) may be found. Now the temperature of north latitude \( 40^\circ \) has been found by the best observations to be 0.1°, and that of latitude \( 50^\circ \), 52°. The square of the sine of \( 40^\circ \) is nearly 0.410, and the square of the sine of \( 50^\circ \) is nearly 0.509.

\[
\begin{align*}
    m &\approx 0.41 \times m^n \approx 0.41, \\
    m &\approx 0.58 m^n 52.9, \\
    m &\approx 0.58 n^2 40.9, \\
    m &\approx 0.58 n^2 50.9. \\
\end{align*}
\]

Each of these equations is equal
Table of the Mean Annual Temperature of the Standard Station from to . From this last equation the value of is found to be 53 nearly; and as is nearly equal to 84. The mean temperature of the equator, therefore, is 84°, and that of the pole 31°. To find the mean temperature for every other latitude, we have only to find 88 arithmetic means between 84 and 31. In this manner Mr. Kirwan calculated the following table:

<table>
<thead>
<tr>
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</thead>
<tbody>
<tr>
<td>30</td>
<td>31</td>
<td>32</td>
<td>33</td>
<td>34</td>
<td>35</td>
</tr>
</tbody>
</table>

This table, however, only answers for the temperature of the atmosphere of the ocean. It was calculated for the part of the Atlantic Ocean which lies between the 80th degree of northern and the 45th of southern latitude, and extends westward, as far as the Gulf-stream, and to within a few leagues of the coast of America, and for all that part of the Pacific Steam reaching from latitude 45° north to latitude 40° south, from the 20th to the 27th degree of longitude east of London. This part of the ocean Mr. Kirwan calls the standard; the rest of the ocean is subject to anomalies which will be afterwards mentioned.

Mr. Kirwan has also calculated the mean monthly temperature of the standard ocean. The mean temperature on the average appears to

The mean temperature of April seems to approach very nearly to the mean annual temperature; and as far as heat depends on the action of the solar rays, the mean heat of every month is as the mean altitude of the sun, or rather as the sine of the sun's altitude. The mean heat of April, therefore, and the sine of the sun's altitude, being given, the mean heat of every other month results from the following formula:


tins

The temperature of these months, therefore, must be looked upon as an arithmetical mean between the astronomical and terrestrial heats. Thus, in latitude 51°, the astronomical heat of the month of September is 44°, and the mean annual heat is 32°; therefore the real heat of this month should be

TABLE of the Monthly Mean Temperature of the Standard from to .

<table>
<thead>
<tr>
<th>Lat.</th>
<th>60°</th>
<th>60°</th>
<th>60°</th>
<th>60°</th>
<th>60°</th>
<th>60°</th>
<th>60°</th>
<th>60°</th>
<th>60°</th>
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<th>60°</th>
</tr>
</thead>
<tbody>
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<td>33°</td>
<td>34°</td>
<td>35°</td>
<td>36°</td>
<td>37°</td>
<td>38°</td>
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<td>42°</td>
</tr>
<tr>
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<td>22°</td>
<td>23°</td>
<td>24°</td>
<td>25°</td>
<td>26°</td>
<td>27°</td>
<td>28°</td>
<td>29°</td>
<td>30°</td>
<td>31°</td>
<td>32°</td>
</tr>
<tr>
<td>March</td>
<td>38°</td>
<td>39°</td>
<td>40°</td>
<td>41°</td>
<td>42°</td>
<td>43°</td>
<td>44°</td>
<td>45°</td>
<td>46°</td>
<td>47°</td>
<td>48°</td>
<td>49°</td>
</tr>
<tr>
<td>April</td>
<td>42°</td>
<td>43°</td>
<td>44°</td>
<td>45°</td>
<td>46°</td>
<td>47°</td>
<td>48°</td>
<td>49°</td>
<td>50°</td>
<td>51°</td>
<td>52°</td>
<td>53°</td>
</tr>
<tr>
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<td>54°</td>
<td>55°</td>
<td>56°</td>
<td>57°</td>
<td>58°</td>
<td>59°</td>
<td>60°</td>
<td>61°</td>
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<td>64°</td>
</tr>
<tr>
<td>June</td>
<td>65°</td>
<td>66°</td>
<td>67°</td>
<td>68°</td>
<td>69°</td>
<td>70°</td>
<td>71°</td>
<td>72°</td>
<td>73°</td>
<td>74°</td>
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<td>76°</td>
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<tr>
<td>July</td>
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<td>79°</td>
<td>80°</td>
<td>81°</td>
<td>82°</td>
<td>83°</td>
<td>84°</td>
<td>85°</td>
<td>86°</td>
<td>87°</td>
<td>88°</td>
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<tr>
<td>August</td>
<td>89°</td>
<td>90°</td>
<td>91°</td>
<td>92°</td>
<td>93°</td>
<td>94°</td>
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<td>96°</td>
<td>97°</td>
<td>98°</td>
<td>99°</td>
<td>100°</td>
</tr>
</tbody>
</table>

After going through a tedious calculation, found the result to agree so ill with observation, that he drew up the following table, partly from principles, and partly by studying a variety of sea journals:
From this table it appears, that January is the coldest month in every latitude, and that July is the warmest month in all latitudes above 48°. In lower latitudes, August is generally warmest. The difference between the hottest and coldest months increases in proportion to the distance from the equator. Every habitable latitude enjoys a mean heat of 60° for at least two months; this heat seems necessary for the production of corn. Within ten degrees of the poles the temperatures vary very little; neither do they differ much within ten degrees of the equator: the temperatures of different years differ very little near the equator; but they differ more and more as the latitudes approach the poles.

2. That the temperature of the atmosphere gradually diminishes, according to its height above the level of the sea, is well known. Thus the late Dr. Hutton, of Edinburgh, found, that at a thermometer, kept on the top of Arthur's-seat, usually stood three degrees lower than a thermometer kept at the bottom of it. Hence, then, a height of 800 feet occasioned 3° of diminution of temperature. On the summit of Pichincha, the thermometer stood at 3°, as observed by Bouger; while at the level of the sea, in the same latitude, it stood at 84°. Here a height of 15564 feet occasioned a diminution of temperature, amounting to 47°. But though there can be no doubt of the gradual diminution of temperature, according to the height, it is by no means easy to determine the rate of diminution. Euler supposes it to be in a harmonious proportion; but this supposition is contradicted by observations. Sauvage supposes, that in temperate climates the diminution of temperature amounts to 1° for every 287 feet of elevation. But Mr. Kirwan has shewn that no such rule holds, and that the rate of diminution varies with the temperature at the surface of the earth. We are indebted to this philosopher for a very ingenious method of determining the rate of diminution in every particular case, supposing the temperature at the surface of the earth known.

Since the temperature of the atmosphere is constantly diminishing as we ascend above the level of the sea, it is obvious, that at a certain height we arrive at the region of perpetual congelation. This region varies in height according to the latitude of the place; it is highest at the equator, and descends gradually nearer the earth as we approach the poles. It varies also according to the season, being highest in summer, and lowest in winter. M. Bouger found the cold on the top of Pichincha, one of the Andes, to extend from seven to nine degrees below the freezing-point every morning immediately before sunrise. He concluded, therefore, that the mean height of the term of congelation (the place where it freezes during some part of the day all the year round) between the tropics was 15,577 feet above the level of the sea; but in latitude 28° he placed it in summer at the height of 13,449 feet. Now, if we take the difference between the temperature of the equator and the freezing-point, it is evident that it will bear the same proportion to the term of congelation at the equator, that the difference between the mean temperature of any other degree of latitude and the freezing-point bears to the term of congelation in that latitude. Thus the mean heat of the equator being 64°, the difference between it and 32 is 32, the mean height of latitude 28° is 72.3°; the difference between which and 32 is 40.3°; then 15,577 \cdot 40.3 = 12072. In this manner Mr. Kirwan calculated the following table:

<table>
<thead>
<tr>
<th>Lat.</th>
<th>Mean height of the term of congelation</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>15377</td>
</tr>
<tr>
<td>5</td>
<td>15437</td>
</tr>
<tr>
<td>10</td>
<td>13007</td>
</tr>
<tr>
<td>15</td>
<td>12088</td>
</tr>
<tr>
<td>20</td>
<td>12408</td>
</tr>
<tr>
<td>25</td>
<td>13719</td>
</tr>
<tr>
<td>30</td>
<td>13203</td>
</tr>
<tr>
<td>35</td>
<td>11392</td>
</tr>
<tr>
<td>40</td>
<td>10064</td>
</tr>
<tr>
<td>45</td>
<td>9016</td>
</tr>
<tr>
<td>50</td>
<td>7683</td>
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<tr>
<td>60</td>
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</tr>
<tr>
<td>65</td>
<td>3084</td>
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<tr>
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<td>75</td>
<td>1357</td>
</tr>
<tr>
<td>80</td>
<td>748</td>
</tr>
</tbody>
</table>

Beyond this height, which has been called the lower term of congelation, and which must vary with the season and other circumstances, M. Bouger has distinguished another, which he called the upper term of congelation; that is, the point above which no visible snow ascends. Mr. Kirwan considers this line as much less liable to vary during the summer months than the lower term of congelation, and therefore has made choice of it to determine the rate of the diminution of heat, as we ascend in the atmosphere. Bouger determined the height of this term in a single case, and Kirwan has calculated the following table of his height for every degree of latitude in the northern hemisphere:

<table>
<thead>
<tr>
<th>Lat.</th>
<th>Feet.</th>
<th>Lat.</th>
<th>Feet.</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>28000</td>
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<td>27784</td>
</tr>
<tr>
<td>5</td>
<td>27784</td>
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</tr>
<tr>
<td>10</td>
<td>27749</td>
<td>15</td>
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</tr>
<tr>
<td>15</td>
<td>27040</td>
<td>20</td>
<td>26664</td>
</tr>
<tr>
<td>20</td>
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<tr>
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</tr>
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<td>28830</td>
</tr>
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</tr>
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<td>29460</td>
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</tr>
<tr>
<td>75</td>
<td>29800</td>
<td>80</td>
<td>30160</td>
</tr>
</tbody>
</table>

The following rule of Mr. Kirwan will enable us to ascertain the height at any required temperature, provided we know the temperature at the surface of the earth.

Let the observed temperature at the surface of the earth be \( t \), the height given \( h \), and the height of the upper term of congelation for the given latitude be \( z \); then \( h = z + \frac{100}{t} \).

This rule is evidently derived from the rule of the preceding paragraph, and is calculated by supposing the temperature of every degree of latitude to be the same as at the equator, and that the temperature of the equator is equal to the mean temperature of the same degree of latitude.

The temperature required by this rule is obviously that of the lower term of congelation. An example will make this rule sufficiently obvious. In latitude 56°, the heat below being 34°, required the temperature of the air at the height of 500 feet! This theorem is called the principle of the action and reaction of the atmosphere, and is a fundamental theorem in hydrostatics.
METEOROLOGY.

Here \( a = 54 \), \( r = 5339 \), \( n = 52 \) \( \frac{a}{100} = 0.401 \), and \( \frac{r}{100} = 0.401 \times 8.03 \) \( \frac{r}{100} = 8.03 \times \frac{a}{100} = \frac{a}{100} = 5.27 \).

From this method of estimating the diminution of temperature, which agrees remarkably well with observation, we see that the heat diminishes in an arithmetical progression. Hence it follows, that the heat of the air at a distance from the earth is not coming to the ascent of hot strata of air from the surface of the earth, but to the conducting power of the air.

3. This rule, however, applies only to the temperature of the air during the summer months of the year. In winter the upper strata of the atmosphere are often warmer than the lower. There, on this 31st of January, 1776, the thermometer on the summit of Arthur's-seat stood six degrees higher than a thermometer at Hawkhill, which is 834 feet lower. Mr. Kirwan considers his observation, almost uniformly observed during winter, to be a current of warm air from the equator, which rolls towards the pole north during our winter.

4. Such, then, is the general method of finding the mean annual temperature over the globe. There are, however, several exceptions to these general rules, which I now come to mention.

That part of the Pacific Ocean which lies between north latitudes 10° and 60°, is no colder at its northern extremity than 42 miles, and at its southern extremity than 1300 miles; it is reasonable to suppose, therefore, that its temperature will be considerably influenced by the surrounding land, which consists of ranges of mountains covered a great part of the year with snow; and there are besides a great many high, and consequently cold, islands scattered through it. For these reasons Mr. Kirwan concludes, that the temperature is at least four or five degrees below the standard. But we are not yet furnished with a sufficient number of observations to determine this with accuracy.

It is the general opinion, that the southern hemisphere, beyond the 40th degree of latitude, is considerably colder than the corresponding parts of the northern hemisphere. Mr. Kirwan has shown that this holds with respect to the summer of the southern hemisphere, but that the winter in the same latitudes is milder than in the northern hemisphere.

Small seas surrounded with land, at least in temperate and cold climates, are generally warmer in summer and colder in winter than the standard ocean, because they are a good deal influenced by the temperature of the land. The gulf of Bothnia, for instance, is for the most part frozen in winter; but in summer it is sometimes heated to 79°, a degree of heat never to be found in the opposite part of the Atlantic. The German Sea is above three degrees colder in winter, and five degrees warmer in summer, than the Atlantic. The Mediterranean Sea is, for the greater part of its extent, warmer both in summer and winter than the Atlantic, which therefore flows into it. The Black Sea is colder than the Mediterranean, and flows into it.

The eastern parts of North America are much colder than the opposite coast of Europe, and fall short of the standard by about 10° or 12°. On the American side of the air 500 feet above the surface of the earth it is 57° and 72°.

From this method of estimating the diminution of temperature, which agrees remarkably well with observation, we see that the heat diminishes in an arithmetical progression. Hence it follows, that the heat of the air at a distance from the earth is not coming to the ascent of hot strata of air from the surface of the earth, but to the conducting power of the air.

3. This rule, however, applies only to the temperature of the air during the summer months of the year. In winter the upper strata of the atmosphere are often warmer than the lower. There, on this 31st of January, 1776, the thermometer on the summit of Arthur's-seat stood six degrees higher than a thermometer at Hawkhill, which is 834 feet lower. Mr. Kirwan considers his observation, almost uniformly observed during winter, to be a current of warm air from the equator, which rolls towards the pole north during our winter.

4. Such, then, is the general method of finding the mean annual temperature over the globe. There are, however, several exceptions to these general rules, which I now come to mention.

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the earth is also probably less frequent from cloud to cloud. The far greater part of the visible phenomena of the weather, after which, being raised by evaporation, is transported from place to place in vapour, and which, physically speaking, is a proper component part of the air. When any means a portion of this is deposited at its confluence, it reappears in minute drops, which are at first uniformly diffused, and lessen the transparency of the air in proportion to their abundance. By the report of those who have ascended the highest mountains, or performed acroatic voyages, there is usually a sufficient quantity of this diffused water, especially towards evening, to become visible from above as a sea of haze. It should seem that this is, in fact, the veil which, being drawn over the sable of the sky, converts it to a blue of various degrees of intensity; or at least that it shares with the transparent air in this effect.

The next stage is either dew, or rather haze, for the latter term is more appropriate to the appearance of dew while it is falling. Here the drops have so far become collected as to form an aggregate faintly defined in the air. To this stage of the phenomena may be reduced under the general term cloud. Out of the latter are formed rain, snow, and hail, by which the product of evaporation is finally restored to the earth. The excess for any given time, of the fall of rain or snow which is evaporated, passes off by the springs and rivers to that grand reservoir which forms the far greater part of the surface of the globe.

Tracts of forest, especially if mountainous, invite the rain, and protect the springs; while the accumulated heat on cultivated plains often causes the clouds to pass over them, or to be dissipated. Clearing of land and culture, therefore, tends to lessen the rain and the rivers; but it is for the interest of agriculture to leave a certain quantity of timber growing, especially in springy lands, and to repair the waste of it by planting; for it is not impossible, that in a series of ages, the atmosphere, in a manner so prepared, may convert a tract of fruitful country into one little better than an African desert.

The mean annual quantity of rain is greatest at the equator, and decreases gradually as we approach the poles. Thus at Granada, Andalusia, 12° N., it is 126 inches Cape Francois, St. Domingo — 19° 46' — 120
Calcutta — 22° 23' — 81
Rome — 41° 54' — 30
England — 33' — 32
Petersburg — 59° 16' — 16.

On the contrary, the number of rainy days is smallest at the equator, and increases in proportion to the distance from it. From north latitude 12° to 43°, the mean number of rainy days is 78; from 43° to 46° the mean number is 103; from 46° to 50° it is 134; from 51° to 60°, 161.

The number of rainy days is often greater in winter than in summer; but the quantity of rain is greater in summer than in winter. At Petersburg the number of rainy or snowy days during winter is 81, and the quantity which falls is 30 inches; while during summer the number of rainy days is nearly the same, but the quantity which falls is about 11 inches.

**METEOROLOGY.**

More rain falls in mountainous countries than in plains. Among the Andes it is said to rain almost perpetually; while in Egypt it falls only 134 times in 46 years; and that which is deposited on the ground, and another at some height perpendicularly above it, more rain will be collected into the lower than into the higher; a proof that the quantity of rain increases as it descends, owing perhaps to the drops attracting vapour during their passage through the lower strata of the atmosphere where the greatest quantity resides. This, however, is not always the case, as Mr. Copland demonstrates by the course of his experiments. He observed also, when the quantity of rain collected into the lower gauge was greatest, the rain commonly continued for some time; and that the greatest quantity was collected in the higher gauge only either at the end of great rains, or during rains which did not last long. These observations are important; and may, if followed out, give us new knowledge of the causes of rain. He observes, that during rain the atmosphere is somewhere or other brought into a state which induces it to part with its moisture; and that the rain continues as long as this state continues. The following appears to have been made on this subject in different places, and was the atmosphere carefully analysed during dry weather, during rain, and immediately after rain, we might soon perhaps discover the reason of the latter.

Rain falls in all seasons of the year, at all times of the day, and during the night as well as the day; though, according to M. Tosillo, a greater quantity falls during the day than the night. The cause of rain then, whatever it may be, must be something which operates at all times and seasons. Rain falls also during the continuance of every wind, but oftenest when the wind blows from the south. Falls of rain often happen likewise during perfect calms.

It appears from a paper published by M. Cotte in the Journal de Physique for Oct. 1791, containing the mean quantity of rain falling at 147 different places, the lat. 11° and 60°, derived from tables kept at these places, that the mean annual quantity of rain falling in all these places is 34.7 inches. Let us suppose then (which cannot be very far from the truth) that the mean annual quantity of rain for the whole globe is thirty-four inches. The superficies of the globe consists of 170,681,012 square miles, or 685,461,408,471,500,000 square inches. The quantity of rain therefore falling annually will amount to 53,337,650,815,020,15,800 cubic inches, or somewhat more than 91,751 cubic miles of water.

The dry land amounts to 33,745,253 square miles; the quantity of rain falling on it annually therefore will amount to 30,960 cubic miles. The quantity of water running annually into the sea is 13,140 cubic miles; a quantity of water equal to which must be supplied by evaporation from the sea, otherwise the land would soon be completely drained of its moisture.

The quantity of rain falling annually in Great Britain may be seen from the following table, which is compiled between north lat. 51° and 54°.

<table>
<thead>
<tr>
<th>Country</th>
<th>Mean ann. depth</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cumberland</td>
<td>67</td>
</tr>
<tr>
<td>Carlisle</td>
<td>20</td>
</tr>
<tr>
<td>Westmoreland</td>
<td>59</td>
</tr>
<tr>
<td>Kendal</td>
<td>11</td>
</tr>
<tr>
<td>Fells, 8</td>
<td>55</td>
</tr>
<tr>
<td>Wolfield</td>
<td>55</td>
</tr>
<tr>
<td>Wakefield</td>
<td>56</td>
</tr>
<tr>
<td>Lancaster</td>
<td>40</td>
</tr>
<tr>
<td>Liverpool</td>
<td>34</td>
</tr>
<tr>
<td>Manchester</td>
<td>32</td>
</tr>
<tr>
<td>Townley</td>
<td>41</td>
</tr>
<tr>
<td>Cravawaloon,</td>
<td>65</td>
</tr>
<tr>
<td>near Hamburg,</td>
<td>80</td>
</tr>
<tr>
<td>Gloucester</td>
<td>30</td>
</tr>
<tr>
<td>Brant, 9</td>
<td>20</td>
</tr>
<tr>
<td>Somersetshire</td>
<td>20</td>
</tr>
<tr>
<td>Bridgewater,</td>
<td>30</td>
</tr>
<tr>
<td>Cornwall</td>
<td>41</td>
</tr>
<tr>
<td>Ludgarn, near Mount's Day</td>
<td>5 years</td>
</tr>
</tbody>
</table>

The general mean is 32.9 inches. As the places subject to much rain predominate considerably in this list, it will probably be nearer the truth, if we take the mean annual rain in England and Wales at a quantity not exceeding 32 inches.

In this country it generally rains less in March than in November, in the proportion of 7 to 12. It generally rains less in April than October in the proportion of 1 to 2. In winter rain is generally less than in summer; and when it rains less in May than in September, the chances that it does so are at least 14 to 3: but when it rains plentifully in May (as 1.8 inches or more), it generally rains but little in September; and when it rains plentifully in May, it rains plentifully in September.

Snow is evidently formed by a process of regular crystallisation among minute frozen particles of water floating in the air. It is remarkable, that previous to, and during, the fall of snow in quantity, the temperature continues about 32°. It should seem that the evolution of the constituent caloric of the water produces the same effect when ice is formed in the atmosphere, as when it is formed in water. The structure of a crystal of snow demonstrates that a drop of rain is also formed by the union of a great number of smaller drops. When these come together in the act of freezing, and suddenly form a nucleus of white spongy ice, which, by its extreme coldness, becoming incrustated with clear ice from the water it collects in its descent, constitutes hail as we usually see it. Sometimes, however, the nucleus falls uncrustated, which is a prognosis of sharp jOets.

Hail has been likewise observed perfectly transparent, and having the form of an oblate spheroid, showing that it consisted
METEOROLOGY.

There are three simple and distinct modifications, in any one of which the aggregate of the parts of the cloud, may become increased to its greatest extent, and finally decrease and disappear.

By modification is to be understood simply the structure or manner of aggregation, not the precise form or magnitude, which varies every moment in most clouds. The principal modifications are commonly as distinguishable from each other as a tree from a bush, or the latter from a leaf; although clouds may be continuous, or separate, with respect to each other, have often only the common residuum which exist among trees, hills or lakes, taken generally.

The same aggregate, which has been formed in one modification, upon a change in the attendant circumstances may pass into another.

Or it may continue a considerable time in an intermediate state, partaking of the characters of two or three; and it may also disappear in this stage, or return to the first modification.

Lastly, aggregates, separately formed in different modifications, may unite and pass into one, exhibiting different characters; or a portion of a simple aggregate may pass into another modification, without separating from the remainder of the mass. Hence, together with the simple, it becomes necessary to admit intermediate compound modifications, and to impose names on such of them as are worthy of notice.

The simple modifications are thus named and defined: (See Plate Meteorology.)


Parallel, flexuous, or diverging fibres, extensible in any or in all directions.


Craves or crenat crescents, increasing upward from a horizontal base.


A widely extended, continuous, horizontal sheet, increasing from below.

The intermediate modifications which require to be noticed are:


Small, well defined, roundish masses, in close horizontal arrangement.


Horizontal or slightly inclined masses, attenuated towards a part or the whole of their circumference, concave downward; or undulated, separate, or in groups, consisting of small clouds, having these modifications.

The compound modifications are:

6. Cumulo-stratus. Def. Nubes dense, basin cumuli cum strauctura patentia exhibentes. A dense cloud with the base of the cumulus, but in its upper part extended into a broad flat structure.


The rain cloud. A cloud, or system of clouds, from which rain is falling. It is a horizontal sheet, above which the cirrus spreads, while the cumulus extends laterally, and from it.

Of the cirrus.

Clouds in this modification have the least density, the greatest elevation, and the greatest variety of extent and direction. They are the earliest appearance after severe weather. They are generally indicated by a few threads pencilled, as it were, much in the same way that black inks are delineated. These increase in length, and new ones are at times added likewise. Often the first formed 1 threads serve as stems to support numerous branches, which in their turn give rise to others. The process is usually compared to vegetation or to crystallisation; but it is clearly analogous to the delicate arrangements which exist in the particles of coloured powders, such as chalk, vermilion, &c, when these are projected on a deck of wax, after it has been touched with the knife of a charged Leyden phial. We may consider the particles of water as similarly placed upon or beneath a state of charged air.

Their duration is uncertain, varying from a few minutes after the first appearance to an extent of many hours. It is long when they appear alone, and at great heights, and shorter when accompanied by other, and in the vicinity of other clouds.

This modification, although in appearance almost motionless, is intimately connected with the variable motions of the atmosphere.想像 that cloud of this kind have long been deemed a prophecy of storm. Continued wet weather is attended with horizontal sheets of this cloud, which subsequently, and pass to the cirro-stratus. The cirrus pointing upward is a distant indication of rain, and downward a more immediate or present weather. Before storms they appear lower, denser, and usually in the quarters opposite to those by which the storm arises. Steady high winds may also preceded and attended by streaks running quite across the direction in which they blow. These, by an optical deception, appear to meet in the horizon.

The relations of this modification with the state of the barometer, thermometer, hygrometer, and electroscope, have not yet been attended to.

Of the cumulus.

Clouds in this modification are commonly of the most dense structure. They are formed in the lower atmosphere, and move along with the current which is next the earth.

A small irregular spot first appears, and is as it were the nucleus on which they increase. The lower surface continues irregularly plane, while the upper rises into conical or hemispherical heads.

Their appearance, increase, and disappearance, in fair weather, are often periodic, and keep pace with the temperature of the day. They begin to form after some hours before sunrise, arrive at their maximum at the hottest part of the afternoon, then go on diminishing, and totally disappear about sunset.

But in changeable weather they partake of
of subsidence, as in common cases of precipitation in fluids at rest.

Of the cumulo-stratus.

The different modifications which have been just treated of, sometimes give place to each other: at other times two or more appear in the same sky; but in this case the clouds are in the same modal form, and are in the same plane of elevation, those which are more elevated appearing through the intervals of the lower, or the latter showing dark against the lighter ones above them. When the cumulus increases rapidly, a cirro-stratus is frequently seen to form around its summit, rising thereon as on a mountain; while the former cloud continues discernible in some degree through it. This state continues but a short time. The cirro-stratus quickly becomes denser, and spreads; while the superior part of the cumulus extends itself, and passes into it, the base continuing as before, and the convex protruberances changing their position till they precede, move laterally, and downward. More rarely the cumulo-stratus alone performs this evolution, by the movement or mode of increase of its superior part. In either case, a large lofty dense cloud is formed, which may be compared to a mushroom with a very thick stem. It appears to be preceded by a current of rarefied air, or to pass the cirrus or cirro-stratus. The cirro-cumulus is frequent in summer, and is attendant on warm and dry weather. It is also occasionally, and more sparingly, seen in the intervals of showers, and in winter. A cloud is a sure prognostic of increased temperature. The cumulus is the cloud of the day, of the heavens, or of the air. The cumulus is never seen in the fortune of any other cloud, or to pass the cirrus or cirro-stratus.

Of the cirro-stratus.

This cloud appears to result from the subidence of the fibres of the cirrus to a horizontal position, at the same time that they approach towards each other laterally. The cumulus and stratus are separated by a distance, frequently give the idea of sheets of fish. Yet in this, as in other instances, the structure must be attended to, rather than the form, which varies much; presenting at other times the appearance of parallel bars, interwoven streaks like the grain of polished wood, &c. It is always thickest in the middle, or at one extremity, and extended towards the edge. The distinct appearance of these clouds depends always on the production of this and the last modifications.

The cirro-stratus precedes wind and rain, the near or distant approach of which may sometimes be estimated from its greater or less abundance and permanence. It is almost always to be seen in the intervals of storms. Sometimes this and the cirro-cumulus appear together in the sky, and even alternate with each other in the same cloud, when the different evolutions which ensue are a curious spectacle; and a judgment may be formed of the weather likely to ensue, by observing which modification prevails at last. The cirro-stratus is the modification which most frequently and completely exhibits the phenomena of the solar and lunar halo, and (as supposed from a few observations) the parhelion and paraseleune also. Hence the reason of the prognostic for foul weather commonly drawn from the appearance of halo. This cloud is among those natural indications which may be used as the criterion of the indications of the barometer and hydrometer for rain. It may be reasonably thought to originate from a supervening cold and moist current, occluding precipitation in the atmosphere below, before it is itself to be perceived. Its appearance often indicates the simple act of subsidence, as in common cases of precipitation in fluids at rest.
commences; and the lower clouds, arriving from the windward, move under this sheet, and are successively lost in it. When the latter has parted, or when the sheet breaks, every one's experience teaches him to expect an abatement or cessation of rain. But there often follows, what seems hitherto to have been unnoticed, an immediate and great addition to the quantity of clouds on the cessation of rain, the lower broken clouds which remain rise into cumuli, and the superior sheet puts on the various forms of the cirro-stratus, sometimes passing to the cirrus-cumulus.

If the interval is long before the next shower, the cumulo-stratus usually makes its appearance, which it also does sometimes very suddenly after the first cessation.

But we see the nature of this process more perfectly, in viewing a distant shower in profile.

If the cumulus be the only cloud present at such a time, we may observe its superior part to be momentarily tufted with cirrus. Several adjacent clouds also approach, and unite laterally by subduction.

The cirri increase, extending themselves upward and laterally; after which the shower is seen to commence. At other times the cumulus may have been described relative to the cessation of rain. The cirro-stratus is previously formed above the cumulus; and their sudden union is attended with the production of cirri and rain.

In either case the cirri vegetate, as it were, in proportion to the quantity of rain falling; and give the cloud a character by which it is easily known at great distances, and to which, in the language of meteorology, we may appropriate the nimbus of the Latin:

Quinis ubi ad terras abrupto sidere nimbus
It mare per medium; miraris, heu! prescia longe
Horrescunt cordis agricolæ.—Virgil

When one of these arrises hastily with the wind, it brings but little rain, and frequently some hail or driven snow. In heavy showers the cloud, once formed, increases to windward, the cirri being propagated above and against the lower current, while the cumuli, arriving with the latter, are successively arrested in their course, and contribute to reinforce the shower.

In continued gentle rains it does not appear necessary, for the resolution of the clouds, that the different modifications should come into actual contact. It is sufficient, that there exist two strata of clouds, one passing beneath the other, and each continually tending to horizontal uniform diffusion. It will rain during this state of the two strata, although they should be separated by an interval of many hundred feet in elevation.

As the masses of cloud are always blended, and their arrangement destroyed, before rain comes on, so the reappearance of those is the signal for its cessation. The thin sheets of cloud which pass over during a cloudy day, certainly receive from the humid atmosphere a supply proportionate to their consumption; while the latter prevents their increase in bulk. Hence a seeming paradox, which yet accounts with observation; that for any given hour of a wet day, or any given day of a wet season, the more cloud the less rain. Hence also arise some further reflections on the purpose answered by clouds in the economy of nature. Since rain may be produced by great cold, to fall from the slightest obstruction of the sky, by the nimbus, that is, by two sheets in different states, while the cumulus, or cumulo-stratus, with the most dark and threatening aspect, passes over without letting fall a drop, until their change of state commences; it should seem that the latter are the reservoirs, in which the water is collected from a large space of atmosphere, for occasional and local irrigation in dry seasons, and by means of which it is also arrested at times in its descent, in the midst of wet ones. In this so evident provision for the sustenance of all animal and vegetable life, as well as for the success of mankind in that pursuit so essential to their welfare, in temperate climates, of cultivating the earth, we may discover the wisdom and goodness of the Creator and Preserver of all things.

The nimbus, although in itself one of the least beneficial yet now and then superbly decorated with its attendant, the rainbow, which can only be seen in perfection when backed by the widely extended uniform gloom of this modification.

METEOR. See Architecture.
METRE. See poetry. See Hexameter, Pentameter &c.
METROSIDEROS, a genus of the class and order icosaedra monogyna. The calyx is five-cleft, half superior; petals five; stamens very long, standing out; stigma simple; capsule oval, and Fr. The genus consists of 13 species, of New Holland, &c.
MEZEREON. See Daphne.
MEZZOTINTO. See Engraving.
MIASMA, among physicians, denotes the contagious effluvia of pestilential diseases, whereby they are communicated to people at a distance.
MICA. This stone forms an essential part of many mountains, and has been long known under the names of glaciers Maria, and Muscovy glass. It consists of a great number of thin laminæ adhering to each other, sometimes of a very large size. Specimens have been found in Siberia nearly 25 yards square.
It is sometimes crystallized; its primitive form is a rectangular prism, whose bases are rhombs with angles of 120° and 60°; its integral molecule has the same form. Sometimes it occurs in rectangular prisms, whose bases also are rectangular, and sometimes also in short six-sided prisms; but it is much more frequent in plates or scales of no determinate form, and of an angular shape.

Its texture is foliated. Its fragments flat. The lamellete flexible, and somewhat elastic. Very tough. Often absorbs water. Specific gravity from 2.6356 to 2.9342. Feels smooth, but not greasy. Powder feels greasy. Colour, when pure, silver white or grey, but it occurs also yellow, greenish, reddish brown, and black. Mica is fusible by the blow-pipe into a white, grey, green, or black enamel; and this last is affected by the magnet, a small part being rubbed by it becomes negatively electric.

A specimen of mica, analysed by Vanquezin, contained

<table>
<thead>
<tr>
<th>Substance</th>
<th>Quantity</th>
</tr>
</thead>
<tbody>
<tr>
<td>50.00 silic.</td>
<td>35.00 alumina</td>
</tr>
<tr>
<td>7.00 oxide of iron</td>
<td>1.35 magnesia</td>
</tr>
<tr>
<td>1.33 lime.</td>
<td>94.08</td>
</tr>
</tbody>
</table>

Mica has long been employed as a substitute for glass. A great quantity of it is said to be used in the Russian marine for panes to the cabin-windows of ships; it is preferred, because it is not so liable as glass to be broken by the agitation of the ship. It is also used in our navy for lanterns, for the use of the powder-rooms.

MICHELIJA, a genus of the octandria polygynia class of plants, the flower of which consists of eight petals; the fruit consists of a cluster of globose unilocular berries, disposed in a cluster, in which there are four seeds, convex on one side, and angular on the other. There are two species, trees of the East Indies.

MICHAUXIA, a genus of the class and order octandria monogyna. The calyx is 16-parted; corolla wheel-shaped, 8-parted; nect. 8-valved, staminiferous; caps. 8-celled, many-seeded. There is one species, a biennial of Aleppo, resembling the campanula.

MICROMETER, an astronomical machine, which, by means of a screw, serves to measure extremely small distances in the heavens, &c., and that to a great degree of accuracy.

The micrometer consists of a graduated circle (Plate Miscell. fig. 162), of a screw q q, and its index . The threads of the screw are such, that one thread makes 0.1 inch exactly. When it is to be used, the point . is set to the side of the part to be measured, and then the index is turned about with the finger, till the eye perceives the point has just passed over the diameter of that part; then the number of turns, and parts of a turn, shown by the graduated circle, will give the dimensions in parts of an inch, as we shall show by the following example: Suppose it is required to measure the diameter of a human hair, and I observe the index is turned just once round while the point . passes over it; then is the plain diameter of the hair in the image . of an inch. Now if the microscope, D E F, D' E' F', magnifies 6 times, or makes the image 6 times larger in diameter than the object, then is the diameter of the hair itself . of an inch. Also it is to be observed, that as there are ten large divisions, and twenty small ones, on the micrometer plate, so each of those small divisions is the 6th part of an inch. Also if in measuring any part of an object, you observe how many of these smaller divisions are passed over by the index, you will have so many thousandths of an inch for the measurement required.
D and that the GGG, of the ischium. The pubis a tuberosity parietal bladder. The clitoris which is at the same time downwards directed. AB, the vertebrae of the longs, os sacrum, and coccyx. C, the os pubis of the left side. D, the lower part of the rectum. E, the perineum. F, the left labium pudendi. GGG, the uterus.

Fig. 11. shows in a lateral view the face of the child, forced down into the lower part of the pelvis, the chin below the pubes, and the mouth in the same position as the elevation of the surface. AB, the vertebrae of the longs, os sacrum, and coccyx. C, the os pubis of the left side. D, the lower part of the rectum. E, the perineum. F, the left labium pudendi. GGG, the uterus.

Fig. 12. shows the head of the child in the same position as the elevation of the surface. AB, the vertebrae of the longs, os sacrum, and coccyx. C, the os pubis of the left side. D, the lower part of the rectum. E, the perineum. F, the left labium pudendi. GGG, the uterus.

Fig. 13. shows the head of the fetus, strong labour-pains, squeezed into a long form, with a tumour on the vertix, from long compression of the head in the pelvis. K, the tumour on the vertix. L, the forceps. M, the urinary bladder much distended with a little fluid. N, the long pressure of the head against the urethra. N, the under part of the pelvis. O, the os uteri.

Fig. 14. exhibits a front view of the pelvis, the breech of the fetus presenting, and distating the os interna, the membranes having been prematurely ruptured. Fig. 15. represents in a front view of the pelvis, the fetus compressed by the contraction of the pelvis into a round form, the fore parts of the former being towards the inferior part of the latter, and one foot and hand drawn into the pelvis. In this figure, the anterior part of the pelvis is removed by a longitudinal section, through the middle of the foramen magnum. A, the superior portion of the os ilium. BB, the uterus. C, the mouth of the uterus shooting and appearing in OOOO the vagina. D, the inferior and posterior part of the os externum. EEEE, the remaining portion of the os pubis and ischium. FFF, the termion of the os.

Fig. 16. represents the forearms and blunt hook, a, the straight forceps, b, the posterior part of a single blade, c, the blunt hook, which is employed to assist the extraction of the head after the pelvis is opened, by introducing the small end along the car on the outside of the head, to above the under jaw, where the point is to be fixed; the other extremity of the hook being held with one hand, while two fingers of the other are to be introduced into the opening. The small end is useful in abortions, to draw down the secundines when they are not expelled by labour-pains, or cannot be extracted by the fingers. The large hook at the opposite end is useful to assist the extraction of the body when the breech presents, but should be used with much caution.

Fig. 17. A represents the whole bone filled, which, when the operator is not provided with forceps, may sometimes be useful in laborious cases. BB, two views of a pessary for the prolapsus uteri. C, a round pessary which is in more general use than the former. DDD, two views of a female catheter.

Fig. 18. A, represents a pair of curved crotches, locked in the same manner as the forceps: the dotted lines indicate a sheath, contrived to defend the point till it is introduced sufficiently high, and gives a view of the back part of one of the crotches. c, a front view of the point, d, the scissors for perforating the cranium, in very narrow and distorted pelvies.

MIGRATION, of birds. It has been generally believed, that many different kinds of birds annually pass from one country to another, and spend the summer or the winter in some foreign country, and return to their own. It has long been an opinion previously received, that swallows reside during the winter season in the warm southern regions; and Mr. Adamson particularly relates his having seen them at Senegal, when they were obliged to leave their country. But besides the swallow, Mr. Pennant enumerates many other birds which migrate from Britain at different times of the year, and are then to be found in other countries; after which they again leave those countries for Britian.

1. Crows. Of this genus, the hooded crow migrates regularly with the woodcock. It inhabits North Britain the whole year; a few are annually said to breed on Dartmoor, in Devonshire. It breeds also in Sweden and Aithonia, in some parts of France it follows the alteration of its seasons it shifts its quarters, in others it resides throughout the year. Our author is at a loss for the summer retreat of these birds which visit us in such numbers in winter, and quit our country in the spring; and for the reason why a bird whose food is such that it may be found at all seasons in this country, should leave us.

2. Cuckoo. A bird which leaves us in the winter. If its diet is aut sole, as several assert, the cause of its migration is very evident. This bird disappears before winter, and revisits us in the spring, a little earlier than the cuckoo.

3. Wryneck, a bird that leaves us in the winter. Though it be the same with that which breeds in the southern countries, it is said to arrive in winter; that bird either leaves us, or else returns towards the sea-coasts.

4. Hoopoe. Comes to England but by accident. Mr. Pennant once heard of a pair that attempted to winter in a meadow at Seiborne, Hampshire, but were frightened away by the curiosity of people. It breeds in Germany.

5. Grouse. The whole tribe, except the quail, live here all the year round; that bird either leaves us, or else returns towards the sea-coasts.

6. Pigeons. Some few of the ring doves breed here; but the multitudes that appear in winter are so disproportioned to what continues here the whole year, as to make it certain that the greatest part quit the country in the spring. It is most probably they go to Sweden to breed, and return thence in autumn: as Mr. Eekmar informs us, they entirely escape that circumstance. Multitudes of the common wild pigeons also make the northern retreat, and visit us in winter; though numbers breed in the high cliffs in all parts of this island. The turtle also probably leaves us in the winter, at least changes its place, removing to the southern counties.

7. Stare, breeds here. Possibly several remove to other countries for that purpose, since the produce of those that continue
here seems unequal to the clouds of them that appear in winter. It is not unlikely that many migrate into Sweden, whither Mr. Berger observes they return in spring.

8. Thrushes. The fieldfare and the redwing breed their summers in Norway and other cold countries; their food is berries, which abounding in our kingdoms tempt them hither in the winter. The two these, and the Royarton crow, are the only land birds that regularly and constantly migrate into England, and do not breed here. The hawfinch and crossbill come hither at uncertain times as not to deserve the name of birds of passage.

9. Chatterer. The chatterer appears annually about Edinburgh in flocks during winter, and feeds on the berries of the mountain ash. In South Britain it is an accidental visitor.

10. Grosbeaks. The grosbeak and crossbill come hither but seldom; they breed in Austria. The pine grosbeak probably breeds in the forests of the Highlands of Scotland.

11. Bunting. Every genus inhabits the land throughout the year, except the greater brambling, which is forced hither from the north in very severe seasons.

12. Finches. All continue in some part of themselves, except the siskin, which is an irregular visitant, said to come from Russia. The LINNETS shift their quarters, breeding in one part of this island, and move with their young to others. All finches feed on the seeds of plants.

13. Larks, fly-catchers, wagtails, and warblers. All these birds feed on insects and worms; yet only part of them quit these kingdoms, though the reason of migration is the same to all. The nightingale, blackcap, fly-catcher, willow-wren, whinchat, and white-throat, leave us before winter, while the small and delicate golden-crowned kinglet braves our severest frosts. The migrants of this genus continue longest in Great Britain in the southern counties, the winter in those parts being later than in those of the north: Mr. Stillingfleet having observed several wheatears in the Isle of Purbeck on the 18th of November. As these birds are incapable of very long flights, Spain, or the south of France, is probably their winter asylum.

14. Swallow and goat-sucker. Every species disappears at the approach of winter.

WATER-FOWL, CLOVEN-FOOTED.

15. Herons. The white heron is an uncommon bird, and visits us at uncertain seasons; the common kind and the bittern never leave us.

16. Curlews. The curlew breeds sometimes on our mountains; but, considering the vast flights that appear in winter, it is probable that the greater part retire to other countries; the whimbrel breeds on the Grampian hills, in the neighbourhood of Invercauld.

17. Snipes. The woodcock breeds in the moist woods of Sweden, and other cold countries. Some snipes breed here; but the greatest part retire elsewhere, as do every other species of this genus.

18. Sandpipers. The piping continues here the whole year; the ruff breeds here, but retires in winter; the redshank and sandpiper breed in this country, and reside here.

All the others absent themselves during summer.

19. Flamingo and oystercatchers. The long-legged plower and the sandpiper visit us only in winter; the spotted appears in spring and in autumn; yet, what is very singular, we do not find it breeds in South Britain. The oystercatcher lives with us the whole year.


We must remark, that every species of the genus of curlews, woodcocks, sandpipers, and plovers, that forsake us in the spring, retire to Sweden, Poland, Prussia, Norway, and Lapland, to breed; as soon as the young can fly, they return to us again, because the fogs which set in early in those countries totally deprive them of the means of subsisting; as the dryness and hardness of the ground, in general, during our summer, prevents their finding the least of their food. So, most of the genera in search of worms, which are the natural food of these birds.

20. Rails and gallinules. Every species of these two genera continue with us the whole year, excepted, which is not seen here in winter. It likewise continues in Ireland only during the summer-months, when it is very numerous.

FINNED-FOOTED WATER-BIRDS.

21. Phalaropes visit us but seldom; their breeding-place is Lapland and other Arctic regions.

22. Grebes. The great-crested grebe, the black and white grebe, and little grebe, breed with us, and never migrate; the other visit us accidentally, and breed in Lapland.

WEB-FOOTED BIRDS.

23. Avocet. Breed near Fossdike in Lincolnshire, but quit their quarters in winter. They are then shot in different parts of the kingdom; which visit not regularly, but accidentally.

24. Auk and guillemot. The great auk or pinguin sometimes breeds in St. Kilda. The auk, the guillemot, and puffin, inhabit most of the maritime cliffs of Great Britain, and the land-tongues, during summer. The black guillemot breeds in the Bass Isle, and in St. Kilda, and sometimes in Llandinno rocks. We are at a loss for the breeding-place of the other species; neither can we be very certain of the winter residence of any of them, except of the lesser guillemot and black-billed auk, which, during winter, visit in vast flocks the Firth of Forth.

25. Divers, chiefly breed in the lakes of Sweden and Lapland, and in some near the pole; but some of the red-throated divers, the northern, and the imber, may breed in the north of Scotland and its islands.

26. Terns. Every species breeds here, but leaves us in the winter.

27. Petrels. The fulmar breeds in the isle of St. Kilda, and continues there the whole year except September and part of October. The shearwater visits the Isle of Man in April; breed there; and, leaving it in August or the beginning of September, disperses over all parts of the Atlantic ocean. The stormfich is seen at all distances from land on the same vast watery tract; nor is ever found near the shore except by some very rare accident, unless in the breeding-season. Mr. Pennant found it on some little rocky isles, on the north of Skye. It also breeds in St. Kilda. He suspects too that it nests on the Blasquet isles off Kerry, and that it is the gourmand of Mr. Smith.

28. Mergansers. This whole genus is met with among the birds that haunt the lakes and land during summer. Mr. Pennant has seen the young of the red-breasted in the north of Scotland; a few of these, and perhaps of the goosanders, may breed there.

29. Ducks. Of the numerous species that form the genus of one or two that breed here; the swan and goose, the shelduck, the eider-duck, a few shovellers, garganey, and teals, and a very small portion of the wild ducks.

The rest contribute to form that amazing multitude of water-fowl that annually repair from most parts of Europe to the woods and lakes of Lapland and other Arctic regions, to perform the functions of migration and nutrition in full security. They migrate by thousands in September, and disperse themselves over Europe. With us they make their appearance the beginning of October; circulate first round our shores; and, when compelled by severe frost, betake themselves to the lakes and rivers. Of the web-footed fowl there are some of harbinger constitutions than others; these endure the ordinary winters of the more northern countries; but when the cold reigns there with more than common rigour, they repair for shelter to these kingdoms: this regulates the appearance of some of these kinds, as of the wild swan, the swallow-tailed shield-duck, and the different sorts of goosanders which then visit our coasts. But the English statute-mile is fourscore chains, or 1760 yards; that is, 5280 feet. See Chains, Yard, and Foot.

We shall here give a table of the miles in use among the principal nations of Europe, in geometrical paces, 69,000 of which make a degree of the equator.

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<th>Geometrical paces,</th>
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MILIARY FEVER, a malignant fever, so called from the eruption of certain pustules resembling millet-seeds. See Medicine.

MILIUM, MILLET, a genus of the daisy order, in the tribe of a class of plants; and
MILK.

In the natural method ranking under the 4th order, gramium. The calyx is bifurred and unilobar; the corolla is very short; the stamens and style, like. There are 12 species, of which the most remarkable is the ellusium, or common milk.

MILK, is a fluid secreted by the female of all those animals denominated mammaeans, and intended evidently for the nourishment of her offspring.

The milk of every animal has certain peculiarities which distinguish it from every other milk. But the animal whose milk is most made use of by man as an article of food, and with which, consequently, we are best acquainted, is the cow. Chemists, therefore, have made choice of cow's milk for their experiments.

Milk is a opaque fluid, of a white colour, a slight peculiar smell, and a pleasant sweetish taste. When newly drawn from the cow, it has a taste very different from that which it acquires after it has been kept for some hours.

It is liquid, and wets all those substances which can be moistened in water; but its consistence is greater than that of water, and it is slightly astringent. Like water, it freezes when cooled down to about 30°; but Parmenient and Deyerux, to whom we are indebted for the most complete account of milk, have discovered, that when its freezing-point varies considerably in the milk of different cows, and even of the same cow at different seasons, it also was insufficiently heated; but the same variation takes place in the boiling-point of different milks, though it never deviates very far from the boiling-point of water. Milk is slightly heavier than water, and lighter than blood; but the precise degree cannot be ascertained, because almost every particular milk has a specific gravity peculiar to itself.

When milk is allowed to remain for some time at rest, there collects on its surface a thick unctuous yellowish-coloured substance, known by the name of cream. The cream appears sooner on milk in summer than in winter, evidently owing to the difference of temperature. In summer, about four days of repose are necessary before the whole of the cream collects on the surface of the liquid; but in winter it requires at least double the time.

After the cream is separated, the milk remains a much thinner than before, and it has a blueish-white colour. If it is heated to the temperature of 100°, and a little rennet (which is water digested with the inner coat of a calf's stomach, and preserved with salt) is poured into it, coagulation ensues; and if the coagulum is broken, the milk very soon separates into two solid white parts known by the name of curd, and a fluid part known as whey.

We see that milk may be easily separated into three parts; namely, cream, curd, and whey.

1. Cream is of a yellow colour, and its consistence increases gradually by exposure to the atmosphere. In three or four days it becomes so thick that the vessel which contains it may be inverted without incurring any loss. In eight or ten days in air, its surface is covered with a yellowish matter, and it has no longer the flavour of cream, but of very fat cheese. This is the process for making what in this country is called cream cheese.

Cream possesses many of the properties of an oil. It is specifically lighter than water; it has an altogether different consistence in the manner of oil; and if it is kept fluid, it contracts at last a taste which is very analogous to the rancidity of oil. When kept boiling for some time, a little oil makes its appearance through its surface. Cream is neither soluble in alcohol nor in oils. These properties are sufficient to show us, that it contains a quantity of oil; but this oil is combined with a part of the curd, and mixed with some serum; cream, then, is composed of a peculiar oil, curd, and serum. The oil may be easily obtained separate by agitating the cream for a considerable time. This process, known to every bobby, is called churning. After a certain time, the cream separates into two portions; one fluid, and resembling creamed milk; the other solid, and called butter.

Butter is of a yellow colour, possesses the properties of an oil, and mixes readily with sandy bodies. When heated to the temperature of 96°, it melts, and becomes transparent; if it is kept for some time melted, some curd and water, or whey, separates from it, and it assumes exactly the appearance of oil. But this process deprives it of its great measure of its peculiar flavour.

When butter is kept for a certain time, it becomes rancid, owing to a good measure to the presence of these foreign ingredients; for if butter is well-washed, and a great portion of these matters separated, it does not become rancid nearly so soon as when it is not treated in this manner. It was formerly supposed that this rancidity was owing to the development of a peculiar acid, but Parmenient and Deyerux have shown that no acid is present in rancid butter. When butter is distilled, there comes over water an acid, and an oil, at first fluid, but afterwards concrete. The carbonaceous residuum is but little different.

Butter may be obtained by agitating cream newly taken from milk, or even by agitating milk newly drawn from the cow; but it is usual to allow cream to remain for some time before it is churned, as this lengthens, by standing, acquires a solid taste; butter, therefore, is commonly made from sour cream. Fresh cream requires at least four times as much churning before it yields its butter, as sour cream does; consequently cream acquires, by being kept for some time, new properties, in consequence of which it is more easily converted into butter. When very sour cream is churned, every one who has paid the least attention to these matters has observed, that the buttermilk, after the churning, is not nearly so sour as the cream had been. The butter, in all cases, is perfectly sweet; consequently the acid which had been evolved is a great skin and status dissolved during the process of churning. It has been ascertained, that cream may be churned, and butter obtained, though the contact of atmospheric air should be excluded. On the other hand, it has been affirmed, that when cream is churned in contact with air, it absorbs a considerable quantity of it.

In all cases there is a considerable extinction of gas during the churning of butter.

From the phenomena, it can scarcely be doubted that this gas is carbonic acid. Dr. Young affirms, that during the churning there is an increase of temperature amounting to four degrees.

These facts show that considerable chemical changes go on during the process of churning. The agitation keeps the different substances in contact, and enables them to get upon each other the expulsion of carbonic acid for the diminution of acidity after churning; while the other phenomena would lead us to suppose that the cream, before it becomes butter, united to a new portion of oxygen.

The affinity of the oil of cream for the other ingredients is such, that it never separates completely from them. Not only are curd and whey always found in the cream, but some of this oil is constantly found in creamed milk and whey; for it has been ascertained by actual experiment, that butter may be obtained by churning whey.

Scotch pints of whey yield at an average about a pound of butter. This is, for a fact well known to those who superintend dairies, that a good deal more butter may be obtained from the same quantity of milk, provided it is churned as drawn from the cow, than when the cream alone is collected and churned.

The buttermilk, as Parmenient and Deyerux ascertained by experiment, possesses precisely the properties of milk deprived of cream.

2. Curd, which may be separated from creamed milk by rennet, has many of the properties of coagulated albumen. It is white and solid; and when all the moisture is squeezed out, it has a good deal of brittleness. It is insoluble in water; but pure alkalies and lime dissolve it readily, especially when assisted by heat; and when mixed alkalie is used, a great quantity of ammonia is emitted during the solution. The solution of curd in soda is of a red colour, at least if heat is excited; owing probably to the preparation of charcoal from the curd by the action of the alkalie. Indeed, when a strong heat has been used, charcoal precipitates as the solution cools. The matter dissolved by the fixed alkalie may be separated from the mass of an acid; but it has lost all the properties of curd. It is of a black colour, melts like tallow by the application of heat, leaves oily stains on paper, and never acquires the consistence of curd. Hence it appears that curd, by the action of a fixed alkalie, is decomposed, and converted into two new substances; ammonia, and oil or rather fat.

Curd is soluble also in acids. If over curd newly precipitated from milk, and not dried, there are poured eight parts of water, containing as much of any of the mineral acids as gives it a sensibly acid taste, the whole is dissolved after a little boiling. Acetic acid and lactic acid do not dissolve curd, when very much diluted; but these acids, when concentrated, dissolve it readily, and in considerable quantity. It is remarkable enough, that concentrated vegetable acids dissolve curd readily, but have very little action on it when they are very much diluted; whereas the mineral acids dissolve it when much diluted; but when concentrated, have either very little effect on it, as sulphuric acid, or decompose.
Milk.

it, as nitric acid. By means of this last acid, as Berthollet discovered, a quantity of acetic gas may be obtained from curd.

Curd, as is well known, is used in making cheese and the cheese is the better the more it contains of cream, or of the oil of curd which constitutes cream. It is well known to cheesemakers, that the goodness of it depends in a great measure on the manner of separating the whey from the curd. If the milk is much heated, the coagulum broken in pieces, and the whey forcibly separated, as is the practice in many parts of Scotland, the cheese is scarcely good for anything; but the whey is delicious, especially when the whey last squeezed out, and butter may be obtained from it in considerable quantity. This is a proof that nearly the whole creamy part of the milk has been separated with the whey. Whey is, if the milk is not too much heated (about 100 degrees is sufficient), if the coagulum is allowed to remain unbroken, and the whey separated by very slow and gentle pressure, the cheese is excellent; but the whey is almost transparent, and nearly colourless.

Good cheese melts at a moderate heat; but bad cheese, when heated, dries, curls, and exhibits all the phenomena of burning horn. Hence it is evident, that good cheese contains a quantity of the peculiar oil which constitutes the distinguishing characteristic of cream; whence its flavour and smell.

This resemblance of curd and albumen makes it probable that the coagulation of milk and albumen depends upon the same cause. Heat, indeed, does not coagulate milk, because the curd in it is diluted with too large a quantity of water; but if milk is boiled in contact with air, a pellicle soon forms on its surface, which has the properties of curd. If this pellicle is removed, another succeeds; and by continuing the boiling, the whole of the curdy matter may be separated from milk. When this pellicle is allowed to remain, it falls at last to the bottom of the vessel; where, being exposed to a greater heat, it becomes brown, and communicates to milk that disagreeable taste which, in this country, is called a "stinged" taste. It happens more readily when milk is boiled along with rice, flour, &c.

If to boiling milk there is added as much of any neutral salt as it is capable of dissolving, or of sugar, or of gum arabic, the milk coagulates, and the curd separates. Alcohol also coagulates milk; as do all acids, rennet, and the infusion of the flowers of artichoke and of the thistle. If milk is diluted with ten times its weight of water, it cannot be made to coagulate at all.

3. Whey, after being filtered to separate a quantity of curd which still continues to float through it, is a thin pellicular fluid, of a yellowish-green colour and pleasant sweetish taste, in which the flavour of milk may be distinguished. It always contains a portion of curd; nearly the whole may be separated by keeping the whey for some time boiling; a thick white scum gathers on the surface, which is known by the name of skim-curd. When the liquid, which consists of the curdy part, is carefully separated, the whey, after being allowed to remain at rest for some hours, to give the remainder of the curd time to precipitate, is deanted off as almost colourless as water, and scarcely any of the peculiar taste of milk can be distinguished in it. If it is now slowly evaporated, it deposes at last a number of white-coloured crystals, which are sugar of milk. Towards the end of the evaporation, some crystals of curd and of milk of soda make their appearance. According to Scheele, it contains also a little phosphat of lime, which indeed may be precipitated by ammonia.

After the whey has been obtained from whey, what remains concretes into a jelly on cooling. Hence it follows that whey also contains gelatine. Whey, then, is composed of water, sugar of milk, gelatine, curd, and phosphat of lime. The other salts which are sometimes found in it, are only accidentally present.

If whey is allowed to remain for some time, it becomes sour, owing to the formation of a peculiar acid known by the name of lactic acid. This is to the property of whey that we are to ascribe the acidity which milk contracts for neither curd nor cream, perfectly freed from serum, seems susceptible of acquiring acid properties. Hence the reason also that milk, after it becomes sour, also coagulates. Both ed milk has the property of continuing longer sweet, but it is singular enough that it runs sooner to putrefaction, than ordinary milk.

The acid of milk differs considerably from the acetic; whey, however, may be obtained from milk by a very simple process. If to somewhat more than 8 lbs. of milk six spouls of alcohol are added, and the mixture well corked is exposed to a heat sufficient to support fermentation, provided attention is paid to allow the carbonic acid gas to escape from time to time, the whey, in about a month, will be found converted into vinegar.

Milk is almost the only animal substance which may be made to undergo the vinous fermentation, and to afford a liquor resembling wine or beer, from which alcohol may be separated by distillation. This singular fact seems to have been first discovered by the Tartars, who, by reason of the great quantity of liquors from mare's milk. It has been ascer-

tained, that milk is incapable of being converted into wine till it has become sour; after this nothing is necessary but to place it in the proper temperature, and the fermentation begins of its own accord, and continues till the formation of wine is completed. Scheele had shewed that milk was capable of fermenting; and that a great quantity of carbonic acid gas was extracted from it during this fermentation; but he did not suspect that the result of this fermenta-

tion was the formation of an intoxicating liquor similar to wine: The Tartars call the vinous liquid which they prepare "koomiss.

A very exact account of its preparation and medical uses has been published by Dr. Guth-rie.

When milk is distilled by the heat of a water-bath, there comes over water having the peculiar odour of milk which purifies; and consequently contains, besides mere water, some of the other constituent parts of milk. After some time the milk coagulates, as always happens in hot Alun, and requires a certain degree of concentration. There remains behind a thick mucous yellowish-white substance, to which Hofmann gave the name of fenchiphan. This substance, when the fire is increased, yields at first a tranparent liquid, which becomes gradually more coloured; some very fluid oil comes over, then amnion, an acid, and at last a very thick black oil. Towards the end of the distillation the milk is disengaged. There remains in the retort a coal which contains carbonat of potass, muriat of potass, and phosphat of lime; and sometimes magnesia, iron, and muriat of soda.

Thus we see that cow's milk is composed of the following ingredients:

2. Oil. 7. Muriat of potass.
5. Sugar of milk.

The milk of all other animals, as far as it has hitherto been examined, consists nearly of the same ingredients; but there is a very great difference in their proportion.

Woman's milk has a much sweeter taste than cow's milk. When allowed to remain a long time, a cream gathers on its surface. This cream is more abundant than in cow's milk, and its colour is usually much whiter. After it is separated, the milk is exceedingly thin; and has the appearance of a blueish-white colour, than of cream-milk.

None of the methods by which cow's milk is coagulated succeed in producing the coagulation of woman's milk. It is certain, however, that it contains curd; for if this boiled, particles form on its surface, which have all the properties of curd. Its not coagulating, therefore, must be attributed to the great quantity of water with which the curd is diluted.

Though the cream is churned for a long time, no butter can be obtained from it; but if, after being agitated for some hours, it is allowed to remain at rest for a day or two, it separates into two parts: a fluid which occupies the inferior part of the vessel, pelliculated and of a yellowish colour, and a milk-white translucent fluid which swarms on the surface. The lowermost fluid contains sugar of milk and some curd; the uppermost does not differ from curd, except in consistence. The oily part of the cream, then, would be separated by agitation from the curd. This cream contains a greater portion of curd than the cream of cow's milk.

When this milk, after the curd is separated from it, is slowly evaporated, it yields crystals of sugar of milk and of muriat of soda. The quantity of sugar is rather greater than in cow's milk. According to Halier, the sugar obtained from milk is to that obtained from an equal quantity of woman's milk as 35 to 38, and sometimes as 37 to 67, and in all the intermediate ratios.

Thus it appears that woman's milk differs from that of cow's in three particulars:

It contains a much smaller quantity of curd.

Its oil is so intimately combined with its curd that it does not yield butter. It contains rather more sugar of milk.

Parmentier and Deyeux ascertained, that the quantity of curd in woman's milk increases in proportion to its age after delivery. Nearly the same thing has been observed with respect to cow's milk.
As's milk has a very strong resemblance to human milk. It has nearly the same colour, smell, and consistence. When left at rest for a sufficient time, a cream forms upon its surface, but by no means in such abundance as in woman's milk. This cream, by very long agitation, is converted into butter, which is highly nutritious, of pleasant taste, and fat, and, what is singular, very readily mixes again with the butter milk; but it may be again separated by agitation, while the vessel contains it, is plunged into cold water. Creamed as's milk is thin, and has an agreeable sweetish taste. Alcohol and acids separate it from a little curd, which has but a small degree of consistence. The serum yields sugar of milk, and muriat of lime. As's milk therefore differs from cow's milk in three particulars:

1. Its cream is less abundant and more insipid. It contains less curd. It contains more sugar of milk; the proportion is 35 to 90. Great milk, in consequence of the consistence which is greater, does not differ much from cow's milk. Like that milk it throws up abundance of cream, from which butter is easily obtained. Its milk contains less cow's milk, and yields a greater quantity of curd. Its whey contains sugar of milk, muriat of lime, and muriat of soda.

2. Eve's milk resembles almost precisely that of the cow. Its cream is rather more abundant, and yields a butter which never acquires the consistence of butter from cow's milk. Its curd has a fat and viscid appearance, and is not without difficulty made to assume the consistence of the same, of a kind of cow's milk. It makes excellent cheese.

3. Marc's milk is thinner than that of the cow, but scarcely so thin as human milk. Its cream cannot be converted into butter by agitation. The cream of cow's milk, therefore, makes precisely as of cow's milk, but the curd is not so abundant. The serum contains sugar of milk, sulphate of lime, and muriat of lime.

MILK-WAY, in astronomy, a broad track or path in the heavens, distinguishable by its white appearance; whence it obtains its name. See Astronomy.

MILL, a machine or engine for grinding corn, &c.; or which there are several kinds, according to the various methods of applying the moving power; as water-mills, windmills, &c.

In water-mills the momentum of the water is the moving power; and the attrition of the two stones in grinding is the force to be overcome. Of these there are two kinds, viz., those where the force of the water is applied above the wheel, and those in which it is applied below the wheel; the former being called overhead, and the latter undershot mills; and to these we may add a breast-mill, where the water strikes against the middle of the wheel.

Few people are ignorant that corn is ground by two mill-stones, placed one above the other, without touching. The lower, or rather, mill-stone, is immovable; but the upper one turns upon a spindle. The opposite surfaces of both stones, to grind the corn, are not plane or flat; but the upper one is hollow, and the under ones swell upwards; each of them being of a conic figure, whose axes fades is very short in proportion to the diameter of its base; for the upper one, being six feet in diameter, is hollowed but about one inch at its centre; and the lower one rises but about three-fourths of an inch. These two mill-stones come nearer and nearer towards their circumferences, whereby the corn that falls from the hopper has room to incise between them as far as two-thirds of the radius, which is the place of the breakage, where it is impossible for the stone to make the greatest resistance that it is capable of; the space between the stones being in that place but about two-thirds or three-fourths of the thickness of a grain of corn. But as the mill-stones will not be raised or sinking the upper stone a little, they can proportion its distance from the lower one, according as they would have the floor finer or coarser.

The circular motion of the upper mill-stone brings the corn out of the hopper by jerks, and causes it to recede from the centre towards the circumference; where being quite reduced to flour, it is thrown out of the milling, and there must be a hole provided for purpose.

As the water acts upon an overshot-mill both by impulsion and weight, so does it act upon a breast-mill, or that where the water contains the full weight of the body of water; and here, though the weight of the water is not so great as in the overshot mill, being contained in the buckets of the lower quarters: yet the impulse of the water is much greater, the height of the water being increased nearly the semidiameter of the great wheel, all other things being equal. If the height of the water remains the same, the aperture of the penstock, or flood-mate, must be enlarged twice or three times the area, that the force may be the same; so that to produce the same effect, twice as much water is necessary for a breast-mill as for an overshot one, every thing else being the same.

As to the undershot-mill, it is evident that there can be only the impulsion from the water; and therefore the height of the water remains the same, the aperture of the penstock, or flood-mate, whence a greater area of water is expended in it than in any other mill, and can only be supplied for a constancy by a river; and where this can be had, the undershot is the easiest, cheapest, and most simple structure a mill is capable of.

Mr. Smeaton has considered the best methods of constructing all these mills from machines and models made on purpose; but, conclusions of the inferiority of models to actual practice, and that it is to give his opinion without having seen them actually tried, and the truth of his doctrines established by practice.

Having described the machine and models used for making his experiments, he observes, that, with regard to power, it is most properly measured by the raising of a weight; or, in other words, if the weight raised is multiplied by the height to which it can be raised, we have the greatest positive effect or impact of the power raising it; and, of consequence, all those powers are equal whose products made by such multiplication are equal; for if a power can raise twice the weight to the same height, or the same weight twice the height, in the same time that another can, the former power will be double the latter; but if it raises irrationally twice half the weight to double the height, or double the weight to half the height, in the same time that another can, the two powers are equal. This, however, must be understood only of an insensible change; for if a power could raise an object or retard it by alternation or retardation, that the velocity is either very quickly accelerated or retarded, the vis inerar, in our author's opinion, will produce an irregularity.

To compute the effect of water-wheels exactly, it is necessary to know, in the first place, what is the real velocity of the water which impinges on the wheel: 2. The quantity of water expended in a given time; and, 3. How much of the power is lost by the friction of the machinery.

1. With regard to the velocity of the water, Mr. Smeaton determined by experiments with machinery, that with a head of water 15 inches in height, the velocity of the wheel is 8.960 feet in a minute. The area of the head being 10 square inches, this multiplied by the weight of a cubic inch of water, equal 16.379 of an ounce avoirdupois, gives 61.26 ounces for the weight of as much water as is contained in the head upon one inch in depth; and by further calculations, the machinery made use of, in computing that 204.7 pounds of water descend in a minute through the space of 15 inches. The power of the water, therefore, to produce mechanical effects in this case, will be 204.7 x 13, or 2670. From the result of the experiment, however, it appeared that a vast quantity of the power was lost; the effect being only to raise 9.375 pounds to the height of 135 inches; so that the power was to the effect as 3770 to 0.375 x 133 = 1260, or as 10 to 3.18

This, according to Mr. Smeaton, must be considered as the greatest single effect of water upon an undershot-wheel, where the water descends from a height of 15 inches; but as the force of the current is not by any means exhausted, we must consider the true proportion between the power and effect to be that between the quantity of water already mentioned, and the sum of all the effects of that current. This remainder of power, it is plain, must be equal to that of the velocity of the wheel itself multiplied into the weight of the water. In the present experiment, the circumference of the wheel moved with a velocity of 3.123 feet in a second, which answers to a head of 1.822 inches; and this height being multiplied by 204.7, the quantity of water expended in a minute, gives 481 for the power of the water; after it has passed the wheel, and hence the true proportion between the power and the effect will be as 3849 to 1260; or as 11 to 4.

As the wheel revolved 86 times in a minute, the velocity of the water must be equal to 86 circulations of the wheel; which, according to the dimensions of the apparatus used by Mr. Smeaton, was as 86 to 30, or as 20 to 7. The greatest load with which the wheel would move was .9 lb. 6 oz. and by 12 lb. it was entirely stopped; but accelerating, that the author concludes, that the impulse of the water is more than double of what ought to be according to theory; but this he accounts for by supposing, that in his experiment the wheel was placed not vertically, as in the natural current, after it has communicated.
its impulse to the float, has room on all sides to escape, as the theory supposes, but in a conical form, to which the float being adapted, the water cannot otherwise escape but by moving along with the wheel. It is observable, that a wheel working in this manner, as soon as it begins to turn, and the water, receiving a sudden check, rises up against the float like a wave against a fixed object; insomuch that, when the sheet of water is not a quarter of an inch thick before the float, yet this sheet will not act upon the whole surface of the float whose height is three inches; and, consequently, was the float no higher than the thickness of the sheet of water, as the theory also supposes, a great part of the force would have been lost by masking the float.

Mr. Smeston next proceeds to give tables of the velocities of wheels with different heights of water; and from these deduces the following conclusions: 1. The velocity produced by the water in the same time, will nearly be as the quantity of water expended. 2. The expence of water being the same, the effect will be nearly as the height of the virtual, or effective head. 3. The expence of water expended being the same, the effect is nearly as the square of the velocity. 4. The aperture being the same, the effect will be nearly as the cube of the velocity of the water. Hence, if water passes over a wheel, the expence being the same, but with different velocities, the expence will be proportional to the velocity; and therefore, if the expence is not proportional to the velocity, the section of the aperture is not the same. The virtual head, that from which we are to calculate the power, bears no proportion to the head-water; but when the aperture is larger, the power of the water is nearer to a coincidence; and consequently, in the large openings of mills and machinery, where great quantities of water are discharged from moderate heads, the head of water, and virtual head determined from the velocity, will nearly agree: which is also confirmed by experience.

6. The most general proportion between the power and expence is that of 10 to 3; the extremes 10 to 2, and 10 to 2.5. But it is to be considered, where the power is greatest, the second term of the ratio is greatest also; hence we may allow the proportion subsisting in great works to be as three to one. 7. The proportion of velocity between the water and wheel is, in general, about five to two. 8. There is no certain ratio between the load that the wheel will carry at its proper maximum, and what will totally stop it; though the proportions are contained within the limits of 20 to 19, and 20 to 15: but as the effect approaches nearest to the ratio of 20 to 15, of 4 to 3, when the power is greatest, either by increase of velocity, or quantity of water, this seems to be the most applicable to large works; but as the load that a wheel ought to have, in order to work to the best advantage, can be assigned by knowing the effect that it ought to produce, and the velocity it ought to have in producing it, the exact knowledge of the greatest load it will bear is of the least consequence in practice.

Mr. Smeston, after having finished his experiments on the undershot-mills, reduced the number of floats, which were originally 24, to 12; which caused a diminution in the effect, by reason that a greater quantity of water escaped between the floats and the floor than before; hence, in order to keep the original impulse, the remainder being spent in changing their figure in consequence of the stroke. The ultimate conclusion is, that the effects as well as the powers are as the quantities of water and perpendicular heights multiplied together respectively.

2. By increasing the head, it does not appear that the effects are at all augmented in proportion; for, by raising it from 3 to 11 inches, the effect was augmented by less than one-seventh of the increase of perpendicular height. Hence it follows, that the higher the wheel is in proportion to the whole descent, the greater will be the effect; because it diminishes less upon the impulse of the head, and more upon the gravity of the water in the buckets: and if we consider how obliquely the water issuing from the head must strike the buckets, we shall not be at a loss to account for the same solid advantage that arises from the impulse thereof, and shall immediately see of how little consequence this is to the effect of an overshot-wheel. This, however, as well as other things, must be subject to improve the writer's conclusions, in the theory of the water should be somewhat greater than the wheel, otherwise the latter will not only be retarded by the striking of the buckets against the water, but some of the power will also be lost in the dashing of the water over the buckets.

3. To determine the velocity which the circumference of the wheel ought to have, in order to produce the greatest effect, Mr. Smeston observes, that the more slowly any body descends by the force of gravity, when acting upon any piece of machinery, the more that force will be spent upon it; and consequently the effect will be greater. If a stream of water falls into the bucket of an overshot-wheel, it will be there retained till the wheel discharges it by moving round; and of consequence, the slower the wheel moves, the more water will it receive: so that what is lost in velocity, with the greater pressure of water upon the buckets. From the experiments, however, it appears, that when the wheel made about 20 turns in a minute, the effect was the greatest; when it made only 18 it was very faulty, and when loaded so as not to admit its turning 18 times, the wheel was overloaded with the load. When it made 30 turns, the power was diminished more than a twentieth; and when the number of turns was increased to 40, it was diminished by one-fourth. Hence we see, that in practice, the velocity of the wheel should not be diminished farther than what can be done by raising the point of power; because, ceteris paribus, the buckets must be larger as the motion is slower; and the wheel being more loaded with water, the stress will be proportionately increased upon every part of it. Moreover, this velocity is necessary for practice, therefore, will be that when the wheel makes 30 turns in a minute, which is little more than three feet in a second. This velocity is applicable to the highest overshot-wheels as well as the lowest. Experience however determines, that high wheels may deviate farther from this rule before they will lose their power by a given aliquot part of the whole, than low ones can be permitted to do; for a wheel of 24 feet high may move at
the rate of six feet per second, while our author states one of them to be steady and well win a velocity of little more than two feet. The reason of this superior velocity in the 24-feet wheel, may probably be owing to the small proportion that the overhead wheel bears to the whole height.

4. The maximum load for an overshot-wheel is that which reduces the circumference of the wheel to its proper velocity; which is known by dividing the effect it ought to produce in a given time, by the space intended to be described by the circumference of the wheel in the same time: the quotient will be the resistance overcome at the circumference of the wheel, and is equal to the load required, including the friction and resistance of the machinery.

5. The greatest velocity that an overshot-wheel is capable of, depends jointly upon the diameter, or height of the wheel, and the velocity of falling bodies; far it is plain that the velocity of the circumference can never be greater than to describe a semicircumference, while a body let fall from the top describes the same in the same time. The difference in point of time must always be in favor of that which falls through the diameter. Thus, suppose the diameter of the wheel to be 10 feet and an inch in diameter, a heavy body would fall through this space in one second; but such a wheel could never arrive at this velocity, or make one turn in two seconds, nor could an overshot-wheel ever come near it, because, after it has acquired a certain velocity, and from the force of the water is prevented from entering the buckets, and part is thrown out again by the centrifugal force; and as these circumstances have a considerable dependence upon the form of the buckets, it is impossible to lay down any general rule for the velocity of this kind of wheels.

6. Though in theory we may suppose a wheel to be made capable of overcoming any resistance whatever, yet, as in practice, it is known by experience, that the wheel and buckets of some certain and determinate size, we always find that the wheel will be stopped by such a weight as is equal to the effort of the water in all the buckets of a semicircumference once put into action, by the force of the water, from the structure of the buckets themselves; but, in practice, an overshot-wheel becomes unserviceable long before this; for when it meets with such an obstacle as diminishes its velocity to a certain degree its motion becomes irregular; but this never happens till the velocity of the circumference is less than the two feet per second, when the resistance is equal.

7. From the above observations we may easily deduce the force of water upon breast-wheels, &c. But, in general, all kinds of wheels where the water cannot descend through a given space unless the wheel moves with it, are to be considered as overshot-wheels; and those which receive the impulse or shock of the water, whether in a horizontal, oblique, or perpendicular direction, are to be considered as undershot. Hence in a wheel in which the water strikes at the top point below the surface of the head, and after that descends in the arch of a circle, pressing by its gravity upon the wheel, the effect of such a wheel will be equal to that of an undershot whose head is equal to the difference of level between the surface of the water in the receiver and where it strikes the wheel, added to that of an overshot whose height is equal to the difference of level between the point where it strikes the wheel and the level of the tail-water.

We shall require these transactions for our author considers some of the causes which have produced dislocations and disputes among mathematicians upon this subject. He observes, that soon after Sir Isaac Newton had discovered, that "the quantity of motion is the measure of the same, arising from the velocity and quantity of matter conjointly," it was controverted by his contemporary philosophers. They maintained, that the measure of the quantity of motion should be estimated by taking the quantity of matter and the square of the velocity conjointly. On this subject he remarks, that from equal impelling powers acting for equal intervals of time, equal augmentations of velocity are acquired by bodies when they are not resisted by a medium. Thus a body descending one second by the force of gravity, passes through a diameter in one second. After the end of that time it has acquired a velocity of 32 ft. 2 inc. in a second: at the end of 2 sec. it has acquired one that would carry it through 64 ft. 4 inches in a second. If, therefore, in consequence of this equal increase of velocity, we define this to be a double quantity of motion generated in a given time in a certain quantity of matter, we come near to sir Isaac's definition: but in trying experiments with the bodies of matter. It appears, that when a body is put in motion, by whatever cause, the impression it will make upon a uniformly resistless medium, or upon uniformly yielding substances, will be as the mass of matter of the moving body multiplied by the square of its velocity. The question therefore properly is, whether those terms, the quantity of motion, the momentum, or forces of bodies in motion, are to be conceived to be such quantities, when they have been generated by an equal impulse acting for an equal, double, or triple time? or that it should be measured by the effects being equal, double, or triple, in overcoming a certain space, or being able to stop? For, according to the meaning we put upon these words, the momenta of equal bodies will be as the velocities or squares of the velocities of the moving bodies.

Though by a proper attention to the terms employed, however, we shall find both these doctrines to be true; it is certain that some of the most celebrated writers upon mechanics have fallen into errors by neglecting to attend to the meaning of the terms they make use of. Desaguliers, for instance, after having been at pains to show that the dispute, which in his time had subsisted for 30 years, was a dispute merely about words, tells us, that both opinions may be easily reconciled in the following case, viz. that the wheel of an undershot water-wheel is capable of doing quadruple work when the velocity of the water is doubled, instead of double work only; on the contrary, admitting the same, we find, that as the water's velocity is doubled, there are twice the number of particles that issue out, and therefore the ladle-board is struck by twice the matter; which matter moving with twice the velocity that it had in the first case, the whole effect must be quadruple, though the instantaneous stroke of each particle is increased in the last proportion of the velocity." In another place the same author tells us, that though the knowledge of the foregoing particulars is absolutely necessary for setting an undershot-wheel to work, yet the advantage to be required from it would still be guess-work, and we should at a loss to find out the utmost that it could perform, had it not been for an ingenious proposition of that excellent mechanic, M. Parenst, of the royal academy of sciences, who has shewed, that an undershot-wheel can do the most work when its velocity is equal to the third part of that of the water; because then two-thirds of the water are employed in driving that part of the force proportional to the square of the velocity. By multiplying the surface of the adjutage or opening by the height of the water, we shall have the column of water that moves the wheel. The wheel then moved will consist of two sides only four-ninths of that weight which will keep it in equilibrium; but what it can move with the velocity it has, is only one-ninth of the equilibrium. This conclusion is likewise adopted by Mr. M. Hov.

Mr. Snaeton, in the year 1759, instituted another set of experiments; the immediate object of which was, to determine what proportion or quantity of mechanical power is expended in giving the same degree of motion, or in producing the same degree of velocity. Having constructed a proper apparatus for the purpose, and with it made a number of experiments, he concludes, that "power, properly speaking, has nothing to do with the production of mechanical effects, otherwise than as by equally flowing it becomes a common measure; so that, whatever mechanical effect is found to be produced in a given time, is always the same, and is independent of the whole power employed, if the same quantity of corn is in an hour: but, supposing the mill to be capable of receiving a greater impulse with as great advantage as is less; then, if the corn is let out twice as fast, the same quantity of corn will be ground in half an hour, the whole of the water being likewise expended in that time. What time has therefore to do in the case is this: Let the rate of division be supposed to be the effect, be what it will; if this rate is uniform, when I have found by experiment what is done in a given time, then, proceeding at the same rate, twice the effect will be produced in twice the time; on supposing that the supply of mechanical power to go on with. Thus, 1000 tons of water descending through 20 feet perpendicular, being, as has been shewn, a given mechanical power, let it be expended in three minutes; then, if this power, being continued, we are to wait another hour till an equal quantity can be procured, then we can only expend 12 such quantities in 24 hours." But if, while the thousand tons of water are expending in one hour, the same quantity is
renewed, we can then expend 24 such in the 24 hours, or go on without intermission. The product or effect will then be in proportion to time, which is the common measure; but the quantity of mechanic power arising from the flow of the two rivers, compared by taking the work done in any one, is equal to that done one to the other; though each has a mill-that, when going, will grind an equal quantity of corn in an hour.\footnote{The following is a description of a common mill of the most common sort. See Plate, Mills.}

A & B (fig. 1) is the water-wheeler, which is generally from 18 to 24 feet in diameter, reckoned from the outermost edge of any flint-board at A, to that of the opposite one at B. The water striking on the floats of this wheel drives it round, and gives motion to the mill. The wheel is fixed upon a very strong axis or shaft, C, one end of which rests on D, and the other on E, within the mill-house.

On this shaft, or axis, and within the mill-house, is a wheel F, about eight or nine feet in diameter, having cogs all round, which work in with the float-board when the wheel is turned to E. This trunche is fixed upon a strong iron axis, called the spindle, the lower end of which turns in a brass foot fixed at H, in a horizontal beam I, called the bridge-tree; and the upper end of the spindle turns in a wooden bush fixed into the nether mill-stone, which lies upon beams in the floor I. The top of the spindle above the bush is square, and goes into a square hole in a strong iron cross-head, (fig. 2,) called the rynd; under which, and close to the bush, is a round piece of thick leather upon the spindle, which it turns round at the same time as it does the rynd.

The rynd is let into grooves in the upper surface of the running mill-stone K, and so turns it round in the same time that the trunche G is turned round by the cog-wheel F. This mill-stone has a large hole quite through its midst, and, like that of the stone, through which the middle part of the rynd and upper end of the spindle may be seen; whilst the four ends of the rynd lie below the stone in their grooves.

One end of the bridge-tree, which supports the spindle, rests upon the wall, whilst the other is let into a beam, called the brayer, LM.

The brayer rests in a mortice at L; and the other end M hangs by a strong iron rod N, which goes through the floor I, and has a screw-nut on its top at O; by the turning of which nut, the end M of the brayer is raised or depressed at pleasure; and consequently the bridge-tree and the upper mill-stone. By this means the upper mill-stone may be set as close to the lower one, or raised as high from it, as the miller pleases.

The nearer the mill-stones are to each other, the finer the corn is ground; and the more remote from one another, the coarser.

The upper mill-stone is inclosed in a round box, which does not touch it anywhere, and is about an inch distant from its edge all round. On the top of this box stands a frame for holding the hopper P, to which is hung the shoe Q, by two lines fastened to the hinder part of it, fixed upon hooks in the hopper, and by one end of the string R fastened to the fore part of it; the other end being twisted round the pin S. As the pin is turned one way, the string draws up the shoe closer to the hopper, and so lessens the aperture between them; and as the pin is turned the other way, it lets down the shoe, and enlarges the aperture.

If the shoe is drawn up quite to the hopper, no corn can fall from the hopper into the mill: if it is let down a little, some will fall; and the quantity will be more or less, according as the shoe is more or less let down; for the hole in the bottom of the shoe, not directly under the bottom of the hopper, but nearer to the lowest end of the shoe, over the middle eye of the mill-stone.

There is a square hole in the top of the spindle, in which is put the feeder F (fig. 2); this feeder, as the spindle turns round, jogs the shoe three times in each revolution, and so causes the corn to run constantly down from the hopper through the shoe into the eye of the stone where it falls upon the top of the rynd, and is, by the motion of the rynd, and the leather under it, thrown down the upper stone, and ground between it and the lower one. The violent motion of the stone creates force in stone, as it is going round with it, by which means it gets farther and farther from the stone, as in a spiral, in every revolution, until it is quite thrown out; and being then ground, it falls through the middle eye of the mill-stone, into a trough placed to receive it.

When the mill is fed too fast the corn bears up the stone, and is ground too coarse; and, besides, it clogs the mill, so as to make it go too slow. When the mill is too slowly fed, it goes too fast; and the stones, by their attrition, are apt to strike fire. Both these inconveniences are avoided by turning the pin S backward or forward, which draws up or lets down the shoe; and then regulates the feeding, as the miller sees convenient.

The heavier the running mill-stone is, and the greater the quantity of water that falls upon the wheel, the faster will the mill bear to be fed, and consequently it will grind the more: and, on the contrary, the lighter the stone, and the less the quantity of water, the slower the miller must feed it. But when the stone is considerably worn, and become light, the mill must be fed slowly at any rate; otherwise the stone will be too much borne up by the corn under it, which will make the meal coarse.

The quantity of power sufficient to turn a heavy mill-stone, is but very little more than what is necessary to turn a light one; for as the latter is supported upon the spindle by the bridge-tree, and the end of the spindle that turns in the brass foot therein being but small, the difference arising from the weight is but very inconsiderable in its action against the power or force of the wheel and, besides, a large stone has the same advantage as a heavy lye, namely, that it regulates the motion much better than a light one.

The centrifugal force carrying the corn towards the circumference of the stone, is natural it should be crushed, when it comes to a place where the interval between the two mill-stones is less than its thickness; yet the upper mill-stone being supported on a point which it can never quit, it does not so clearly appear why it should produce a greater effect when it is heavier than when it is lighter; since, if it were equally distant from the nether mill-stone, it could only be capable of a limited impression. But as experience proves that this is really the case, it is necessary to discover the reason. The reason is, that the upper stone being supported by a horizontal piece of timber, about nine or ten feet long, resting only on both ends, by the elasticity of this piece, the upper mill-stone is allowed a vertical motion, playing up and down; by which movement, the heavier the stones are, the more forcibly is the corn wedged in between them.

In order to cut and grind the corn, both the upper and under mill-stones have channels or furrows cut into them, proceeding obliquely from the centre to the circumference. And these furrows are cut perpendicularly on one side, and obliquely on the other, which gives each furrow a sharp edge; and in the two stones they come against one another, like the edges of a pair of scissors; and so cut the corn, to make it grind the easier, when it falls upon the places between the furrows. These are cut the same way in both stones, but so as to make them run crossways to each other when the upper stone is invected, by turning its furrowed surface towards that of the lower; so as the furrows of both stones lay the same way, a great deal of the corn would be driven over in the lower furrows, and so come out from between the stones, without being either cut or bruised.

The grinding surface of the under stone is a great concave, cut so as to be edge to the centre, and that of the upper stone a little concave, so that they are farthest from one another in the middle, and approach gradually nearer towards the edges. By this means the corn, at its first entrance between the stones, is only bruised; but as it goes farther on towards the circumference or edge, it is cut smaller and smaller; and, at last, finely ground, just before it comes out from between the stones.

When the furrows become blunt and shallow by wearing, the running-stone must be taken up, and both stones new dressed with a chisel and hammer; and every time the face of the stone is worked over, the same allowance is made in the upper stone, so that when round the spindle upon the bush, which will soon be melted by the heat, the spindle acquires from its turning and rubbing against the bush, and so will get in betwixt then; otherwise the bush would take fire in a very little time.

The bush must embrace the spindle quite close, to prevent any shake in the motion, which would make some parts of the stones grate upon others, whilst the other parts of them would be too far asunder, and by that means spoil the meal.

Whenever the spindle wears the bush, so as to begin to shake in it, the stone must be taken up, and a chisel driven into several parts of the bush; and when it is taken out, wooden wedges must be forced into the holes; by which means the bush will be made to embrace the spindle again, close round. In order to drive these wedges into the bush on opposite sides of the spindle; otherwise it will be thrown out of the perpendicular, and so hinder the upper stone from being set parallel to the under one, which is absolutely necessary for
making good work. When any accident of this kind happens, the perpendicular position of the spindle must be restored, by adjusting the bridge-true with proper wedges put between it and the beam.

It often happens that the yund is a little wrinkled in laying down the upper stone upon it, or is made to sink a little lower on one side of the spindle than on the other; and this will cause one edge of the upper stone to drag all round upon the other, while the opposite edge will not touch. But this is easily set to rights, by raising the stone a little with the lever, and putting bits of paper, cards, or thin chips, between the yund and the stone.

A less quantity of water will turn an undershot-mill (where the wheel has buckets instead of float-boards) than a breast-mill, where the fall of water seldom exceeds half the height of the wheel; so that there is but a small quantity of water, and a fall great enough for the wheel to lie under it, the bucket, or overshot-wheel, is always used: but there is a great difference in the speed of the water under a little fall, the breast, or float-board, wheel must be used. Where the water runs only upon a small declivity, it can act but slowly upon the under part of the wheel; in which case the motion of the wheel will be slow, and therefore the floats ought to be very long, though not high, that a large body of water may act upon them; so that what is wanting in velocity may be made up in power; and then the cog-wheel may have a greater number of cogs, in proportion to the rounds in the trundle, in order to give the mill-stone a sufficient degree of velocity.

It was the opinion of Sneaton, that the powers necessary to produce the same effect on an undershot-wheel, a breast-wheel, and an overshot-wheel, must be to each other as the numbers 2, 1.75, and 1.

Practical rules for the construction of mills. — 1. Measure the perpendicular height of the fall of water, in feet, above that part of the wheel on which the water begins to act, and call that the height of the fall.

2. Multiply this constant number 64.2892 by the height of the wheel, and the root of the product will be the velocity of the water at the bottom of the fall, or the number of feet that the water there moves per second.

3. Divide the velocity of the water by three, and the quotient will be the velocity of the float-boards of the wheel, or the number of feet they must each go through in a second, when the water acts upon them so as to have the greatest power to turn the mill.

4. Divide the circumference of the wheel in feet by the velocity of its floats in feet per second, and the quotient will be the number of seconds in which the wheel turns round.

5. By this last number of seconds divide 60, and the quotient will be the number of turns of the wheel in a minute.

6. Divide 120 (the number of revolutions a mill-stone four feet and a half diameter ought to have in a minute) by the number of turns of the wheel in a minute, and the quotient will be the number of turns the mill-stone ought to have for one turn of the wheel.

Then, as the number of turns of the wheel in a minute, is to the number of turns of the mill-stone in a minute, so must the number of stones in the trundle, be to the number of cogs in the wheel, in the nearest whole numbers that can be found.

By these rules the following table is calculated to a water-wheel 18 feet diameter, which may be a good size in general.

The Mill-Wright's Table.

<table>
<thead>
<tr>
<th>Height of the fall of water</th>
<th>Velocity of the water per second</th>
<th>Velocity of the wheel per second</th>
<th>Revolutions of the wheel in 120 parts of a rev.</th>
<th>Revolutions of the mill-stone for one of the cogs or staves in the trundle.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Feet</td>
<td>Feet of a foot</td>
<td>Feet</td>
<td>Feet of a foot</td>
<td>Revolutions</td>
</tr>
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<td>-----</td>
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<td>-------------</td>
</tr>
<tr>
<td>1</td>
<td>8.02</td>
<td>2.67</td>
<td>2.83</td>
<td>42.40</td>
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<td>2</td>
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<td>30.00</td>
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<td>13.92</td>
<td>4.65</td>
<td>4.91</td>
<td>31.44</td>
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<tr>
<td>4</td>
<td>16.04</td>
<td>5.35</td>
<td>5.67</td>
<td>21.16</td>
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<td>17.93</td>
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<td>18.92</td>
</tr>
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<td>19.64</td>
<td>6.53</td>
<td>6.94</td>
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<td>7.07</td>
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<td>16.90</td>
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<td>22.68</td>
<td>7.56</td>
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<td>24.05</td>
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<td>35.36</td>
<td>12.15</td>
<td>12.37</td>
<td>12.46</td>
</tr>
</tbody>
</table>

To construct a mill by this table, find the height of the fall of water in the first column, and against that height, in the sixth column, you have the number of cogs in the wheel, and staves in the trundle, for causing the mill-stone, four feet six inches diameter, to make about 190 revolutions in a minute, as near as possible, when the wheel goes with one-third part of the velocity of the water. And it appears by the 7th column, that the number of cogs in the wheel, and staves in the trundle, are so near the truth for the required purpose, that the number of revolutions of the mill-stone in a minute is 118, and the greatest number never exceeds 121; which is according to the speed of some of the best mills.

One of the most usual communications of motion in machinery, is by means of toothed wheels acting on each other. It is of the greatest consequence to have the teeth so formed, that the pressure by which one of them urges the other round its axis is constantly the same. This is by no means the case when the common construction of a spur-wheel, acting in the cylindrical staves of a lathe, or trundle, is used. The ends of teeth should never be formed of parts of circles, but of a particular curve, called the epicycloid, which is formed by moving the circle, called the generating circle, round the circumference of another circle, while it cuts the inner or under sides of the teeth may be of any form, yet it is better to make both sides alike, which will serve to make the wheel turn backwards. The more teeth that work together the better; at least one tooth should always begin before the other has done working. The teeth ought to be disposed as not to trouble or hinder one another before they begin to work.

If the cogs of a wheel and rounds of a trundle could be put in as exactly as the teeth are cut in the wheel and pinnings of a rack, then the trundle might divide the wheel exactly, that is to say, the trundle might make a given number of revolutions for one of the wheel, or their fraction. But as any exact number is not necessary in mill-work, the cogs and rounds cannot be set in so truly as to make all the intervals between them equal, a skilful mill-wright will always give the wheel what he calls a hunting-cog; that is, one more than what will answer to an exact division of the wheel by the trundle. And then as every cog comes to the trundle, it will take the next staff, or round, behind the one which it took in the former revolution; and by that means will wear all the parts of the cog, and rounds which work upon one another equally, and to equal distances from one another, in a little time. See Flour-Mill.

Mills, BARK, like most other mills, are worked sometimes by means of horses, at others by water, and at others by wind. One of the best mills we have seen described for this purpose is that invented by Mr. Bag- 

wells, of Worcestershire; this machine will serve not only to grind, to riddle, and pound it, but to beam, or work green hides and skins out of the master- ing, or drench, and make them ready for the ome, or bark-barrow; to beam sleeperskins and other skins for the Skinner's use, and to scour and take off the bloom from tanned
leather, when in the currying state. The nature and connection of the different parts of this contrivance may be understood from the figures and following description:

Fig. 3 is a horizontal plan of the mill. Fig. 4, a vertical section of it. Fig. 5, a transverse section of it.

A, the water-wheel, by which the whole mechanism is worked.
B, the shafts.
C, the spur-wheel, which is fixed on the water-wheel shaft B, and turns the upright shaft E, by the wheel F, and works the cutters and hammer by taps.
D, the spur and bevel-wheel at the top of the large upright shaft E.
E, the upright shaft.
F, the crown-wheel, which works in the pit-wheel G.
G, the spur-wheel or the stone I.
H, the hammer, to crush or bruise the bark that falls into the dish S, which said dish is on the incline, so that the hammer keeps forcing it out of the lower side of the said dish when bruised.
K, the wheel, to receive the dust and moss that passes through the trial Q.
L, the bevel-wheel, which works in the wheel D, which works the beam-knife by a crank V, at the end of the shaft n.
M, the pinion or pin-wheel, which leads from the crank V to the start x.
N, the start, which has several holes in it to lengthen or shorten the stroke of the beam-knife.
O, the shaft, to which the slide-rod k, h, are fixed by the start n.
P, the slide-rod, on which the knife f is fixed; which knife is to work the hides, &c.
Q, the trial that receives the bark from the cutters, and conveys it into the hopper H, by which it descends through the shoe to the stone I, where it is ground.
R, the spur-wheel, which receives the bark from the stone I, and conveys it into the trial L, which trial is used to sift or dress the bark, as it descends from the stone I.
S, the mout, through which to receive the bark that passes through the trial L. It is not necessary to describe the other parts of this machine, which are to be understood from the annexed drawing. The principal parts of the mechanism which relates to the turning of the sides of the bark are fixed on the axis, and the long axis of the mill.

The bark, after it has been cut by the knife f, is conveyed by the beam-knife B, into the hopper H, thence conveyed by the upright shaft E, and turned by the beam-knife B, and the hammer C, and the crown-wheel F, which works on the pit-wheel G, and works with the upright shaft E, and works with the upright shaft E, and the water-wheel A, which is turned by the water-wheel A.

The beam P, with knives or cutters, may either be worked by tappers, as described, or by the bevel-wheel B, with a crank, as V, to cut the same as shears.

The knife f is fixed at the bottom of the start, which is fixed on the slide-rod k; the bottom of the start is split open to admit the knife f, which should have a gudgeon at each end, to fix it in the open part of the start; and the two springs a, a, prevent the knife from giving too much play in this way when working; the knife should be one foot long, and from five to seven inches broad.

The arch-head e will shift nearer to, or farther from, the beam b, and will be fixed so as to carry the knife back as far as is wanted, or it may be taken away till wanted.

The trials k, for use in placing the knife at the handle m, which takes up the slide-rod so high as to give head-room under the beam-knife. The handle may be hung up with a wheel to turn it in the required direction, or to be turned by hand to turn it up or down. The wheel will turn it up or down, and the handle may be turned in either direction.

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feet while his fore feet will be at rest; and further, the motive force being applied near the vertex of the wheel will act with but little advantage, and the work done will be comparatively trifling.

Hand – Mill, or horse-mill, is that worked by the hand, or by horses, &c. There is a long beam or lever for moving it, so attached that it may receive many men or horses, to drive several mills at once. There is the cog-wheel, placed horizontally, with pins fixed, not on its plane, but on the outside, at the circumference of the joints. There are also the trundle-head, the support, the iron rails, and the drum where the mill-stones are inclosed.

MILLENIARIES, or CHILLASTS, a name given to those who, in the primitive ages, believed that the saints will one day reign on earth with Jesus Christ a thousand years.

MILLEPES. See OSICUS.

MILLEPORA. See MADRASPORA, ZOO-PHITAE, and Plate Nat. Hist. figs. 266, 267.

MILLERIA, a genus of the syngeosis polygamaeian class of plants, the compound flower of which is radiated; there is scarcely any visible receptacle of the seeds, which are scattered after each particular flower, and have no pappus or down. There are three species.

MILLET. See MILLUM, and PANCUM.

MILLET-GRASS. See MILIUM.

MILLING. See FOLLING.

MIMOSA, the sensitive plant, a genus of the polygama order, in the monocot class of plants, and in the natural method ranking under the 33d order, lomentaceae. The herbaceous calyx is quinquedentate; the corolla quinquelat; there are five or more stamens, one pistil, and a legumen; the male calyx is quinquedentate; the corolla quinquelat, with five, ten, or more stamens.

The name mimosa signifies "tender," and is given to this genus, from the sensitiveness of the leaves, which, by their motion, mimic or imitate the motion of animals. This genus comprises 83 different species, all natives of warm climates. Of the species cultivated here in our gardens, &c. some are of the shrub and tree kind, and two or three are herbaceous perennials and annuals. The sensitive kinds are exceedingly curious plants in the very singular circumstance of their leaves receding rapidly from the touch, and running up close together; and in some sorts the foot-talks and all are affected, so as instantly to fall downward as if fastened by hinges, which last are called humire sensitive. They have all winged leaves, each wing consisting of many small pinnae.

The following are the most remarkable:

1. The sensitive, or common sensitive humire plant, rises with an under-shrub pricky stem, branching six or eight feet high, armed with crooked spines; conjugated, pinnated leaves, with bigjugated partial lobes or wings, having the inner ones the least, each leaf on a long footstalk; and at the sides and ends of the branches many purple flowers in roundish heads; succeed by broad, flat, jointed pods, in radiated clusters. This is somewhat of the humble sensitive kind; the leaves, footstalks and all, receding from the touch, though not with such facility as in some of the following sorts.

2. The pudica, or bashful humire plant, rises with an under-shrubby, pricked stem, branching two or three feet round, armed with hairy spines. This is truly of the humble sensitive kind; but for the leaves to touch the leaves instantly recede, contract, close, and, together with the footstalk, quickly decline downward, as if ashamed at the approach of the hand.

3. The perambuca, or perambuca slothful mimosa, recedes very slowly from the touch; it has only a little, when smartly touched: hence the name slothful mimosa.

4. The asperata, or Panama sensitive plant, seldom rises above three feet in height; but it has a stem, the leaves of which are so sensitive that it will recede, when touched, upon the neighbouring bushes. It is armed with crooked sharp spines, so thickly set on the trunk, branches, and leaves, that there is no touching it with safety. But the plant has a most singular appearance; it is covered with long and globular, growing at the extremity of the branches. The pods are hairy, brown, and jointed; each containing a small, flat, and brown seed. The leaves are numerous, small, and rounded, and the mimosa princi- dica they are the most irritable; contracting with the least touch, and remaining so for several minutes after. This species would form a good hedge or fence round a garden.

The punctuated sensitive mimosa, rises with a shrubby, upright, taper, spotted, unarm ed stem, branching erectly five or six feet high; bipinnated leaves, of five or five pair of long winged foli oles, having each about 20 pair of pins e; and at the axillias and termination of the branches oblong spikes of yellowish decandrous flowers, the inferior ones castrated; succeeded above by oblong pod-pods. This species is naturally on the shrubby and perennial in its native soil, yet in this country sometimes decays in winter. It is only sensitive in the foliolas, but quick in the motion.

5. The saya, lively mimosa, or smallest sensitive weed, has many creeping roots, and spreads itself so as to cover large spots of ground. It rises at most to two inches, and has winged leaves, with numerous small pinnas. The fruits are characteristic of the mimosa colour, and grows in clusters from the axille: these are followed by little, short, hairy pods, containing smooth shining seeds. This is the most sensible of all the mimosas, the pudica not excepted. By running a stick over the plant, a person may write his name, and it will remain visible for ten minutes.

6. The quadrivalvis, perennial, or quadrivalve humire mimosa, has herbaceous, slender, quadrangular, prickly twigs or branches, spreading all around, armed with recurved spines; bipinnated leaves of two or three pair of winged lobes, having each many pins e; and at the axillias globular heads of purple flowers, succeeded by quadrivalve pod-pods. This is of the humble sensitive kind, both leaves and footstalks receding from the touch.

7. The plena, annual, or double-flowered mimosa mimosa, rises with an herbaceous, erect, round, unarmed stem, closely branching and spreading every way, three or four feet high; bipinnated leaves of four or five pair of winged lobes, of many pairs of pinnae; and at the axillias and termination of the branches, spikes of yellow petaloid flowers, the lower ones double, succeeded by short pod-pods. This annual is only sensitive in the foliolas, but extremely sensible of the touch or air.

8. The cornigera, or horned Mexican mimosa, has a shrubby, upright, pricked stem, branching irregularly, armed with very large horn-like white spines, by pairs, connected at the base; bipinnated leaves thinly plac ed; and flowers growing in spikes. This species is esteemed for curiosity for the oddity of its large spikes, resembling the horns of animals, and which are often variously wretched, twisted, and contorted.

9. The barbatens, or fragrant acacia, grows in woods and waste lands in most parts of Jamaica; rising to 25 or 30 feet, with suitable thickness. Formerly the flowers of this tree were used as an ingredient in the thecias and androches, or the capers. The tree is sometimes planted for a hedge or fence round inclosures; and the timber, though small, is useful in rural economy.

10. The arbores, or wild tamarind-tree, is common in all the woods and openings, but nowhere where settlements have been made, in Jamaica. It rises to a considerable height, and is proportionally thick. The timber is excellent, and serves many purposes in rural economy, and is of the colour of cedar, pretty hard, and takes a good polish. The leaves are numerous; the flowers globular and white. The pods are about a foot in length, of a fine scarlet colour; when they ripe they open and become twisted. The seeds then appear.

11. The latifolia, slag-bark, or white wild tamarind. This excellent timber-tree is very common in Jamaica, and rises to a moderate height and good thickness. The trunk is rough and scaly; the leaves are numerous, of a rhomboidal figure, and yellowish, cast. The flower-spikes are from the axille; their colour is yellow. The seed-vessels are flat, jointed, and twisted, with the bigness of a vetch, white, and finely streaked with blue.

12. The lebeck, or ebony-tree. This is a native of the East Indies, but raised from seeds in Jamaica and St. Vincent. The tree is very small, and of a very hard wood. The flowers are red, and the manna taken from the sap is used for the manufacture of a fine sugar.

13. The scandens, caecum, or maltooloo, is frequent in all the upland valleys and woodlands on the north side of Jamaica. It climbs up the tallest trees, and spreads itself in every direction by means of its branches, or claspers, so as to form a complete arbour, and to cover the space of an English acre from one root. This circumstance has a bad effect on the trees or bushes so shaded; light, air, and rain, (so necessary for all plants,) being shut out, the leaves drop off, the tree gradually rots, and the limbs fall down by the weight of this parasite.

The roots of this plant run superficially under the ground or herbage. The trunk is seldom thicker than a man's thigh; and sends off many branches, with numerous shining green leaves, each of which terminates in a tendril or clasper, that serves to fasten it to the tree or bush. The flower-spikes are from the axille: they are slender, and the flowers on them small and numerous. The pod is perhaps the largest and longest in the world; being sometimes eight or nine feet in length,
five inches broad, jointed, and containing 10 or 13 seeds. These seeds are brown, shining, flattened, and very hard, and called carcons. They are the same as mentioned in the Philos. Herc. No. 222, page 261; and by Sir Hans Sloane, as being thrown ashore on the Hebrides and Orkneys.

This bean, after being long soaked in water, is boiled and eaten by some negroes; but, in general, there seems to be no other use made of it than as a sort of snauff-box.

15. The catechu, according to Mr. Ker (Med. Obs. and Inquir. vol. v. p. 131, &c.), grows only to 12 feet in height, and to one foot in diameter; it is covered with a thick, rough, brown bark, and towards the top divides into many close branches; the leaves are bipinnate, or doubly winged, and are placed alternately upon the younger branches; the partial pairs are nearly two inches long, and are commonly from 15 to 30 pair, having full glands inserted between the pinnae; each wing is usually furnished with about 40 pair of pinnule, or linear lobes, beset with short spines. From this tree, which grows plentifully on the mountainous parts of Indostan, where it flowers in June, is produced the official drug long known in Europe by the name of terra japo- nica.

16. The nilotica, or true Egyptian acacia, rises to a greater height than the preceding. The fruit is a long pod, resembling that of the lupin, and contains many flattish brown seeds. It is a native of Arabia and Egypt, and flowers in July. Although the mimosa nilotica grows in great abundance over the vast extent of Africa, yet gum arabic is produced chiefly by those trees which are situated near the equatorial regions; and we are told that in Lower Egypt the solar heat is never sufficiently intense for this purpose. The gum exudes in a liquid state from the bark of the trunk and branches of the tree, in a similar manner to the gum which is often produced upon the cherry-trees, &c. in this country; and by exposure to the air it soon acquires solidity and hardness. In Senegal the gum begins to flow upon the trees first opened, and the flowers continue during the rainy season till the month of December, when it is collected for the first time. Another collection of the gum is made in the month of March, from incisions in the bark, which the extreme dryness of the air at that time is said to render necessary. Gum arabic is now usually imported into England from Barbary, in large casks or hog-heads. The common appearance of this gum is well known; and various the figures which it assumes seem to depend upon a variety of accidental circumstances attending its transmu- nation and concretion. Gum arabic of a pale yellowish colour is most esteemed; on the contrary, those pieces which are large, tough, of a roundish figure, and of a brownish or reddish hue, are found to be less pure, and are said to be produced from a different spe- cies of mimosa; but the Arabian and Egyp- tian gum is contaminated with the mineral of this kind, similar to that which comes from the coast of Africa near the river Senegal.

Gum arabic does not admit of solution by spirit oil; but in twice its quantity of water it dissolves into a mucilaginous fluid, of the consistence of a thick syrup; and in this state answers many useful pharmaceutical purposes, by rendering oily, resinosous, and phlegmous substances, miscible with water. The glutinous quality of gum arabic is pre- sumably traced to two substances, as a demulcent in coughs, hoarse- nesses, and other catarhal affections, in order to obtain irritating acrimonious humours, and to supply the loss of abraded mucous. It has been very generally employed in pastes of arder urine and strangury; but it is the opinion of Dr. Cullen, "that even this mu- cilage, as an internal demulcent, can be of no service beyond the alimentary canal." The inner part of the Nilotic or Greek gum, is a kind of muscle, in which the vessels are large, and through which the water flows. It is more numerous in the East Indies, and was some time ago introduced into Jamaica. The flowers are globular, yellow, and fragrant. The pods are brown, and of the size of a goose-quill. The tree, on being wound, exudes gum arabic, though in less quantity, and less transparent, than that of the shops, which is obtained from the nilotica above described.

There are above 40 other species character- ized in Systema Vegetabilium.

MIMULUS, monkey flower, a genus of the dillenium angiospernia class of plants, with double stigmas, and a ringent monopetalous flower; the fruit is a bilocular carpel, with three seeds in each cell. There are three species.

MIMUSOPS, a genus of the octandra monogynia class of plants, the corollas of which consist of eight petals; and its fruit is a drupe. There are three species, tree of the East Indies.

MINA, in Grecian antiquity, a money of account, equal to a hundred drachms.

MINE, a deep pit under ground, whence various kinds of minerals are dug out; but the term is more particularly applied to those which yield metals. Where stones only are procured, the appellation of quarries is uni- versally bestowed upon the places from which they are dug out, however deep they may be.

The internal parts of the earth, as far as they have been yet investigated, do not consist of a homogeneous mass of one uniform substance, but of strata or beds of substances, extremely differ- ent in their appearances, specific gravities, and chemical qualities, from one another. Neither are these strata similar to one an- other, either in their nature or appearance, in different countries; so that, even in the short extent of half a mile, the strata will be found quite different from what they are in another place. As little are they the same either in depth or solidity. Incalculable cracks and fissures, by the miners called lodes, are found in every one of them; but these are so entirely different in size and shape, it is impossible to form any inference from their side in one place to that in another. In these lodes or fissures the metallic ore is met with; and, considering the great uncer- tainty of the dimensions of the lodes, it is evident that the business of mining, which depends on that size, must in like manner be quite unlimited; and therefore the miners must not suffer the vein to descend in any direction, but follow it as far as possible.

The sides of the fissures are commonly covered over with a hard, crystalline, earthy substance or rind, which very often, in the breaking of hard ore, comes off along with the fissure; and is only called the caps or walls of the lode.

The breadth of a lode is easily known by the distance between the two intrusted sides of the stones of ore; and if a lode yields any kind of ore, it is a better sign that the vein is regular and at least that one of them is so, than otherwise; but there are not many of these fissures which have regular walls until they have been sunk down some fathoms.

Thus the inner part of the fissure in which the ore lies is all the way bounded by two walls of stone, which are generally paralleled to one another, and include the breadth of the vein or lode. Whatever angle of inclina- tion some fissure may have, and however at their beginning, generally continue to do the same all along. Some are very uncer- tain in their breadth, as they may be small at their upper part and wide underneath; and vice versa. Their regular breadth, as well as their depth, is subject to great variation; for though a fissure may be many fathoms wide in one particular place, yet a little far- ther east or west it may not perhaps be one inch wide. This effect takes place generally in very compact strata, where the vein or fissure is squeezed, in a manner, through hard rocks which seem to press and straiten it. A true vein or fissure, however, is never entirely but always shows a string of metallic ore, or of a vein substance; which often serves as a leader for the miners to follow, until it sometimes leads them to a large and richly impregnated part.

The length of a fissure is not great in measure, unlimited, though not the space best fitted for yielding metal. The richest state for copper is from 40 to 50 fathoms deep; for tin, from 20 to 60; and though a great quality of either may be raised at 80 or 100 fathoms, yet the quantity is often too much decayed and dry for metal.

The fissures or veins of the Cornish mines extend from E. to W.; or, more properly, one end of the fissure points W. and by S., or W. and by N., while the other trends E. and by S. or E. and by N. Thus they fre- quently pass through a considerable tract of country with very few variations in their di- rection, and they are divided by some intervening cause. But, besides this east and west direction, we are to consider what the miners call the underlying, or lode, of the vein or lode, viz. the deflection or deviation of the fissure from its original line, as it is followed in depth like the slope of a house, or the descent of the steep side of a hill. This slope is generally to the north or south; but varies much in different veins, or sometimes even in the same vein; for it will frequently slope or underlie a small space in different ways, as it may appear to be forced by hard strata on either side. Some of the fissures do not vary much from a perpendicular, while some deviate more than a fath- som; that is, for every fathom they descend in perpendicular height, they deviate like- wise as much to the south or north. Others differ so much from the perpendicular that they assume a position almost horizontal; whereby they are also called flat or flat or lodes, and sometimes lode-plots. Another kind of these has an irregular position with regard to the rest, widening horizontally away, and then descending perpen- dicularly almost by a small string or leader to follow after; and thus they alternately vary, and yield ore in several flat
MINE.

or horizontal fissures. This, by the Cornish miners, is called a floor or squaw; which, properly speaking, is a hole or_space incogged with metal, making no continued line of direction or regular wall. Neither does a floor of ore descend to any considerable depth; for underneath it there appears no sign of a vein or fissure, either leading directly down, or any other way. This kind of vein is very rare in Britain. The fissures most common in Britain are the perpendicular and inclined, whether their direction is north or south, east or west.

The perpendicular and horizontal fissures probably remain little altered from their first position, when they were formed at the inclination of the strata immediately after the waters left the land. The perpendicular fissures are found more commonly situated in level ground, at a distance from hills, and from the sea-coast; but with regard to the latter, we find that the upper and under masses of strata differ in their solidity and other properties.

"Hence it is very plain that inclined fissures owe their direction or underlie to some extraordinary cause. Though the metallic veins generally run from east to west, they are frequently intersected by veins or lodes of other matters, which run from north to south. Some of these cross veins contain lead or antimony, but never tin or copper. Sometimes one of these unmetallic veins intersects the true one at right angles; sometimes obliquely; and sometimes the mixture of both is so intimate, that the searchers are at a loss to discover the separated part of a true vein. When this last is intercepted at right angles, it is moved, either north or south, a very little way, perhaps not more than half a mile, or two miles at the utmost. Sometimes the miners have worked to a small distance in one of these directions, if they find themselves disappointed, turn to the other hand, and seldom fail of meeting with what they expected. Sometimes they are directed in their search by the pointing of a rib or string of the true vein; but when the interruption happens in an oblique direction, the difficulty of finding the vein again is much greater.

When two metallic veins in the neighbourhood of each other run in an oblique direction, and of consequence meet together, they commonly produce a body of ore at the place where they intersect; and if both are rich, the quantity will be considerable; but if one is poor and all the other rich, it will not be required that the miners have worked to a small distance in one of these directions, if they find themselves disappointed, turn to the other hand, and seldom fail of meeting with what they expected. Sometimes they are directed in their search by the pointing of a rib or string of the true vein; but when the interruption happens in an oblique direction, the difficulty of finding the vein again is much greater.

Sometimes there are branches without the walls of the vein in the adjacent strata, which often come either obliquely or transversely into the strata, as if impregnated with ore, or if they underlie faster than the true vein (that is, if they dip deeper into the ground), then they are said to overtake or come into the lode, and to enrich it; or if they do not, then they are said to go off from it, and to impoverish it. But neither these, nor any other, marks, either of the richness or poverty of a mine, are entirely to be depended upon: for many mines, which have very bad appearance at first, do nevertheless turn out extremely well afterwards; while others, which in the beginning seemed very rich, turn gradually worse and worse: but, in general, where a vein has had a bad appearance at first, it will be imprudent to be at much expense with it.

Veins of metal, as has been already observed, are frequently compressed between hard strata that they are not an inch wide; and consequently, if the vein of good ore, it will generally be worth while to pursue them; and they frequently turn up well at last, after they have come into softer ground. In like manner, it is an encouraging thing to go on in the chambers of ore, and to enlarge either in width or depth as they are worked; but it is a bad sign if they continue horizontal without inclining downwards; though it is not proper always to discontinue the direction of a vein till a favourable object is met with at first. Veins of tin are worth working when only three inches wide, provided the ore is good; and copper ores when six inches wide will pay well for the working. Some of the great mines, however, have very large veins, with a number of other small ones very near each other. There are also veins crossing one another sometimes met with, which are called contras, or small counters. Sometimes two veins run down into the ground in such a manner that they meet in the direction of their depth; in which case the observations applied to them as are applicable to shafts that meet at right angles, or are perpendicular. The method of recovering their vein is to drive on their work in the direction of the former part, so that their new work shall make the same angle with the clay that the other part of the vein making at times they sink a shaft down from the surface; but it is generally a matter of difficulty to recover a vein when thus lost.

The method of discovering mines is a matter of so much difficulty, that it seems surprising how those who were totally unacquainted with the nature of metals first came to think of digging them out of the earth. In modern times we know that mines have been frequently discovered by accident; as by washing of the tides or floods; by the washing of the tides or floods; also by irrigations and torrents of water issuing out of hills and mountains, and sometimes by the wearing of high roads.

Mines, however, are now most commonly discovered by investigating the nature of such veins, ores, and stones, as may seem most likely to turn to account: but there is a particular sagacity, or habit of judging from particular signs, which can be acquired only by long practice. Many of those who acquire the art of knowing whether those vein of copper, may also be discovered by the harsh and disagreeable taste of the waters which issue from them; though it is probable that this only happens when the ore lies under the level of the water which breaks out; for it does not seem likely that the taste of the ore could ascend, unless we were to suppose a pond or lake of water standing above it. The presence of copper in any water is easily discovered by introducing in it a bit of polished iron, which will instantly be turned of a copper colour, from the precipitation of the metal upon it. A candle, or a piece of tallow, put into water of this kind, will in a short time be tinged of a green colour.

After the mine is found, the next thing to be considered is, whether it may be dug to advantage. In order to determine this, we are duly to weigh the nature of the place, and its situation; the nature of the water; the quality, healthiness, and the like; and compare the result with the richness of the ore, the charge of digging, stamping, washing, and smelting.

The form and situation of the spot should be particularly well considered, for no mine must either happen, 1. in a mountain; 2. in a hill; 3. in a valley; or, 4. in a flat. But mountains and hills are dug with much greater ease and convenience, chiefly because the drains and burrows, that is, the adits or avenues, may be here readily cut, both to drain the water, and to form gangways for bringing out the lead, &c. In all the four cases, we are to look out for the veins which the rains or other accidental circumstances may have laid bare; and if such a vein is found, it may often be proper to open the mine at that place, especially if the vein proves tolerably large and rich; otherwise mines may be more advantageously prospected by being determined upon for the purpose, viz. neither on a flat, nor on the top of mountains, but on the sides. The best situation for a mine is a mountainous, woody, wholesome spot, a safe passage, and a clear and wholesome river. The places abounding with mines are generally healthy, as standing high, and every where exposed to the air; yet some places where mines are found prove poisonous, and can upon no account be dug.

Devonshire and Cornwall, where there are a great many mines of copper and tin, are a very mountainous country, which gives an opportunity in many places to make adits or shafts and levels to the mine, without much distance, by which to carry off the water from the mine, which otherwise would drown them out from getting the ore. These adits are sometimes carried a mile or two, and dug at a vast expense, as from 2000l. to 4000l. especially where the ground is rocky; and yet they find this cheaper than to draw up the water out of the mine quite to the top, when the water runs in plenty, and the mine is deep. Sometimes the water is conveyed from a mine under a level near enough to which an adit may be carried from the bottom of the mine; yet they find it worth while to make an adit.
at half the height to which the water is to be raised, thereby saving half the expense.  

The late Mr. Coster, considering that sometimes from small streams and sometimes from little springs or collections of rainwater, one might have a good deal of water above ground, though not a sufficient quantity to answer the end to which it was intended, thought that if a sufficient full might be had, this collection of water might be made useful in raising the water in a mine to the adit, where it might be carried off.  

But now the most general method of draining mines is by the steam-cugue.

A Mine (in military affairs) is also a subterraneous cavity made according to the rules of art, in which a certain quantity of powder is lodged, which by its explosion blows up the earth above it.  

It has been found by experiment that the figure produced by the explosion is a paraboloid; and that the centre of the powder, or charge, occupies the focus.

The place where the powder is lodged is called the chamber of the mine, or foramen.

The passage leading to the powder is called the gallery.

The line drawn from the centre of the chamber, perpendicular to the nearest surface of the ground, is called the line of least resistance.

The pit or hole, made by springing the mine, is called the excavation.

The fire is communicated to the mine by a pipe or hose, made of coarse cloth, whose diameter is about one inch and a half, called a saucisson (for the filling of which near half a pound of powder is allowed to every foot), extending from the chamber to the entrance of the gallery; to the end of which is fixed a match, that the miner who sets fire to it may have time to retire before it reaches the chamber.

To prevent the powder from contracting any dampness, the saucisson is laid in a small trough, called an auger, made of boards, three inches and a half broad, joined together with straw in it, and round the saucisson, with a wooden cover nailed upon it.

**Galleries and chambers of mines.**—Galleries made within the fortification, before the place is attacked, in which several branches are carried to different places, are generally four feet or four and a half wide, and five feet or five and a half high.  

The earth is supported from falling in by arches and walls, if they are to remain for a considerable time; but when mines are made to be used in a short time, then the galleries are but three feet or three and a half wide, and five feet high, and the earth is supported by wooden frames or props.

The gallery being carried on to the place where the powder is to be lodged, the miners make the chamber.  

This is generally of a cubical form, large enough to hold the wooden box, which contains the powder necessary for the charge: the box is lined with straw and sand-bags, to prevent the powder from contracting dampness.

The chamber is sunk something lower than the gallery, if the soil permits; but where water is to be apprehended, it must be made higher than the gallery; otherwise the besieged will let in the water, and spoil the mine.

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**Quantities of powder to charge mines.**—Before any calculation can be made of the proper charge for a mine, the density and tenacity of the soil must be ascertained, either by experiment, or otherwise; for in soils of the same density, that which has the greatest tenacity will require the greatest force to separate its parts.  

The density is determined by weighing a cubic foot (or any certain quantity) of the soil; but the tenacity can only be determined by making a mine.  

The following table contains experiments in six different soils, which may be of some use to form a judgment of the nature of the soil, when an actual experiment cannot be had:

<table>
<thead>
<tr>
<th>Nature of the Soil</th>
<th>Density</th>
<th>Tenacity</th>
<th>Weight of powder to raise 1 cub. foot</th>
<th>Quantity of powder of various grades.</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Loose earth or sand</td>
<td>95 pds.</td>
<td>8 pds.</td>
<td>100</td>
<td>100</td>
</tr>
<tr>
<td>2. Common light soil</td>
<td>124</td>
<td>10</td>
<td>120</td>
<td>120</td>
</tr>
<tr>
<td>3. Loam, or strong soil</td>
<td>137</td>
<td>10</td>
<td>130</td>
<td>130</td>
</tr>
<tr>
<td>4. Potter's clay, or stiff soil</td>
<td>125</td>
<td>10</td>
<td>120</td>
<td>120</td>
</tr>
<tr>
<td>5. Clay, mixed with stones</td>
<td>180</td>
<td>10</td>
<td>180</td>
<td>180</td>
</tr>
<tr>
<td>6. Masonry</td>
<td>203</td>
<td>10</td>
<td>203</td>
<td>203</td>
</tr>
</tbody>
</table>

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**Loading and stopping of mines.**—The gallery and chamber being ready to be loaded, the strong box of wood is made of the size and figure of a box, and fastened to the side of the chamber, being about one-third or one-fourth bigger than is required for containing the necessary quantity of powder; against the sides and bottom of the box is put some straw; and this straw is covered over with empty sand-bags, to prevent the powder from contracting any dampness: a hole is made in the side next the gallery, near the bottom, for the saucisson to pass through; which is fixed to the middle of the bottom, by means of a wooden peg, to prevent its falling from the powder; or, if that, the enemy should get to the entrance, he may not be able to tear it out.  

This done, the powder is brought in sand-bags, and thrown loose in the box, and covered also with straw and sand-bags; upon this put the cover of the box, pressed down very tight with strong props; and, to render them more secure, planks are also put above them, against the earth, and wedged in as fast as possible.

This done, the vacant spaces between the props are filled up with stones and dung, and rammed in the strongest manner; the least neglect in this work will considerably alter the effect of the charge.

The auger is then laid from the chamber to the entrance of the gallery, with some straw at the bottom; and the saucisson laid in it, with straw over it; lastly, it must be shut with a wooden cover nailed upon it. Great care must be taken, in stopping up the gallery, not to press too hard upon the auger, for fear of spoiling the saucisson; which may hinder the powder from taking fire, and so prevent the mine from sprang; the gallery is stopped up with stones, earth, and dung, well rammed, six or seven feet further from the chamber than the length of the line of least resistance.

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**MINERAL WATERS.** See Waters.

**MINERALOGY.** is that science which treats of the solid and inanimate materials of which our globe consists; and these are usually arranged under four classes: the earthly, the saline, the inflammable, and the metallic materials; which are classified into:

1. The earthly minerals compose the greater part of the crust of the earth, and generally form a covering to the rest. They are not remarkable for being heavy, brittle, or light-colored. They are liable to be extracted with ease, and are inadmissible in a low temperature, insipid, and without much smell.

2. The saline minerals are commonly moderately heavy, soft, sapid, and possess some degree of transparency.

3. The inflammable class of minerals is light, brittle, mostly opaque, of a yellow, brown, or black colour, seldom crystallized, and never feel cold.

4. Metallic minerals are characterized by being heavy, generally opaque, tough, malleable, cold, not easily inflamed, and by exhibiting a great variety of colours, of a peculiar kind.

Under each of these classes are various genera, species, sub-species, and kinds, which will be noticed in order. Sometimes, as in the vegetable kingdom, we find a strict affinity between different species of minerals, and in that case they are said to belong to the same family; but in mineralogy, one class does not always blend with another in a chemical point of view, or furnish that beautiful gradation and almost imperceptible union which is to be traced in the other kingdoms of nature.

As the external characters are of the first importance in facilitating our acquaintance with minerals, we shall briefly explain this subject, before we proceed to the classification of the different substances.

**Of the external characters of Minerals.**

The external characters of minerals are either generic or particular. The generic characters are certain properties of the mineral, without any reference to their differences, as colour, lustre, weight, &c.; and the differences between these properties form the specific characters.

Generic characters may be general or particular. In the first division are comprehended those that occur in all minerals, in the last those that are found only in particular classes of minerals.

The particular generic external characters are thus advantageously arranged:

1. **Colour.**

2. **Density**; distinguished into solid, friable, and fluid.

In solid minerals are to be regarded the external shape, the external surface, and the external lustre. When broken, the lustre of the fracture, the fracture itself, and the shape of the fragments, are to be noticed. In distinct concretions, regard must be paid to the shape of the concretions, their surface, their lustre, transparency, streak, and soilling. All of which may be ascertained by the eye. By the touch, we may discover the hardness of minerals their tenacity, friability, flexibility, their unctuousness, coldness, weight, and their adhesion to the tongue. By the ear we
MINERALOGY.

Aspect of the distinct Concretions.

The shape of the distinct concretions forms very prominent external characters. They may be granular, mineral in shape, or in minutiae; they may be lamellar, distinct, concretions, differing in the direction of the lamelle, in the thickness, with regard to shape, and in the position.

The surface of the distinct concretions may be smooth, rough, streaked, or uneven; as for their lustre, it may be determined in the same manner as the external lustre.

General Aspect as to Transparency.

Minerals, as is well known, have different degrees of transparency, which may be considered among their external characters. They may be transparent, semitransparent, translucent, or opaque.

The Streak.

The colour of this external character may be either similar or different. It is presented to us when a mineral is scraped with the point of a knife: and is similar, when the powder that is formed is of the same colour with the mineral, as in chalk; or dissimilar or different, as in cinnaemon, &c.

The Soiling or Colouring.

Is ascertained by taking a mineral specimen between the fingers, or drawing it across some other body. It may soil strongly, as in chalk, slightly, as in molybdana, or not at all, which is a quality belonging to most of the solid minerals. All the preceding external characters are recognized by the eye.

External Characters from the Touch.

These are eight in number, and are not destitute of utility to the mineralogical student.


Hardness may be tried by a capacity to resist the file, yielding a little to it, being semi-hard, soft, or very soft. Tenacity has different degrees, in substances being brittle, secrete or solid, or ductile. The frangibility consists in minerals being very delicately frangible, difficultly frangible, easily frangible, or very easily frangible. The flexibility is proved by being simply flexible, elastically flexible, commonly flexible, or inflexible.

The adhesion to the tongue may be strongly adhesive, pretty strongly, weakly, very weakly, or not at all. Uncutability may be maseate, rather greasy, greasy, or very greasy. Coldness is subdivided into cold, pretty cold, rather cold. Weight may be distinguished into swimming or supernatant, light, rather light, heavy, very heavy. The three last divisions from the touch, are in the Wernerian system regarded as anomalous; but they seem proper to be classed under this head.

External Characters from the Sound or Hissing.

The different kinds of sound which occur in the mineral kingdom are:

1. A ringing sound, as in native arsenic and thin splinters of horn-stone; 2. A grating sound, as in fresh-burnt clay; 3. A creaking sound, as that of natural amalgam.

1. Solid Minerals.

External aspect has three things to be regarded:

1. The shape; 2. The surface; and 3. The lustre. The external shape again.

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may be common, particular, regular, or extraneous; and hence arise the different specifiers.

1. The common external shape may be massy; disseminated, undulated, minutely, or finely; in angular pieces, sharp-cornered or blunt-cornered; in grains, large, coarse, small, fine, angular, flat, round; in plates, thick or thin; in membranes or flakes, thick, thin, or very thin.

The particular external shape may be longish, as dentiform, filiform, capillary, reticulate, dendritic, conchoidal, corticaliform, cylindrical, tubiform, claviform, or frustiform; roundish, as globular, spherical, ovoidal, spheroidal, amygdaloidal, botryoidal, reniform, tuberose, or fused-like; flat, as specular, or in leaves, cavernous, as in cellular forms, with impressions, perforated, corroded, amorphous, or vesicular; entangled, as ramosus, &c.

In the regular external shape or chrysallization are to be regarded its genuineness, according to which it may be either true or false; its shape, made up of planes, edges, angles, in which are to be observed the fundamental figure and its parts, the kind of fundamental figure, the varieties of each kind of fundamental figure, with their accidents and distortions, and the alterations which the fundamental figure undergoes by truncation, by bevelling, by acumination, or by a division of the planes. There are a variety of figures under each of these subdivisions.

It must be remarked also that the external shape may be extraneous, or derived from the animal and vegetable kingdoms, as in fossils and petrifications.

2. The external surface contains several varieties of distinctions. It may be uneven, granulated, rough, smooth, or streaked in various ways and directions.

3. The external lustre is the third generic external character, and is of much importance to be attended to. In this we have to consider the intensity of the lustre, whether it is splendid, shining, glistening, glimmering, or dull; next the sort of lustre, whether metallic or common. The latter is distinguished into semimetallic, adamantine, pearly, resinous, and vitreous.

Aspect of the Fracture of solid Minerals.

After the external aspect, the fracture forms no considerable character in minerals. Its lustre may be determined as in the external lustre; but the fracture itself admits of great varieties. It may be compact, splintery, coarsely splintery, finely splintery, even, conchoild, uneven, earthy, hackly; if the fracture is fibrous, we are to consider the thickness of the fibres, if coarse or delicate; the direction of the fibres, if straight or curved; and the position of the fibres, if parallel or diverging.

In the radiated fracture we are to regard the breadth of the rays, their direction, their position, their passage or cleavage. In the foliated fracture, the size of the folia, their degree of perfection, their direction, position, aspect of their surface, passage or cleavage, and the number of cleavages, are to be noted.

The shape of the fragments may also be very various, as cubic, rhombohedral, trapezoidal, &c. or irregular, as coniform, splintery, tabular, indeterminately angular.

C c

Distinguish their sound, and by the smell and taste the qualities which these two senses indicate.

In friable minerals, external shape, lustre, aspect of particles, soiling, and degree of friability, are to be attended to.

In fluid minerals the lustre, transparency, and fluidity, are principal objects to be regarded.

The specific external characters of minerals are founded on the distinctions and varieties of the two great generic divisions. And first, of colours, the names of which are derived from certain bodies in which they most generally occur, either in a natural or artificial state, or from different mixtures and compositions of both.

I. Colour.

1. White. This may be snow-white, reddish-white, yellowish-white, silver-white, greyish-white, greenish-white, milk-white, or tin-white.


5. Green. Verdigris-green, celadon-green, mountain-green, emerald-green, leek-green, apple-green, glaucous-green, pistachio-green, asparagus-green, olive-green, blackish-green, canary-green.


Besides these distinctions, colours may be clear, dark, light, or pale; they may have a tarnished appearance, a play, a changeable, an irreducible, an opalescence, a permanent alteration, and a delineation of figure or pattern, such as dotted, spotted, clouded, flamed, striped, veined, dendritic, or rainiform.

II. Cohesion of Particles.

Minerals are divided into, 1. Solid, or such as have their parts coherent, and not easily movable; 2. Friable, or that state of aggregation in which the particles may be overcome by simple pressure of the finger; and, 3. Fluid, or such as consist of particles which alter their place in regard to each other by their own weight.

1. Solid Minerals.

External aspect has three things to be regarded, 1. The shape; 2. The surface; and 3. The lustre. The external shape again.
MINERALOGY.

2. Friable Minerals.

The external characters drawn from minerals of this class are derived, first, from the external shape, which may be massive, disseminated, thinly coating, spumous, or dendritic; secondly, from the lustre, regarded under its intensity, whether glimmering or dull, and its sort, whether common glimmering or met-lic glinting; thirdly, from the aspect of the particles, as being dusty or scaly; fourthly, from shining or colouring, as strongly or lightly; and lastly, from the fluidity, which may be loose or cohering.


Of external characters drawn from fluid minerals, there are only two kinds, which include three varieties: 1. The lustre, which is either metallic, as in mercury, or resinous, as in rock oil. 2. The transparency, which is transparent, as in naphtha; turbid, as in mineral oil; or opaque, as in mercury. 3. The fluidity, which may be fluid, as in mercury or viscous, as in mountain tar.

External Characters from the Smell.

There may be spontaneously emitted and described: astringent, faintly subacrid, or faintly bitter; or they may be produced by breathing on, and yield a clay-like smell; or they may be excited by friction, and smell urinous, subacrid, garlick-like, or empyreumatic.

External Character from the Taste.

This character prevails chiefly in the saline class, and it contains the following varieties: a sweetish taste, sweetish astringent, styptic, saltly bitter, saltly cooling, alkaline, or urinous.

Having now given a Synopsis view of the external characters of minerals, we shall proceed to their classification, and in this we shall chiefly follow the names and arrangement of professor Jameson.

CLASS I. EARTHY FOSSILS.

First Genus. Diamond.

Diamond.

This precious stone has great variety of shades, exhibiting a beautiful play of colours. It occurs in indeterminate angular and completely spherical grains, which presents planes of crystallization, or are actually crystallized. Its fundamental chrysolite is the octaedron, which passes into various forms. It is hard in the highest degree, brittle, not very diffusely fragrable, and has a specific gravity of 3.600.

The diamond has, by modern experiments, been proved to be nearly pure carbon, and begins to burn at 14° or 15° of Wedgewood. See Plate I, Mineralogy, figs. 1, and 2.

Second Genus. Zircon.

First Species. Zircon.

The prevailing colour is grey, but it occurs likewise green, blue, red, yellow, and brown, with various intermediate tints. It is found most commonly in roundish angular pieces, with rounded angles and edges. When crystallized, the figure is generally a rectangular four-sided prism, some-

what flatly acuminate by four planes, set on lateral planes; but of this figure there are several varieties. The chrysolites are almost always very small, have a smooth surface, bordering on strongly splendent. Internally, the lustre is very splendent, passing into adamantine. Fig. 3.

Zircon is hard in a very high degree, brittle, fragrable without great difficulty. Specific gravity 4.700. It forms a colourless transparent mass with borax, but is insubflable by the blowpipe without addition.

Found in the island of Ceylon, where it was first discovered, and lately in Norway, imbedded in a rock composed of hornblende and felspar.

Frequently cut as a precious stone, and used as an inferior kind of diamond, of which it was once considered as a variety. Its play of colours very considerable.

Second Species. Hyacinth.

The chief colour is red, passing to reddish-brown, and to orange-yellow. The figure a rectangular four-sided prism, flatly acuminate by four planes, which are set in the lateral edges. Of this figure, however, several varieties occur.

The chrysolites are generally small, and all imbedded. The lateral planes smooth, and externally shining. Internally it is splendent and glassy, inclining somewhat to resinous. Fig. 4.

The hyacinth is transparent, very hard, fragrable without particular difficulty; feels a little greasy when cut, and has a specific gravity of about 4.000.

It is fusible with borax. Exposed to the blowpipe it loses its colour, but not its transparency.

Occurs in rocks of the newest flint trap formation, and sometimes in sand. It is native of Ceylon, the country of gems; of Spain, of Portugal, France, Italy, Saxony, and probably Scotland.

It takes a fine polisli, and when the colours are good, it is highly valued. A third species, called cinnamon stone, has lately been discovered at Columbo, in Ceylon.

Third Genus. Flint.

First Species. Chrysoberyl.

The prevailing or general colour is apergas-green, passing into a variety of allied shades. It exhibits a milky-white light; occurs in roundish and angular grains, which sometimes approach in shape to the cube. It is seldom crystallized; but when in this state, it commonly presents a longish six-sided table, having truncated lateral edges, and longitudinally streaked lateral planes. The chrysolites are small, externally shining, and internally splendent. Fig. 5.

It is hard, very easily fragrable, with a specific gravity of 3.600. Without addition, it is insubflable.

The chrysoberyl is found in Brazil, and in the sand of Ceylon. It is sometimes set in rings with a yellow foil, but is rarely in the possession of our jewellers.

Second Species. Chrysolite.

The chief colour is pistachio-green, of all degrees of intensity. It occurs in original angular sharp-edged pieces, with a rough, scaly, splinter surface, and when crystallized, exhibits a broad rectangular four-sided prism, with its lateral edges sometimes truncated, sometimes bevelled, and acuminate by six planes. Fig. 6.

The external surface of the chrysolite is splendent, internally splendent, and vitreous.

Third Species. Olivine.

The colour is generally asparagus-green, of various degrees of intensity. It is found imbedded also in roundish pieces and grains; and when crystallized, which is rare, in rectangular four-sided prisms.

Internally, it is shining, varying between glistening and splendent. It is semitransparent, very easily fragrable; in a low degree hard, and not particularly heavy. It is nearly insubflable without addition. Occurs imbedded in basalt; is frequently found in Bohemia, and also in Hungary, Austria, France, England, Ireland, Scotland, Sweden, Iceland, and Norway. Pieces as large as a man's head have been found in some parts of Germany.

Fourth Species. Augite.

The general colour is blackish green. It occurs chiefly in indeterminate angular pieces and roundish grains. Occasionally it is crystallized, and presents broad rectangular four-sided prisms. The chrysolites are mostly small. Internally the lustre is shining, approaching sometimes to splendent.

The augite is only translucent, and but faintly fragrable. It is hard, not very easily fragrable, and not particularly heavy.

It is found in basalt, either singly or accompanied with olivine, in Bohemia, Hungary; at Arthur's Seat, near Edinburgh; in some of the Hebrides, and in Norway. From olivine it is distinguished by its darker colours, the form of its crystallization, and its greater hardness.

Fifth Species. Vesuvian.

Its principal colour is dark olive-green, passing into other allied shades. It occurs massive, and often crystallized in rectangular four-sided prisms. The chrysolites are mostly short, and placed on one another. Externally their surface alternates between glistening and splendent. Internally they are glistening, with a lustre between vitreous and resinous.

The vesuvian is translucent, hard in a moderate degree, and approaching to heavy. Before the blowpipe it melts without addition.

It is found among the exuviae of Vesuvius, from whence it derives its name, in Cilesia and Kaukaschka. At Naples, it is cut into ring-stones, and sold under various names.

Sixth Species. Leucite.

The colours are yellowish and greyish-white. It occurs mostly in original round and angular grains. When crystallized, it exhibits acute-double eight-sided pyramids. Internally it is shining, and approaching to glistening, with a vitreous lustre, inclining somewhat to resinous.

The leucite is translucent and semitransparent. It is hard in a low degree, brittle, easily fragrable, and not very heavy. It is insubflable without addition. With borax, it forms a brownish transparent glass.

It is found in rocks of the newest floetz.
MINERALOGY.

The chrysalis are small and middle-sized. Internally the lustre is splendid and vitreous. It is more or less transparent in different localities, and is variegated, when cut, exhibits a star of six rays. Fig. 8.

The sapphire is hard in the highest degree, but yields to the diamond; it is easily frangible, and rather heavy, having a specific gravity of about 4.000.

It is infusable without addition: occurs in rocks of the newest flint trap formation, and is supposed to be an immaculate granite, syenite, and other primitive rocks.

This precious stone is found in the utmost beauty in Pegu and Ceylon. It is also a native of Portugal, of France, and of Bohemia. Next to the diamond, it is the most valuable of gems, and is used in the finest kind of jewellery.

It should be observed, that the violet-colored sapphire is the oriental amethyst; that the yellow is the oriental chrysolite and topaz; and that the green is the oriental emerald.

The principal colour is greenish-white, of various degrees of intensity. It occurs in small, middle-sized, and large crystals, and is generally round or oval, and crystallized. The crystallizations resemble those of the sapphire, and the crystals are middle-sized and imbedded.

The corundum is duplicating translucent, hard in a high degree, pretty easily frangible, and approaches to heavy. It is supposed to occur imbedded in granite, syenite, or green-stone, and is found in the Carnatic and on the coast of Malabar. See Corundum.

The colour is a dark hair-brown. It occurs massive, disseminated, in rolled pieces, and crystallized in six-sided prisms, or very acute six-sided pyramids. Internally, its lustre is splendid, approaching in a slight degree to adammite. It may be cut so as to present an opalescent star of six rays, of a peculiar pearly light. It is translucent on the edges, hard in a high degree, easily frangible, and not particularly heavy.

The diamond spar probably occurs in granite. It has hitherto been found only in China. Both this stone and corundum are employed in cutting and polishing hard minerals, and they seem to be nearly allied to each other.

Emery is hard in the highest degree, not very easily frangible, and is heavy. It occurs in beds of talc and slate, and is frequently accompanied with talc spar and blende. It is found in Saxony, in the islands of the Archipelago, in Spain, Normandy, and is said also to be a native of the isles of Guernsey and Jersey.

It is of great use in cutting and polishing hard bodies.

The chief colour is a wine-yellow, of all degrees of intensity. It is found massive, disseminated, and sometimes rolled, but most commonly crystallized in oblique eight-sided or four-sided prisms, which exhibit several varieties. The chrysolite are small and middle-sized, externally splendid; internally, and shining: lustre vitreous.

The topaz alternates from transparent to heavy, and is not particularly heavy. It is infusible with borax; and some kinds in a gentle heat turn white, and are sometimes sold for diamonds.

It is commonly found in veins that traverse primitive rocks in Brazil, Siberia, in Pegu, and Ceylon; in Bohemia, Saxony, and Cornwall. Exhibiting various forms and figures, it has often been confounded with other precious stones. It is much used in seals and rings.

The green called emerald is the characteristic colour of this species, but it has all degrees of intensity from deep to pale. It is said to occur massive and in rolled pieces, but most commonly crystallized in low equiangular six-sided prisms. The chrysolite are middle-sized and small. Internally the lustre is intermediate between shining and splendid, and is vitreous. It alternates from transparent to translucent, and is duplicating translucent.

The emerald is hard, not particularly heavy, melts easily with borax, but is scarcely fusible before the blowpipe. It occurs in veins that traverse clay-flat, and at present occurs only found in South America, particularly in Peru, though the Romans are said to have procured it from Egypt and Ethiopia.

From the beauty and vivacity of its colour, the charming emblem of the vegetable kingdom, this precious stone is much admired, and employed in the most expensive kinds of jewellery. See Emerald.

This is divided into two sub-species, the precious and the schorlous beryl. See Beryl, and fig. 9.

The colour is commonly clove-brown, of various degrees of intensity. It is occasionally found massive, more frequently disseminated; but generally crystallized in very flat and oblique rhombs. Externally, its lustre is generally splendid; internally, it alternates from glistening to shining, and is vitreous.

This species alternates from perfectly transparent to weakly translucent. It is pretty hard, very easily frangible, and not particularly heavy. It appears to be peculiar to the primitive mountains, and is found imbedded in limestone in Saxony, Dauphiny, Norway, Siberia, and Cornwall. Fig. 11.

The colour a yellowish-brown, bordering on liver-brown. It occurs commonly massive, but also crystallized in small equiangular six-sided prisms. Externally, its lustre is splendid; internally, shining, and is intermediate between vitreous and resinous.

Iron-flint is opaque, and slightly translucent on the edges. It is pretty hard, some-
MINERALOGY.

First Sub-species. Common Chalcedony.

The most common colour is grey. The external shape is various, being massive, in blunted-edged grains and rolled pieces, in original round balls, &c. &c. Internally, the chalcedony is also almost always flat, commonly semitransparent, hard, brittle, rather difficultly friable, and not particularly heavy. It occurs in amygdaloidal, and in porphyry; and is found in Transylvania, in Iceland, Siberia, Cornwall, Scotland, and the Hebrides. Being susceptible of a fine polish, it is employed as an article of jewellery.

Second Sub-species. Carnelian.

The principal colour is a blood-red, of all degrees of intensity. It commonly occurs in roundish pieces, and also in layers: the lustre is glistening, bordering on glistening, and semitransparent. See CARNELIAN.

Agate.

The fossils known under this name are all compound substances; and hence cannot have a particular place in any systematic arrangement. We have therefore placed them as a supplement to the species chalcedony, which forms a principal constituent part of them, and dispose them according to their color-delineations, thus: 1. Fortification agate; 2. Landscape agate; 3. Rhomb agate; 4. Moss agate; 5. Tube agate; 6. Clouded agate; 7. Land agate; 8. Star agate; 9. Fragment agate; 10. Punctuated agate; 11. Petrification agate; 12. Coal agate; 13. Jasper agate. They are all compounds of chalcedony, carnelian, jasper, horn-stone, quartz, heliotrope, amethyst, indurated lithomarge, and opal, in different quantities and proportions; and are found in great abundance in Germany, France, England, Scotland, Ireland, and the East Indies.

The uses of agate are various. It is cut into vases, mortars, smalt-boxes, seals, handles to knives, and for many other useful purposes. See AGATE.

Twenty-ninth Species. Heliotrope.

The principal colour is intermediate between leek and dark celadon green, or mountain green, massive, and in angular as well as rolled pieces. Internally the lustre is glistening, and is always resinosous. It is commonly translucent in the edges; is easily friable, hard, and not particularly heavy. Heliotrope is found in rocks belonging to the floetz trap formation, in Asia, Persia, Siberia, Saxony, and Iceland.

On account of its beautiful colour and its hardness, it is employed for nearly the same purposes as agate. See HELIOTROPE.

Twenty-fourth Species. Flint.

The general colour is grey, but with many varieties. It occurs massive, in regular plates, in angular grains and species, in globular and elliptical rolled pieces, in the form of sand, and tuberosous and perforated. Sometimes it is chrysallized, when it exhibits double six-sided prisms, or flat double three-sided prisms. Internally, the lustre is glistening, translucent on the edges, hard, easily frangible, and not particularly heavy.

Twenty-fifth Species. Chaledony.

This is divided into two sub-species, chalcedony and carnelian.

First Sub-species. Common Chalcedony.

The most common colour is grey. The external shape is various, being massive, in blunted-edged grains and rolled pieces, in original round balls, &c. &c. Internally, the chalcedony is also almost always flat, commonly semitransparent, hard, brittle, rather difficultly friable, and not particularly heavy. It occurs in amygdaloidal, and in porphyry; and is found in Transylvania, in Iceland, Siberia, Cornwall, Scotland, and the Hebrides. Being susceptible of a fine polish, it is employed as an article of jewellery.

Second Sub-species. Carnelian.

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Second Sub-species. Carnelian.

The principal colour is a blood-red, of all degrees of intensity. It commonly occurs in roundish pieces, and also in layers: the lustre is glistening, bordering on glistening, and semitransparent. See CARNELIAN.

Agate.

The fossils known under this name are all compound substances; and hence cannot have a particular place in any systematic arrangement. We have therefore placed them as a supplement to the species chalcedony, which forms a principal constituent part of them, and dispose them according to their color-delineations, thus: 1. Fortification agate; 2. Landscape agate; 3. Rhomb agate; 4. Moss agate; 5. Tube agate; 6. Clouded agate; 7. Land agate; 8. Star agate; 9. Fragment agate; 10. Punctuated agate; 11. Petrification agate; 12. Coal agate; 13. Jasper agate. They are all compounds of chalcedony, carnelian, jasper, horn-stone, quartz, heliotrope, amethyst, indurated lithomarge, and opal, in different quantities and proportions; and are found in great abundance in Germany, France, England, Scotland, Ireland, and the East Indies.

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On account of its beautiful colour and its hardness, it is employed for nearly the same purposes as agate. See HELIOTROPE.
This species is divided by Werner into five sub-species. 1. Mealy zeolite; 2. Fi- brous zeolite; 3. Radiated zeolite; 4. Cubic zeolite. As they are principally distinguished from each other by fracture, hardness, and lustre, we shall only observe, that the chief colours of all are yellowish, whitish, and reddish, with a variety of intermediate shades; that zeolite occurs massive, in angular pieces, in balls, and sometimes crystallized in short and oblique four-sided prisms, and in perfect smooth clinoidal cubes; that it is according to the sub-species opaque, translucent, or even transparent; and that it is semihard, easily fracturable, and not particularly heavy. Zeolite occurs in rocks belonging to the newest formation, but it is sometimes, though rarely, found in primitive green stone, either disseminated, in cotemperaneous balls, or filling up air cavities or veins. All the different sub-species are natives of Scotland. The mealy zeolite is found in the Isle of Skye; the fibrous and radiated in the isles of Canary and Sky; the silted in Staffa, and the cubic in the same isle, and likewise in Sky. The mealy zeolite is met with in Iceland, in Sweden, in Germany, and the East Indies. Figs. 13 and 14.

Thirty-third Species. Cross-Stone. The colour is a greyish-white. It occurs crystallized, either in broad rectangular four-sided prisms, or in twin crystals. The crystals are mostly small, and aggregated on one another. Both the internal and the external lustre are shining, inclining to splendent or glistering. The cross-stone is translucent passing to transparent, semi-hard, easily fracturable, and not particularly heavy. It has hitherto been found only in mineral veins, and in agate-balls, at Strenton, in Argyleshire, and at Andeasberg, in Hartz, as well as some other places.

Thirtieth Species. Agate-Stone. The colour is a perfect azure blue, of different shades. It is found massive, disseminated, and in rolled pieces. The lustre is glistening and glistering. It is translucent on the edges, pretty hard, brittle, easily fracturable, and not particularly heavy. The geometrical situation is not correctly ascertained. It is said to have been found near the lake of Baikal, in Siberia, in a vein accompanied with garnet, felspar, and pyrites. It occurs in Persia, China, Tartary, and Siberia; in South America; but in Europe has only been found among the ruins of Rome. Its beautiful colour renders it an object of attraction, and being capable of receiving a high polish, it is applied to various useful purposes, and enters into the composition of many different ornaments. It is the lupis lazuli of painters. Werner is constantly making additions to his species under every genus. Of those belonging to the flint genus, which are less known, and have been described with less precision than the preceding, are coroc/sites, found in Sweden and Elb- way; pistazie, found in Norway, Bavaria, and France; ceylanite, in Ceylon; enclose, in Peru; hvite, near Frankfort; menilite, near Paris; sionite, in Lower Britannia; natrolite, in Subbia; aurete, in Sturia, &c.; andalusite, or hardspar, in Saxony, France, and Spain; chiastolite, or hollow spar, in France and Spain, and probably in Cumberland, in Norway; and arzitze, or wermerte, in Sweden, Norway, Switzerland, and Lazulite.

Fourth Genus. Clay Genus. First Species. Jasper. This is divided into six sub-species; Egyptian jasper, striped jasper, porcelain jasper, common jasper, agate jasper, and opal jasper.

Second Species. Opal. Werner divides this into four sub-species, precious opal, common opal, semi-opal, and wood opal.

Third Species. Pitch-Stone. The colours are black, green, brown, red, and occasionally grey. It occurs always massive in great beds and rocks. Internally, its lustre is shining. It is commonly translucent in a small degree, brittle, and pretty easily fracturable.

Pitch-stone is fusible without addition; occurs in beds between the porphyry and flint clay formation; and is found in Saxony, Hungary, in several of the Hebrides, and in Dumfriesshire. Some of its varieties bear a striking resemblance to pitch, from whence it receives its appellation.

Fourth Species. Obsidian. The principal colour is green-violet. It always occurs in angular roundish-pieces. Internally it is splendent. Some of the varieties are translucent, others semi-transparent. It is hard, easily fracturable, and not very heavy.

Obsidian occurs insular in the newer porphyry formation, and is found in Hungary, Ireland, in Persia, and various other countries. When cut and polished, it is sometimes used for ornamental purposes, and mirrors for telescopes have been formed of it. It probably owes its origin to fire.

Fifth Species. Pearl Stone. Its colour is generally grey, sometimes black and red. It occurs vesicular, and the vesicles are long and roundish, with a shining pearly lustre. It is translucent on the edges, not very brittle, very easily fracturable, and rather light.

Pearl stone is found in beds of porphyry, near Falkay, in Hungary, in the north of Ireland, and the Hebrides.

Sixth Species. Pumice Stone. Its usual colour is a light yellowish-grey, passing into different neighbouring shades. It is small, and lengthened ovoidal; its internal lustre glistening, generally translucent in the edges, soft, and seldom semi-hard, very brittle, easily fracturable, and swims in water.

It occurs in various situations, generally accompanied by rocks that belong to the flint trap formation; and though usually classed among volcanic productions, in some situations it evidently is of aqueous origin. It is found in the Lipari islands, in Hungary, Iceland, and on the banks of the Rhine; and is used for polishing stones, metals, glass, and ivory; and also for preparing parchment.

Seventh Species. Feldspar Is divided into four sub-species; compact felspar, common felspar, adularia, and Labradorite. Fig. 15.

Eighth Species. Pure Clay Is snow white, with occasionally a yellowish tinge, and occurs in kidney-shaped pieces, which have no lustre. It is opaque, soils very little, adheres slightly to the tongue, is light, and intermediate between soft and friable.

Pure clay is found immediately under the soil, accompanied with baked clay and scleulate, at Halle, in Saxony, only.

Ninth Species. Porcelain Earth. The colour is generally a reddish-white, of various degrees of intensity. It occurs massive and disseminated; its particles are fine and dusty, slightly colored, and feeling fine and light. It is found in beds in gneiss, accompanied with quartz and other substances, in Saxony, at Passau, Limoges, and in Cornwall. In China and Japan, where it is called kaolin, it is very abundant. It forms the basis of china ware.

Tenths Species. Common Clay. This is divided into six sub-species, as follows:

1. Loam, of a yellowish-grey colour, frequently spotted with yellow and brown, and occurring massive. It is dull and weakly glimmering, colours a little, adheres pretty strongly to the tongue, and feels slightly greasy. It is often mixed with sand, gravel, and iron ochre.

2. Potter's clay is of two kinds, earthy and slaty. The earthy is of a yellowish-grey, greyish-white colour in general; occurs massive; is opaque, colours a little; feels somewhat greasy, and adheres strongly to the tongue. Slaty potter's clay is generally of a dark ash-grey colour, and feels more greasy than the preceding. It occurs in great rock masses, and is found in various places, universally distributed, and of great importance in the arts and in domestic economy.

3. Pipe clay is greyish-white, passing into yellowish-white, occurring massive, of a glimmering lustre, and having its particles pretty coherent. It feels rather greasy, is easily fracturable, and adheres pretty strongly to the tongue.

4. Variegated clay is commonly white, red, and yellow, striped, veined, and spotted. It occurs massive, is soft, passing into triable, feels a little greasy, and adheres somewhat to the tongue. It is found in Upper Saxony.

5. Clay-stone is commonly grey or red, with various intermediate tints. It occurs massive, is dull, opaque, soft, pretty easily fracturable, feels rather meagre, and does not adhere to the tongue. It forms vast rock masses, occurs in beds and veins, and is found in Saxony, in Scotland, and in Shetland.

6. Slate clay is of a grey colour, presenting several varieties. It is massive, internally
dull, opaque, pretty soft, mild, easily francible, adheres a little to the tongue, and feels meagre. It is generally found wherever the oval, floetz trap, and stratum formation occurs.

Eleventh species. Poller, or Polishing-Stone.

Is of a yellowish-grey colour, striped, and the colours alternate in layers. It occurs massive, is dull, very soft, adheres to the tongue, feels fine but meagre, and is nearly swimming. It is found in the vicinity of pseudo-volcanoes, though hitherto it has only been discovered in Bohemia.

Twelfth species. Tripoli.

Is of a yellow-brown colour, passing into ash-grey; occurs massive, is internally dull, very soft, feels meagre and rough, does not adhere to the tongue, and is rather light. It is found in veins and beds in floetz rocks in Saxony, in Derbyshire, and many other counties of England. Tripoli, from whence it was first brought. Its use in polishing metals and minerals is well known.

Thirteenth species. Alum-Stone.

Is of a greyish-white colour, occurs massive, shews a tendency to crystallization, is soft, passing to friable, and light. It is found at Tolfa, near Rome, from whence the famous Roman alum is manufactured.

Fourteenth species. Alum Earth.

The colour is a blackish-brown, and brownish-black; it is massive, dull, feels a little meagre, and somewhat greasy; is intermedium between soft and friable, and light. It is found in beds of great magnitude in alluvial land, and in floetz trap formation in several parts of Germany, in Naples, and in France. It is Sixted in order to obtain the alum it contains.

Fifteenth species. Alum-Slate.

Is divided into two sub-species, as follow: 1. Common alum-slate is between a greyish and bluish-black colour, occurs massive, and in beds, is soft, not very brittle, easily fracible, and not very heavy. 2. Glossy alum-slate is of an intermediate colour, between blueish and iron-black; occurs massive, with a shining semi-metallic lustre, and in other respects resembles the former. It is found in beds and strata in Saxony, France, Scotland, and Hungary; and affords considerable quantities of alum.

Sixteenth species. Bismiumous Slate.

Is of a brownish-black colour, and occurs massive. Internally, its lustre is limnering; it is very soft, rather mild, feels rather greasy, is easily frangible, and not particularly heavy.

It is found with clay-slate in the coal formation, in Bohemia, England, Scotland, and other coal countries.

Seventeenth species. Drawing Slate, or Black Chalk.

Its colour is a greyish-black, with a tinge of blue; it occurs massive, is opaque, colours and writes, is soft, mild, easily frangible, feels meagre, but fine, and is rather light.

It is found in primitive mountains in France, Germany, Iceland, Scotland, and the Hebrides. When a middling degree of hardness, it is used for drawing.

Eighteenth species. Whit-Slate.

The common colour is greenish-grey; it is massive; internally, weakly glimmering, semi-hard, feels rather greasy, and is not particularly brittle or heavy. It occurs in primitive mountains in Saxony, Bohemia, and the Levant. When cut and polished, it is used for sharpening knives and tools.

Nineteenth species. Clay-Slate.

Its principal colour is grey, with which there are many varieties. It occurs massive; internally, its colour is glistering, the substance opaque, soft, pretty easily frangible. It is found in vast strata in primitive and transitory formation, particularly in Scotland. When split into thin and firm tablets, it is used for roofing houses, and other purposes.

Twentieth species. Lepidolite.

Its colour is a kind of peach-blossom, red, verging on lilac-black, and occurs massive. Its internal lustre is glistering; it is translucent, soft, easily frangible, and easily melts before the blowpipe. Hitherto it has only been found in Moravia, where it lies in gneiss.

Twenty-first species. Mica, or Glitter.

Its common colour is grey, of great variety of shades. It occurs massive, disseminated in thin tables and layers in other stones, and crystallized either in equilateral six-sided tables, or in six-sided prisms. The surface of the crystals is splendent; internally, shining and splendent. In thin plates, it is transparent, but in larger masses only translucent on the edges. It is semi-hard, feels smooth, but not greasy, elastic, flexible, and more or less easily frangible.

It forms one of the constituent parts of granite, gneiss, and mica slate, and is almost peculiar to the primitive mountains. It was formerly used instead of glass, for windows and lanterns. Fig. 16.

Twenty-second species. Pot-Slate.

Its colour is a greenish-grey, of different degrees of intensity; it is massive, lustre, internally, glistering and pearly, translucent on the edges; soft, feels greasy, and is very difficultly frangible.

It occurs in beds, or is indurated; and is found in the country of the Greeks, in Saxony, and probably in Hudson's-bay, and is nearly allied to indurated tale.

Twenty-third species. Chlorite, Which see.

Twenty-fourth species. Hornblende, Which see. See also fig. 17.

Twenty-fifth species. Basalt.

The usual colour is greyish-black, of various degrees of intensity. It occurs massive, in blunt and rolled pieces, and sometimes vesicular. Internally, it is commonly dull. It is usually found in distinct concretions, which are generally columnar, and sometimes upwards of 100 feet in length. Commonly opaque, semi-hard, brittle, very difficultly frangible, melts without addition, and is almost exclusively confined to the floetz trap formation. It occurs in strata, beds, and veins, in almost every quarter of the globe, and is very abundant in Scotland, Ireland, and in other parts of the British and European dominions. It is useful for building, as a touch-stone, as a flux, and in glass manufactures.

Twenty-sixth species. Wauce.

The colour is a greenish-grey, of various degrees of intensity. It occurs massive and vesicular, is dull, somewhat glimmering, opaque, usually soft, more easily frangible, and not particularly heavy.

It is said to belong exclusively to the floetz trap formation, where it occurs in beds and above clay, and also in veins. It is found in Saxony, Bohemia, and Sweden.

Twenty-seventh species. Clink-Stone.

Is commonly of a dark greenish-grey colour, always massive, and occurring in irregular and generally concretion. It is usually translucent on the edges, brittle, easily frangible, and when struck with a hammer, sounds like a piece of metal.

It is said to belong to the floetz trap formation, and generally concretion. It is found in Lusitania, Bohemia, South America, and in the isle of Lambath, in the frith of Clyde.

Twenty-eighth species. Lava.

Is divided into two sub-species.

1. Slag lava is of a greyish-black colour, passing into other strata. Externally, it is always vesicular and distinct concretions. It is generally opaque, semi-hard, brittle, easily frangible, and not particularly heavy.

2. Foam lava is of a dark greenish-grey colour, occurs small and fine, vesicular; externally, glimmering, slightly translucent on the edges, brittle, easily frangible, and light. It has often been contended with pumice-stone, from which, however, it differs very much. On account of its lightness, it is used with advantage in arching vaults, and other kinds of building.

Twenty-ninth species. Green Earth.

Its colour is a calcead green, of various degrees of intensity. It occurs massive, in angular and globular pieces, and also disseminated. Internally, it is dull, streak glistering, very soft, easily frangible, and light. It is principally found in an Eskdale, in Saxony, Bohemia, Scotland, and other places, and is used by painters.

Thirtieth species. Lithomage.

Is divided into two sub-species.

1. Friable lithomage, or rockmarrow, is snow-white, or yellowish-white, occurs massive, as a crust, and disseminated; is generally coherent, feels greasy, and adheres to the tongue. It is found in veins, in Saxony.

2. Indurated lithomage is most commonly white, which presents several varieties; is massive; internally, dull; streak shining, very soft, easily frangible, feels greasy, and adheres strongly to the tongue. It occurs in veins of porphyry, &c. in Saxony, Bohemia, Bavaria, &c.

Thirty-first species. Rock Soap.

Is of a brownish or pitch-black colour, occurring massive, in a bluish-grey stone, and is generally soft, adhering to the tongue, feels greasy, and adheres strongly to the stone. It occurs in veins, in Saxony, Bohemia, etc.
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Seventh species. Serpentine, Which see.

Eighth species. Schiller-Stone. Its colour is olive-green, usually disseminated and massive; lustre shining, is soft, highly brittle, and easily frangible. It occurs imbedded in serpentine, and is found in the Harz, in Saxony, Cornwall, and Ayrshire. It is often confounded with Labrador hornblende.

Ninth species. Talc. This is divided into three sub-species.

1. Earthy talc is of an intermediate colour between greenish-white and light greenish-grey; friable, strongly glistening, soils a little, feels rather greasy, and occurs in thin veins near Freyberg in Saxony.

2. Common, or Venetian talc, is principally of an apple-green colour, massive and disseminated, and in delicate and small tabular crystals. It is almost always splendid and shining, translucent in thin leaves transparent, flexible, but not elastic; soft, easily frangible, feels very greasy, and approaches to light.

3. Indurated talc is of a greenish-grey colour, of various degrees of intensity, occurs, shining, passing to glistening, strongly translucent on the edges, soft, feels rather greasy, and is frangible without particular difficulty. It is found in primitive mountains in Tyrol, Austria, Scotland, and the Shetland isles.

Tenth species. Asbestos. See Asbestos.

Eleventh species. Cyanite, Which see.

Twelfth species. Actinolite Is divided into the following sub-species:

1. Asbestos actinolite is of a greenish-grey colour, occurs massive, disseminated, and is capillary crystals; is internally glistening, translucent, on the edges, soft, brittle, not easily frangible, nor particularly heavy. It is found in mineral beds in Saxony, and other parts of Germany.

2. Common actinolite is generally of a green tinge-colour, passing into other shades of the same; it occurs massive, and, likewise chryostalized in very oblique six-sided prisms, is spangled externally, semi-hard, rather brittle, and not easily frangible.

It is found in beds in primitive mountains, in Saxony, Switzerland, Norway, and Scotland.

3. Glassy actinolite is principally of a mountain-green-grey colour, of various degrees of intensity; occurs massive, or in thin six-sided chrysotile, is shining and vitreous, strongly translucent, brittle, easily frangible, semi-hard, and is found in similar situations with the preceding.

Thirteenth species. Tremolite. This is divided into the following sub-species:

1. Asbestos tremolite is of a whitish colour with a tinge of yellow, grey, red, or green; it occurs massive, and in capillary and acicular crystals; internally glistening, very soft, easily frangible, and translucent on the edges.

2. Common tremolite is nearly of the same colour as the preceding, occurs massive, and in long and very oblique four-sided prisms; internally opaque, translucent and semi-transparent, semi-hard, and very easily frangible.

3. Glassy tremolite is yellowish, reddish, greyish, and greenish-white; occurs massive, and is chryostalized. Internally, it is shining and translucent; composed of very thin prismatic concretions, which are again collected into very thick prismatic concretions. It is translucent, brittle, and very easily frangible, soft, and sometimes very soft, very easily frangible, feels meagre, and rather rough; effervesces strongly with acids, and is confounded principally on the sea-coast, though the Chiffren range in England is wholly composed of it. It is used for polishing and cleansing metals, glass, &c. and in some places as a manure, and cement in building.

Third species. Lime-Stone Is divided into several sub-species:

1. Compact limestone is of two varieties, common compact limestone, and roe-stone. The former is generally of a grey colour, but is frequently veined, zoned, striped, or clouded; occurs massive, and in rolled pieces; is translucent on the edges, semi-hard, brittle, very easily frangible; is almost entirely composed, like lime in general, to the floetz mountains; occurs in sand, stone, and coal formations, in England, Scotland, and many other countries; and is frequently used for building or making roads, or, when burnt, for manure and cement.

The latter, or roe-stone, is of a chesnut-brown colour, is massive; internally dull, composed of small and fine-grained globular distinct concretions; semi-hard, brittle, not very easily frangible; occurs in beds in considerable quantities in Saxony, and is solely used for manure, for which its admixture with marl admirably fits it.

2. Foliated limestone is likewise of two kinds, granular limestone, and calc spar (calc spar, foliated, and calc spar, foliated)' the former is commonly whitish, but presents many varieties of that colour; is massive, occurs almost always in

massive and disseminated, dull, opaque, does not soil, writes like drawing slate, is easily frangible, and easily tended. It is found imbedded in rocks of the flint trap formation, in Poland, and in the isle of Skye, but is very rare, and found only in small quantities.

Thirty-second species. Yellow Earth. The colour is ochre-yellow, of different degrees of intensity; it is massive, streak shining, is soft, and, strongly adheres to the tongue, and feels somewhat greasy. It occurs in beds with iron-stone, in Upper Saxony, and is employed as a pigment.

To the clay genus, likewise, belong adhesions, slate, float-stone, pine, andumber, which may be considered as recent discoveries.

FIFTH GENUS.

Talc Genus.

First species. Bole.

Its colour is cream-yellow, passing into various other shades; is commonly massive, very soft, and, strongly adheres to the tongue, and feels somewhat greasy. It occurs in rocks belonging to the new flint trap formation, and is found in beds of warece or basalt, in Silesia, Italy, &c.

It was formerly employed in medicine, but is now used only as a pigment.

Second species. Native Talc Earth.

The colour is yellowish-grey, passing into cream-yellow. It occurs massive, tuberous, and of other shapes; is internally dull, almost opaque, soft, frangible without much difficulty, and adheres a little to the tongue.

It is found in beds of serpentine, but only hitherto in Moravia.

Third species. Mekrauham. The usual colour is yellowish-white. It occurs massive, is internally dull, opaque, streak shining, is soft, adheres strongly to the tongue, feels a little greasy, and is nearly swimming. It is principally found in Natal, in Samoa, Hungary, Moravia, Spain, and America. It is much used in the manufacture of colour for paper, &c.

It is said that the Turks eat it as a medicine.

Fourth species. Fuller's Earth.

The colours are greenish-white, grey, olive, and oil-green. It is massive; internally dull, usually opaque, gives a shining streak, is very soft, feels greasy, and is not particularly heavy.

It is found in different situations in England, Saxony, Alasce, and Sweden; and is of essential use in cleansing woollen cloth, from which property it receives its name.

Fifth species. Neaphrite, Which see.

Sixth species. Scrotle. The principal colour is white, of which it presents many varieties. It occurs massive, disseminated, in crusts, and chryostalized in six-sided prisms. Internally it is dull, streak shining, very soft, rather difficultly frangible, and feels greasy.

It is found in beds and veins in serpentine in Norway, Sweden, Saxony, England, Scotland, and China. It is used in the manufacture of porcelain, and for other purposes.
granular distinct concretions, is more or less translucent, semihard, brittle, easily fracturable, is peculiar to the primitive and transitional mountains, and is chiefly found in Italy, whence it is distributed over Europe, for the purpose of statuary. The white marble of Paros, or granular limestone, has long been celebrated. Scotland furnishes some beautiful varieties of marbles, whose uses are well-known.

The latter, or calc spar, is principally white, but has many shades. It occurs massive, disseminated, and crystallized, either in six-sided prisms, or three-sided prisms. The lustre alternates from splendent to shining and glistening, and is most commonly vitreous. The massive varieties are translucent, and sometimes even transparent. It is found venuous in almost every rock from granite to the newest flint bed, occurs in a great variety of mineral veins, and is very universally disseminated, but is found particularly beautiful in Derbyshire, in Ireland, Saxony, France, Germany, and Spain.

3. Fibrous limestone, is of two varieties, common fibrous limestone, and fibrous limestone, or calc spar. The former is composed of fibres, of very different lengths, yellowish-white, or yellowish-grey, or white, or greyish, or black; it occurs massive, and only in small veins. The latter, or calc spar, is principally white, of which it exhibits several beautiful varieties; occurs massive, and also in many particular external forms; internally it is glistening and pearly. It is commonly found in the limestone cliffs and rocks of the coast, it is also found in almost every limestone country. It is composed of fibres of various lengths, and is still used in statuary.

4. Pea-stone is commonly yellowish-white, massive, internally dull, opaque or translucent on the edges; soft, very easily fractured, and in great masses in the vicinity of the hot springs at Carlsbad in Bohemia. It is composed of spherically round distinct concretions. All the varieties of limestone effervescence with acids.

Fourth species. Scheum, or foaming earth.

It is principally a light yellowish colour; occurs massive and disseminated; is intermediate between shining and glistening, presents large, coarse, small, and fine-grained distinct concretions; is generally opaque, soft, completely friable; feels fine, but not greasy, and cracks a little. It is found in cavities of the oldest flint limestone in Thuringia, and in the north of Ireland.

Fifth species. Slate spar.

Its colour milky, and greenish or reddish-white; occurs massive; lustre intermediate between shining and glistening, and completely pearly; fragments sly, translucent, soft, and prettily easily fracturable. It is found in the grey, red, or yellow veins, in the mountains, and is produced in Norway, Saxony, and Cornwall.

Sixth species. Brown spar.

This is divided into the following sub-species:

1. Foliated brown spar, is principally white and red, with several varieties of each. It occurs massive, globular, with tabular impressions, and frequently crystallized, externally shining, internally alternating from shining to concretion. It is found in granular, distinct concretions of all magnitudes; is yellow or more or less translucent, semihard; a little difficultly fracturable, and occurs in veins generally accompanied with calc spar, &c. in the mines of Norway, France, Germany, England, and other countries.

2. Fibrous brown spar is of a flesh-red, passing into rose-red; occurs massive, lustre glistening, fragments splintery, in other respects resembling the preceding. Hitherto it has been found only in Hungary and Transylvania.

Seventh species. Rhomb spar.

Its colours are yellowish and greyish-white; occurs only in regular middle-sized rhombs; lustre splendent, generally intermediate between translucent and semitransparent; is semihard, brittle, easily fracturable, and is found imbedded in rocks belonging to the calc gypsum in Sweden, Switzerland, and on the banks of Loch-Iommond in Scotland.

Eight species. Schalensteine.

The most common colour is grey-yellow; it occurs massive, and sometimes disseminated through gyps, is dull or glistening internally, translucent on the edges, rather soft, easily fracturable, and when rubbed, emits a pungent smell. It is found in considerable quantities in the district of Mansfield in Thuringia.

Tenth species. Marle.

Which see.

Eleventh species. Bituminous marble slate.

Its colour is intermediate between greyish and brownish-black; it is massive, from glistening to shining, fragments sly, usually soft, easily fracturable, and streak shining. It is found in beds along with the oldest flint limestone, and contains much copper intermixed with it, on account of which it is usually smelted in Thuringia.

Twelfth species. Calc tuff.

The colour is yellowish-grey; it is generally perforated or marked with the impressions of other substances, also amorphous, amorphous, and corroded. Internally dull, substance opaque, soft, easily fracturable, and approaching to shining. It occurs in alabaster, and is found in Thuringia, at Gouta, and other places in Germany.

Thirteenth species. Arragon.

The principal colours are greenish-grey, and iron red. It occurs crystallized in perfect equiaxial six-sided prisms: the lustre is glistening, passing into shining, and is vitreous; it is semihard, brittle, not particularly heavy, and purpuresces a little. It was first discovered in the province of Aragon, whence its name, imbedded in gyps, but has since been found in some other countries of the continent.

Fourteenth species. Apophite.

The usual colours are white, green, blue, and red; it generally occurs crystallized, the radical form of which is the equiaxial six-sided prism.Externally it is splendent, internally shining and resinous. It is commonly transparent, semihard, brittle, easily fracturable, and occurs in tin veins in Saxony, Bohemia, and in Cornwall. It has been found with schools, &c. Fig. 20.

Fifteenth species. Asparagus or spargel stone.

The principal colour is asparagus-green; it occurs only crystallized in equiaxial six-sided prisms, is internally shining, most frequently translucent, semihard, easily fracturable, and brittle. Hitherto it has been found only in Moravia in Switzerland, supposed to be produced in Norway. It is nearly allied to apophtite. Fig. 21.

Sixteenth species. Boraxite.

Its colours are yellowish, smoke and greyish white, passing to asparagus-green; it occurs in crystallized cubes, with the edges and angles truncated, internally shining, commonly semihard, brittle, and easily fracturable. Hitherto it has been discovered only at Luzenburg in Hanover. Fig. 22.

Seventeenth species. Flour.

Which see, also fig. 23.

Eighteenth species. Gyps.

This is divided into the following sub-species:

1. Gyps earth is of a yellowish-white colour, passing into some allied shades, is intermediate between fine sily and dusty, dull and feebly glistening, soils a little, feels mucilaginous but soft and fine, and is light. It is found, though rarely, in gyps countries, and is formed in the same manner as rock milk, is used as a manure.

2. Compact gyps, is commonly ash-grey, passing into smoke and yellowish-grey, is massive, internally dull, frequently translucent on the edges, very soft, fracturable without great difficulty, and is employed in architecture and sculpture, under the name of travertine.

3. Foated gyps is commonly white, grey, or red, presenting spotted, striped, and veined colour delineations. It occurs massive, and in blunted-edged pieces, but seldom in crystals. Internally it alternates from shining and glistening to glancing, is translucent and duplicating, very soft, and not particularly difficultly fracturable. It has been confounded with granular limestone. It forms glassy spar, and is found under various names of each. It occurs massive and dentiform, the internal lustre is usually glistening and pearly, commonly semihard-transparent and translucent, very soft and easily fracturable.

Fossils belonging to the gyps formation, occupy different situations. They are found in Switzerland, Switzerland, Derbyshire, Cornwall, Morfet in Scotland, and other places. Chips, when burnt, forms an excellent cement, and is used for many ornamental purposes.

Nineteenth species. Scolecite.

Its principal colour is snow-white, passing into other neighbouring shades: is generally
MINERALOGY.

massive, but not infrequently crystallized in pretty oblique six-sided prisms, the crystals seldom large, but internally shining and splendid. Fig. 24.

Selenite is completely transparent, soft, somewhat resistant, and not very fragile, and is found in the oldest gypse formation, in single crystals in clay beds in the newest formation, and in other situations. It is common in Thrangia, in Montmartre near Paris, in Cornwall, and in the Isle of Sheppey. It is employed in taking the most delicate impressions, for crayons and other purposes.

Twentieth species. Cube spar.

The colour is milk-white with various allied shades. It is massive, occurring in large, coarse, and small ground distinct concretions. The lustre is shining, passing into splendent, translucent, soft, very easily frangible, and not particularly heavy. It is found in salt rocks in Salzbourg.

To the calc genus are also referred phosphorite, which has a great bed in Estremadura in Spain; and the anhydrite, found in the duchy of Wirtemberg.


First species. Witherite.

Is commonly of a light yellowish-grey colour, generally massive, but sometimes chryslalized in six-sided prisms, or double six-sided pyramids. The lustre of the principal fracture is shining; the fragments generally wedge-shaped. It is translucent, somewhat semihard, brittle, easily frangible, and pretty heavy. Figs. 23 and 26.

It melts, without addition, before the blowpipe, into a white enameled, and occurs in veins along with heavy spar, lead-glance, &c. at Angiescar in Lancashire. Combined with ammoniacal acid, it may be used in medicine, though a very active poison of itself.

Second species. Heavy spar or baryte. See Barytes.

Eighth genus. Strontian genus.

First species. Strontian.

The usual colour is intermediate between asparagus and apple-green; it occurs most commonly massive, but sometimes chryslalized in a circular six-sided prism. The crystals are scabiously and manipulably aggregated. The lustre of the principal fracture is shining, the cross fracture glistening. It is translucent in a greater or less degree, soft and semihard, brittle, easily frangible, dissolves in acids with effervescence, and occurs along with lead-glance, heavy spar, &c. at Strontian in Argyleshire, the only place where it has yet been found.

Second species. Celestine. Is divided into two sub-species:

1. Fibrous celestine, is at an intermediate colour, between indigo-blue and bluish-grey; it occurs massive and in plates, and also chryslalized, displaying a tendency to primary distinct concretions; is translucent, soft or semi-hard, easily frangible, and pretty heavy. It is found in Pennsylvania and in France.

2. Foliated celestine, is of a milky-white colour, frequently into blue; it occurs massive, and also chryslalized in six-sided tables in

CLASS II. Fossil SALTs.

The substances included in this class are confided to those which are found in a natural state only; and the greater part of them appear to be formed by the agency of water, air, &c.

The distinguishing characters of fossil salts are, their taste and easy solution. They resemble each other so closely, that the term saline consistence is used to express whatever relates to hardness, tenacity, and friableness.

First species. Natron, or Natural Soda. It may be divided into the two following sub-species:

1. Common natron, is of a yellowish or greyish-white colour, occurs in fine flakes or in massive, pale grey or white crystalline species. It occurs along with salts of nitre, effervescing with nitric acid, is easily soluble in water, and strikes blue vegetable tinctures green. It occurs as an efflorescence in the surface of soil, or on the sides and bottoms of lakes that occasionally become dry. It is found in very large quantities in Hungary, Bohemia, and Egypt, and in many other countries of the Old World.

2. Radiated natron, or natural soda, is of a greyish or yellowish-white colour, occurs in crusts or chryslalized in capillary or accicular crystals, is glistening and translucent, and is found in large quantities in the province of Sukana in Berabhi, and in Southern Africa.

Natron is principally employed in the manufacture of glass, soap, and for washing. It is also used as a flux after being purified.

Second species. Natural nitre.

The colour is greyish or yellowish-white, approaching to snow-white; it is flaky, sometimes verges to solid and massive, is of a saline consistence, and tastes saltly and cooling. Placed on hot iron, it hisses and detoneates; is usually found in thin crusts on the surface of the soil at particular seasons of the year, particularly in hot climates. It is also met with in various countries of Europe, and is much used in making gunpowder, in medicine, and the arts. The greatest part, however, employed for these purposes, is an artificial preparation from the refuse of animal and vegetable bodies, undergoing putrefaction, and mixed with calcareous and other earth.

Third species. Natural Rock-salt. Is divided into two sub-species:

1. Rock or stone-salt, which is of two kinds, foliated and fibrous. The former is commonly of a grey or greyish colour, occurs massive and disseminated, and also chryslalized in cubes; in general is strongly translucent, rather hard, easily frangible, and feels somewhat greasy. The latter is greyish, yellowish, and snow-white; it occurs massive, is strongly translucent, vergeing to semi-transparent, decrepitates when laid on burning coals, and is found in beds lying over the first or oldest flint trap formation. It forms large beauty at Cornubia; it is found also in Germany, and almost every country in the world. At Nautwich in Cheshire it has long been dug. Its use is as general as its dissemination. It is employed as a daily seasoning for our food, as a mainer, in various manufactories, and for purposes too numerous to mention.

2. Lake-salt occurs either in thin plates, which are formed on the surface of salt-lakes, or in grains at their bottom. It is translucent, and of a saline consistence. It is found in Cyprus, near the Caspian Sea, and in various parts of Africa.

Fourth species. Natural sal ammoniac.

The colour is commonly greyish or yellowish-white. It is of a saline consistence, and is flaky, with an unitious taste. It is sometimes used in manufacture. It is called blue rose, by twilight, and chrysalized. It is the product of volcanoes and pseudo-volcanes, and is found in Italy, Sicily, in the vicinity of inflamed beds of coal both in England and Scotland, and in several countries of Asia.

Fifth species. Natural Epsom salt.

Colour a greyish-white. It occurs in crystals of a saline consistence, and grows saltly bitter. It is found as an efflorescence on clayey stones or gypse rocks, at Sesa, at Solifarina, in Hungary, and Bohemia. It is also contained in many mineral springs, particularly those of Epsom, and is derived from its name. Epsom salts are much used as an easy purgative. Considerable quantities of magnesia may be obtained from them.

Sixth species. Natural Glanaber salt.

The colour is usually greyish and yellowish-white. It occurs in the form of mealy effluviences, in crusts, and sometimes chryslalized in capillary and hexagonal crystals. Internally it is shining, with a vitreous lustre, is soft, brittle, easily frangible, and has a cooling but a saltly bitter taste. It is found on the borders of salt-lakes, on noxious ground, on old and new-built walls, in different countries of Europe, Asia, and Africa, and is used as a purgative medicine, and in some as a substitute for soda in the manufacture of white glass.

Seventh species. Natural alum.

It is of a yellowish or greyish-white colour; occurs as a mealy efflorescence, or in delicate capillary chryslals; has a sweetish astrangent taste, and is produced in various situations in Scotland, Germany, Italy, Spain, Sweden, and in Egypt.

Alum is employed as a mordant in dyeing, in the manufacture of leather, as a medicine for preventing wood from catching fire, and for preserving animal substances from putrefaction.

Eighth species. Hair salt.

The principal colours are snow, yellowish, and greyish-white. It occurs in delicate capillary chryslals, has a saline consistence, and a sweetish astrangent taste. Hair salts is found in different mine countries on the continent, at Whitby in England, and near Paisley in Scotland, and bears a striking resemblance to fibrous gypse.

Ninth species. Rock butter.

The colour is light-yellow or greyish-white. It occurs massive and tubercular; it is translucent, has a saline consistence, or sweetish-sour
MINERALOGY.

Tenth species. Natural vitriol

Is divided into the three following sub-species.

1. Iron vitriol, is commonly of an emerald and verdigris green. It occurs massive, tuberose, stalactic, and chrysotallized in different figures; is splendent and vitreous, has a saline consistence, and a sourish astringent taste. It is found along with iron pyrites, by the decomposition of which it is formed, in different countries of continental Europe, in many of the English mines, and in America. It is employed to dye linen yellow, and wool and silk black, in the preparation of inks, as a pain, &c.

2. Copper vitriol, is usually of a dark blue or black colour. It occurs massive, disseminated, stalactic, dendritic, and chrysotallized in various mining countries, in Wicklow, and in Anglesea. It is used in cotton and linen printing, and when prepared is employed by painters.

3. Lead vitriol, is a greyish, yellowish, reddish, and greenish colour. It occurs tuberose, stalactic, and coralloidal, is translucent, of a saline consistence, and a stypic taste. It is produced most abundantly where much blende occurs, and is found in Austria, Hungary, and Sweden. Here it must be remarked, that borax, though so well known by name, is without a place in the Wernerian system, as it is uncertain whether or not it occurs in a solid state. It is most probable that it occurs only in solution in certain lakes. See Borax.

The new genus stallicite, of which only one species, cryolite, has been found in Greenland, seems properly to come under this head.

CLASS III.

Inflammable Fossils.

Fossils belonging to this class are light, brittle, mostly opaque, yellow, brown, or black, seldom chrysallized, and never feel cold. They are more nearly allied to the metallic than to the earthy or saline classes.

First Genus. Sulphur Genius.

First species. Natural sulphur.

It contains the following sub-species:

1. Common natural sulphur, is of the colour the name expresses, but of different degrees of intensity. It occurs massive, disseminated, and chrysotallized in octeadehrons or double six-sided pyramids, is internally between shining and glistening, translucent, in chrystals frequently transparent, very soft, easily frangible, and light.

It is found in masses in gyps, in veins that traverse primary rocks, nests of limestone, and in other situations, and is produced in every quarter of the world, though in the British dominions it seems to be confined to Ireland.

2. Volcanic natural sulphur is of the colour the name imports, but with a considerable tinge of green. It occurs corroded, vesicular, perforated, amorphous, and sometimes as a submate in flowers, is glistening and resinous, and translucent in a slight degree. It is found only in volcanic countries, and among lava, but is produced in great abundance; and is employed in medicine, in the composition of gunpowder, and as a vapour in whitening wool and silk.

Second Genus. Bituminous genus. See Bitumens.


Fourth Genus. Graphite genus.

First species. Glance coal.

This is divided into two sub-species:

1. Conchoidal glance coal, is of an iron-black colour, of different degrees of intensity, occurs massive and vesicular, internally shining, bordering sometimes on semilunar, brittle, easily frangible, and light. It burns without flame or smell, and has hitherto been found only in the newest fossils mass formation, accompanied with other kinds of coal, at Meissen in Saxony. The fracture is conchoidal.

2. Slaty glance coal, is of a dark iron-black colour, occurs massive, is shining and glistening, soft, easily frangible, light, and intermediate between semilunar and brittle. It is found imbedded in masses, beds, and veins, in primitive, transitive, and fossil rocks, and is produced in Spain, Savoy, Saxony, Bohemia, and in the Isle of Arran in Scotland. Its principal fracture is more or less slaty.

Second species. Graphite.

This contains two sub-species:

1. Scaly graphite, is commonly of a dark steel-grey colour. It occurs massive if disseminated, is usually glistening, fracture scaly-siluted, is very soft, perfectly sectile, writes and soils, feels very greasy, and is rather difficult to frangible.

2. Compact graphite, is rather blacker than the preceding, is internally glistening with a metallic lustre, fracture fine-grained, in other respects agreeing with the preceding. It usually occurs in beds, and is found near Kold, in Ayrshire, Scotland, and in various other parts of Europe, Asia, and Africa. The finer kinds are first boiled in oil, and then cut into pencils. The course parts and sawings are melted with sulphur, and that part of the pencils used.

The colour is very light steel-grey, approaching to silver-white. It occurs in flat, smooth, and smallish grains, externally shining, lustre metallic, intermediate between semilunar and brittle, sometimes in beds, and in veins. Its principal fracture is more or less slaty. It is found in various countries, in Sweden, Norway, &c. Eas, and according to some, it has been found in the alluvial land near London. It admits of a fine polish, and is cut into necklaces, bracelets, small-boxes, and various other articles. The oil and acid obtained from it are used in medicine.

Second species. Honey-stone. See Mellite.

CLASS IV.

Metallic Fossils.

First, Platina genus.

First species. Native platina.

The colour is very light steel-grey, approaching to silver-white. It occurs in flat, smooth, and smallish grains, externally shining, lustre metallic, intermediate between semilunar and brittle, sometimes in beds, and in veins. Its principal fracture is more or less slaty. It is found in various countries, in Sweden, Norway, &c. Eas, and according to some, it has been found in the alluvial land near London. It admits of a fine polish, and is cut into necklaces, bracelets, small-boxes, and various other articles. The oil and acid obtained from it are used in medicine.

Second genus. Gold.

First species. Native gold.

This is divided into three sub-species:

1. Gold-yellow native gold, is of a perfect colour, corresponding to its name. It seldom occurs entire, is often in membranous, and in small and thin flat pieces, in grains, and also chrysallized in cubes, octahedrons, simple three-sided pyramids, deltoidododecahedrons, and acute double eight-sided pyramids. It is abundant in the crystals of the world, but commonly in too small quantities to be collected for use. America and Africa supply the largest quantities.

2. Brass-yellow native gold, is principally of the colour of brass, occurs disseminated, capillary, moss-like, reticulated, and in leaves, also chrysallized in thin six-sided cubes, and is rather lighter than the preceding. It is found in different situations in Bohemia, Hungary, &c.

3. Greyish-yellow native gold, is of a brass-yellow color falling into steel-grey, occurs in small flatish grains like platina, and is found with that metal.

Third genus. Mercury, which see.
MINERALOGY

First species. Native mercury, or quick-silver.

The colour is tin-white; it occurs perfectly fluid in globular drops, or as a metallic lustre, does not wet, feels very cold, and is uncommonly heavy. Before the blow-pipe it is volatilized, without any smell. It is usually found in cinnabar at Idria. It occurs in a compact limestone, and here it is very abundant. It is likewise produced in different parts of Germany, France, Spain, and in very large quantities in Peru. The uses of quicksilver are multifarious, and cannot be enumerated in this place.

Second species. Natural amalgam.

Fluid or semi-fluid amalgam is of an intermediate colour between tin and silver-white. It occurs in small massive pieces and in balls, also disseminated and chrystralized in different forms.Externally it is shining and splendent, soft and somewhat fluid; when cut or pressed, it emits a cracking sound like natural amalgam, and is uncommonly heavy.

Third species. Mercurial hova-ore, or corrosive mercury.

It is of an ashy-grey colour, of various degrees of intensity; occurs very rarely massive, but commonly in small pieces, internally chrystralized and splendent. It is soft, sectile, easily friable, and heavy. It is usually found with the other species of mercury, and is produced in the same countries. It was first discovered in the mines of the Palatinate.

Fourth species. Mercurial breore, or mercurial lenticular arc.

Compact mercurial liver-ore, is of an intermediate colour between dark-red and lead-grey, occurs massive, is glistening and glimmering internally, opaque, soft, sectile, easily friable, and uncommonly heavy. It is the most common ore of mercury at Frein in Idria.

Fifth species. Cinnabar.

Dark-red cinnabar, is principally of a perfect coelestial red, occurs massive, disseminated, in large broken pieces, in membranes, amorphous, dodecahedrons, and crystallized. The crystals are small, splendent externally, and shining internally. The massive cinnabar is opaque or translucent on the edge, brittle, sectile, softly friable, and uncommonly heavy.

Bright-red cinnabar is of a lively scarlet-red colour. It occurs massive and disseminated, is internally glimmering, substance opaque, streak shining, soot, is very soft, sectile, very easily friable, and heavy. Both belong to the same countries with quicksilver. In Idria, Spain, and Peru, this genus is most abundant. It does not occur in Norway, Sweden, or Great Britain, or Ireland. From the ore of cinnabar the greatest part of the mercury used in commerce is obtained.

Fourth Genus. Silver.

First species. Native Silver.

Common native silver is of the colour the name expresses. It occurs massive, disseminated, in pieces, plates, and membranes, as well as in other forms; besides being chrystralized in cubic, octahedrons, garnet, dodecahedrons, and double eight-sided pyramids. Externally it is shining and glistering; internally it alternates from shining to glistering, and has a metallic lustre. It is soft, completely malleable, pretty flexible, and uncommonly heavy, containing upwards of 80 parts of pure silver; and is found in veins, along with native silver and other minerals, in Hungary, Austria, and other countries of Europe, but more particularly in Mexico and Peru.

Seventh species. Brittle silver-glance.

Silver-glance is of a dark-blackish lead-grey colour, occurs usually massive, disseminated, in membranes, &c. and also chrystralized in cubes, octahedrons, garnet, dodecaedrons, and double eight-sided pyramids. Externally it is shining and glistering; internally it alternates from shining to glistering, and has a metallic lustre. It is soft, completely malleable, pretty flexible, and uncommonly heavy, containing upwards of 80 parts of pure silver; and is found in veins, along with native silver and other minerals, in Hungary, Austria, and other countries of Europe, but more particularly in Mexico and Peru.

Fourth species. Copper pyrites.

When fresh, its colour is brass-yellow, of different shades according to its richness. It occurs massive, disseminated in membranes, &c. and also chrystralized in various figures. Externally it is intermediate between glistering
and shining, internally soft; is between semihard and soft, brittle, easily frangible, and heavy.

Fifth species. White copper ore
Is of an intermediate colour between silver-white and bronze-yellow: occurs massive and disseminated; is internally glistening, with a metallic lustre; rather soft, brittle, easily frangible, and heavy. It is found in veins and mineral beds in primitive mountains, and is produced in Cornwall, in different parts of Germany, in Siberia, and in South America. Next to it is one of the rarest species of copper ore.

Sixth species. Grey copper ore, or Cold ore.
The most common colour is steel-grey: it occurs massive, disseminated, and also crystallized in tetrahedrons, octahedrons, and garnet dodecahedrons. It is more or less semihard, brittle, easily frangible, and heavy; and is found in the newer primitive rocks, and likewise in transitive and loact rocks in several mines of Cornwall, in Germany, Italy, Sweden, Norway, Siberia, and Chili. It is usually smelted on account of the copper it contains.

Seventh species. Copper black.
The colour is usually intermediate between bluish and brownish-black: it occurs massive, or disseminated; and as a coating, to other ores of copper; is always more or less cohering, and heavy, containing from 40 to 50 parts of copper. It is usually found with copper pyrites, &c., and is produced in Silesia, Germany, France, Sweden, Norway, and Siberia. Sometimes it is very beautiful.

Eighth species. Red copper ore.
Compact red copper is usually of a dark cobaltine-red colour: occurs massive, in membranes, crowded, amorphous, and also disseminated. Internally it is glistening, inclining to glistening, with a semimetallic lustre: it is opaque, semihard, brittle, easily frangible, and heavy.

Ninth species. Tile ore.
Earthly tile ore is usually of a red lividaceous colour: massive, disseminated, and inclining copper pyrites; is intermediate between friable and solid, soils slightly, is almost always cohering, and heavy. It is found in veins; commonly accompanied with native copper ore and malachite.

Tenth species. Copper azur.
Earthly copper azure is of a small-blue colour; usually friable, and disseminated; is composed of dusty particles, does not soil, is chiefly cohering, and approaches to heavy. It is found in small quantities, usually accompanied with malachite and copper green, in different parts of Germany, in Norway, and Siberia.

Eleventh species. Malachite, which see.

Twelfth species. Copper green.
The principal colour is verdigris-green, of different degrees of intensity: it usually occurs massive, disseminated, and coating malachite; is internally shining; more or less translucent, soft, not very brittle, easily frangible, and intermediate between heavy and non-precious heavy. It is found in the same geognostic situation with malachite, in Cornwall and other countries, but is rare.

Thirteenth species. Iron-shot copper
Earthly iron-shot copper green is usually of an olive-green colour: occurs massive, and disseminated; is dull, soils a little, soft, passing into friable, not very brittle, easily frangible, and not particularly heavy.

Fourteenth species. Copper emerald.
The colour is an emerald-green. It occurs in crystallized six-sided prisms, which are externally and internally shining, with a vitreous lustre. It is semihard, brittle, and not particularly heavy; and is found in the remoter parts of the Russian dominions, and on the Chinese frontiers.

Fifteenth species. Copper mica.
Is usually of an emerald-green colour: it occurs massive, disseminated, and occasionally crystallized in very thin six-sided tables. Externally it is smooth and splendent, internally shining with a pearly lustre. The massive varieties are translucent; the chrysocolla transparent. It is very brittle, not particularly heavy; and has hitherto been found only in veins in Cornwall, where it passes under the unscientific name of foliated arseniat of copper.

Sixteenth species. Lenticular ore.
The colour is usually deep green, sometimes passing into verdigris green. It occurs crystallized in small, flat, double, four-sided pyramids; is externally shining; translucent, soft, rather brittle, and very easily frangible. Hitherto it has been found only in Cornwall.

Seventeenth species. Oilstone ore.
Foliated olivine ore is of a perfect olive-green: seldom occurs massive, usually in drusy crusts, and in small crystals, presenting acute rhomboeds, and oblique four-sided prisms. Internally it is glistening, with an adamantine lustre. It is very soft, sectile, and heavy in a low degree; and has hitherto been found only in Cornwall.

Sixth Genus. Iron.

First species. Native iron.
Is of a light steel-grey colour, inclining to silver white: it has hitherto been found only in Russia; internally it is intermediate between glistening and glistening, with a perfect metallic lustre. It is between soft and semihard, perfectly malleable, common flexible, difficultly frangible, and uncommonly heavy. Hitherto it has been found only in loose masses on the surface of the earth, and is a rare production.

Common iron pyrites is usually of a perfect bronze-yellow colour: it occurs massive, disseminated, in membranes, and also crystallized in cubes, octahedrons, dodecahedrons, icosahedrons, and hexadecahedrons. It is hard, brittle, and heavy, and when rubbed or struck with steel, emits a strong sulphureous smell. It occurs in almost every kind of mineral repository, but most commonly in granite; its geographical distribution is equally extensive, but it is principally valued on account of the sulphur which may be extracted from it by sublimation.

Third species. Magnetic pyrites.
Is of an intermediate colour between bronze-yellow and copper-red: it occurs massive and disseminated; is generally shining, with a metallic lustre, passes from hard to semihard, is brittle, easily frangible, and heavy. It is attracted by the magnet; is found only in primitive mountains, in Cornwall, in several parts of Germany, in Norway, and Siberia; and is used for the same purposes as common pyrites.

Fourth species. Magnetic ironstone.
Common magnetic ironstone is of an iron-black colour: it is massive, disseminated, and also crystallized in cubes, octahedrons, and garnet dodecahedrons, and rectangular four-sided prisms. It is externally shining; internally between splendent and glistening, with a metallic lustre; is intermediate between hard and semihard, brittle, and heavy. It occurs most frequently in primitive mountains, and is found in the Shetlands, many parts of Germany, and other countries, particularly Sweden. When pure it affords excellent bar iron.

Fifth species. Iron glance.
Common iron glance is usually of a dark steel-grey colour, with several different shades. It commonly occurs massive and disseminated, and also crystallized in flat, double, three-sided pyramids, and in double three-sided pyramids, it alternates from splendent to glistening; internally it is most commonly glistening. It is hard, brittle, heavy, and rather difficulty frangible. It occurs in beds and veins in primitive and transitive mountains, and is found in considerable quantities in Sweden, and other countries, and affords, when smelted, an excellent mallable iron.

Sixth species. Red iron-stone.
Red iron stone is of a reddish-brown colour, and is frequently found in the carboniferous strata. It occurs in beds, and in veins, and is generally found in a compact, massive, and cohering state. It is hard, brittle, and heavy, and occurs in beds, and in veins, in various parts of Germany, and in Chili.
Nineth species. *Black iron-stone.*

Compact black iron-stone, is of an intermediate colour between bluish-black, and dark steel-grey; it occurs massive, tuberose, gemiform, &c, it is semihard, brittle, easily friable, and heavy.

Tenth species. *Clay iron-stone.*

Reddish is of a light brownish-red, passing into chestnut-brown; it usually massive, and friable, and writes, is sectile, easily friable, and rather heavy. It is chiefly found in the newer clay-late, and is produced rather abundantly in Germany and Siberia. The common varieties are used by the carpenter, the fitter by the painter, under the name of red-chalk.

Eleventh species. *Bag iron-ore.*

Morass ore is of a yellow-brown colour, sometimes friable, sometimes coherent, and occurs massive, corroded, in grains, and tubercous. It is very strongly, feels meagre, but soft.

Twelfth species. *Blue iron-ore.*

When fresh it is white, but soon becomes of an indigo-blue colour, of different degrees of intensity; it occurs massive, disseminated, and thinly coating; the particles are dull and dusty; it soils slightly, belts fine, and is lightish. It is in degrees of pyrite on clay-beds, and other situations, in the Sheland islands, Iceland, Sweden, and Siberia.

Thirteenth species. *Green iron-ore.*

Friable green-iron ore is of a sickly-green colour, occurs massive and disseminated, is more or less coherent, soft, fine, easily friable, and sectile, and is intermediate between particularly heavy and hard.

Fourteenth species. *Cube ore.*

The colour is olive-green, of different degrees of intensity; it occurs massive, and exhibits in small cubes, is translucent, soft, brittle, and not particularly heavy. It is found in veins, but hitherto only in Cornwall.

Seventh genus. *Lead.*

First species. *Lead glance.*

Common lead glance is of a fresh leady-grey colour, of different degrees of intensity; it occurs massive, disseminated, in membranes, &c, and also crystalized in crystals, octahedrons, four-sided prisms, six-sided prisms, and three-sided tables. It is soft, sectile, easily friable, and uncommanly heavy; and it is found in veins and beds in primitive, transvive, and floetz mountains, at lead-hills in Lanarkshire, Derbyshire, and several other counties of England, Scotland, and Wales; besides being widely diffused over other parts of the globe, it is most frequently worked as an ore of lead, but sometimes as an ore of silver.

Second species. *Blue-lead ore.*

It is of an intermediate colour between dark indigo-blue and lead-grey; it occurs massive, and crystalized in perfect six-sided prisms, is soft, sectile, easily friable, and heavy; and it is found in veins with other minerals of the same class, but is altogether a rare fossil, nor has it hitherto been discovered in Britain.

Third species. *Brown-lead ore.*

It is of a hair-brown colour of different degrees of intensity; it occurs massive, and exhibits in six-sided prisms, is freely translucent, soft, not very brittle, easily friable, and intermediate between heavy and uncommonly heavy; it is commonly associated with other minerals, in Bohemia, Hungary, Brittany, and Saxony.

Fourth species. *Black-lead ore.*

The colour is greyish-black, of different degrees of intensity; it occurs massive, disseminated, and exhibits in six-sided prisms, externally is usually splendent, internally shining with an adamantine lustre, is rather brittle, easily friable, and heavy. It is found in veins, and almost always accompanied with other kinds of lead ore, at lead-hills in Scotland, in Bohemia, Saxony, and other mineral countries.

Fifth species. *White-lead ore.*

The colour is white, but has various shades; it occurs massive, disseminated, in membranes, but most commonly crystalized in pyramids, and pyramids of different figures. Externally, it is scapolitic, splendent, internally between splendent and glistening, with an adamantine lustre. It is not, brittle, very easily friable, and heavy, and is found in most places where the other species occur, in England, Wales, Scotland, Ireland, &c. Next to lead glance it is the most common of the lead ores, but is seldom in sufficient abundance to become an object to the metalurgist.

Sixth species. *Green-lead ore.*

Its colour is grass-green, of various shades; it generally occurs crystalized, in six-sided prisms, is always translucent, soft, rather brittle, very easily friable, and heavy. It is produced in Scotland and other countries, and is sometimes confounded with the preceding species.

Seventh species. *Redlead ore.*

Its general colour is a hyacinth-red; it occurs massive but rarely, sometimes in membranes, but most commonly crystalized in boudoulo four-sided prisms, is both externally and internally splendent, very soft, between brittle and sectile, easily friable, and heavy. It is found in veins in gneiss and mica slate, accompanied with other fossils of the same kind, in Austria, Saxony, and Sibire, and on account of its beautiful colour is chiefly used as a pigment.

Eighth species. *Yellow-red ore.*

Its principal colour is wax-yellow; it is generally crystalized in rectangular four-sided tables, cubes, octahedrons, equilateral eight-sided tables, and double eight-sided pyramids. Externally, it is shining, and glistening; internally squamulose, with a resonant lustre; it is translucent, soft, between brittle and sectile, easily friable, and heavy. It is found in compact lime-stone in Cornwall, and some other countries of the continent.

Ninth species. *Lead vitriol, or vitriol of lead.*

The colour is yellowish-grey and greyish-white; it occurs only crystalized in octahedrons of different figures. Externally it is shining, internally splendent, with an adamantine lustre. It is often semi-transparent, rather brittle, and heavy, and is found in Scotland, Anglesc, and Spain.

Tenth species. *Lead earth.*

Coherent lead earth is usually of a yellowish-grey colour; it occurs massive, is internally glowing, usually opaque, soft, firmly clining to se-tile, easily friable, and heavy. It is found in primitive lime-stone in Derbyshire, Scotland, and many other countries.

Eighth genus. *Tin.*

First species. *Tin pyrites.*

The colour is intermediate between steel-grey and brass-yellow; it occurs massive and disseminated. Internally it is glistening, and has a metallic lustre, is semihard, brittle, easily friable, and heavy. It melts easily, and has hitherto been found only in Cornwall.

Second species. *Tin stone.*

The most common colour is blackish-brown; it occurs massive, disseminated, in rolled pieces, in grains, like sand, but most frequently crystalized in prisms and pyramids of different figures. Internally it is shining and glistening, it yields a greyish-white streak, is hard, easily friable, brittle, and very heavy. It is found only in primitive rocks, and is confined to a few situations, like all the tin genus.

Third species. *Cornish tin ore, or wood tin.*

The most usual colour is hair-brown, of different degrees of intensity; it occurs usually in rolled pieces, sometimes reniform with impressions. It is found usually in large and coarse granular distinct concretions, is opaque, hard, brittle, easily friable, and uncommonly heavy. It is inflexible, and hitherto has only been found in Cornwall in alluvial land, accompanied with tin stone.

Ninth genus. *Bismuth.*

First species. *Native bismuth.*

Its colour is silver-white, with an inclination to red; it occurs massive, disseminated in leaves, recellularized, and crystalized in small four-sided tables, and in small and distinct cube, and three-sided pyramids. It is soft, sectile, rather difficultly friable, and commonly heavy; and is found in veins in primitive mountains in Saxony, and other parts of the continent; but it is doubtful if produced in Britain.

Second species. *Bismuth glance.*

The colour is a light lead-grey; it occurs massive, disseminated, and in acicular and capillary crystals; it soils, inclines to sectile, is easily friable, and heavy. It is found always in veins, and is usually accompanied with native bismuth, chiefly in Saxony, Bohemia, and Hungary.

Third species. *Bismuth-ochre.*

The colour is a straw-yellow, passing into other yellow shades of the same species; it occurs massive and disseminated, opaque, soft, not very brittle, easily friable, and heavy. This mineral is rare, and seems to be confined to a few places in Saxony and Bohemia.

Tenth genus. *Zinc.*

First species. *Blende.*

Yellow blende is of a dark wax and sulphur yellow colour; it usually occurs massive and disseminated, but is sometimes crystalized in rectangular four-sided prisms; it is shining and splendent both externally and
MINEALOGY.

Sixth species. Antimonio-ochre.
The colour is a straw-yellow, of various degrees of intensity; it seldom occurs massi-}

evated, and disseminated, but usually as a coating on chrysolite or red antimony ore. It 

dull, soft, not very brittle, nor particularly heavy. It is found always in veins, in differ-

cent parts of Germany, and is evidently found by the decomposition of grey anti-

mony. It is found in veins in Bohemia, Hungary, and Saxony.

Twelfth Genus. Cobalt.

Third species. Cobalt glance.
The colour is a silver-white, slightly inclin-

ing to reddish; it is commonly massive and 

disseminated, sometimes chrysoellized in dif-
erent forms; it is externally splendid, inter-

nally between shining and glistening, and has 

a metallic lustre. It is semihard, brittle, 

not very easily frangible, and heavy. It easily melts 

before the blowpipe, emits a strong arsenical 

smell, and yields a white metallic globule.

Fourth species. Black cobalt ore.
Earthly black cobalt ore is of an interme-

ciate colour between brownish-black and blue-

black, is composed of dust, dusty particles, 

which soil a little, usually cohering, streak 

shining, and very fine granular and distinc-

concretions, is semihard and brittle, and not 

difficult to separate, and heavy. Before 

the blowpipe it emits an arsenical smell and 

colour, and afterwax melts, though with 

difficulty. It is found in Cornwall, Norway, 

and many other countries, and is nearly al-

lied to cobalt.


It is of a apple-green colour, occurs always 
as a coating or efflorescence, is composed of 
dust dusty particles, loose, or little cohering, 
feels meagre, and is light. It is found in the 
same situations with other species. It is 

not certain that native nickel has yet been 
discovered, though it is mentioned by some 

mineralogists.

Fourthteen Genus. Manganese.

First species. Grey manganese ore.
Radiated grey manganese ore is of a dark 

steel-grey colour, occurs massive, dissemi-
nated, and chrysoellized in prisms of different 

varieties. It is found in coarse, large, and 

small granular distinct concretions; soils 

strongly when rubbed, is soft, brittle, rather 
difficulty frangible, and not particularly 

heavy. It is found in several counties of 

England and Scotland, and in different part of 

Germany.

First species. Coppernickel.

It occurs frequently in various grey coatings, 

and disseminated, is feebly glistening, bor-

ering on dull, scarcely soils, has a shining 

streak, and is very soft and light.

Sixth species. Red cobalt ochre.

Cobalt ochre is of a peach blossom-red co-

lour, of different degrees of intensity, occurs 
massively in veins, with grey coatings, and 
disseminated, is feebly glistening, bor-

erling on dull, scarcely soils, has a shining 

streak, and is very soft and light.

Third species. Coppernickel.

It is of a red copper-colour of different de-

grees of intensity; it occurs usually massive 

and disseminated, is internally glistening, and 

has a metallic lustre. It is usually unsepa-

rated; sometimes, however, it is found in 
coarse and small granular distinct concre-
tions, is semihard in a high degree, brittle, 

not very easily frangible, and heavy. Before 

the blowpipe it emits an arsenical smell and 
colour, and afterwards melts, though with 
difficulty. It is found in Cornwall, Norway, 

and many other countries, and is nearly al-

lied to cobalt.


It is of a apple-green colour, occurs always 
as a coating or efflorescence, is composed of 
dust dusty particles, loose, or little cohering, 
feels meagre, and is light. It is found in the 
same situations with other species. It is 

not certain that native nickel has yet been 
discovered, though it is mentioned by some 

mineralogists.

Fourteenth Genus. Manganese.

First species. Grey manganese ore.
Radiated grey manganese ore is of a dark 

steel-grey colour, occurs massive, dissemi-
nated, and chrysoellized in prisms of different 

varieties. It is found in coarse, large, and 

small granular distinct concretions; soils 

strongly when rubbed, is soft, brittle, rather 
difficulty frangible, and not particularly 

heavy. It is found in several counties of 

England and Scotland, and in different part of 

Germany.

Second species. Black manganese ore.

Is of an intermediate colour between brownish-black and blue-black, oc-

urs massive, disseminated, and in octahedral 

chrysals. It is found in small and fine gra-

ular concretions, is opaque, semihard, brittle, and heavy; but is a rare mineral, 

and hitherto found only in a few places of 

Germany and Spain.

Third species. Red manganese ore.

Is of a light rose-red colour, occurs massive and dissemi-
nated, is internally dull, translu-
cent in a slight degree, hard, brittle, easily frangible, and heavy. It is found in veins in 

Norway, France, and some other countries.

Fifteenth Genus. Molybdena.

First species. Molybdena.

Its colour is a fresh burning lead-grey; it 
occur usually massive and disseminated, but also chrysoellized in six-sided tablets, and 

short six-sided prisms; internally it is splen-
dent, the fracture perfectly foliated, and is 

found in large and coarse granular distinct 
concretions. It soils a little, is very soft, 
easily frangible, its thin leaves common flexi-

tle, feels grossy, and is heavy. It is one of 

the oldest of metals, and occurs only in 

primitive mountains, disseminated, or in 

veins; and is produced in Norway, Sweden, 

Bohemia, and other countries.
MINERALOLOGY.

SIXTEENTH GENUS. Arsenic.

First species. Native arsenic.

When fresh broken, it is of a light yellowish lead-grey colour, but it quickly parishes; it occurs massive, disseminated, reniform, and in plates, with various impressions. It is found in thin, curved, bimetallic, distinct concretions; in the streak it becomes shining and metallic, semihard in a high degree, very easily frangible, and between sectile and malleable. It occurs only in primitive mountains, and in veins of a newer formation, and is found in various parts of Germany, in France, and in Chili.

Second species. Arsenic pyrites.

Common arsenic pyrites is, when fresh, of a silver-white colour, but soon acquires a yellowish tarnish; it occurs massive, disseminated, and also in crystals of various figures. Internally, it is shining, with a metallic lustre; and is found usually unseparated, stard, brittle, not easily frangible, and heavy. It occurs only in primitive mountains and in beds, and is produced in Norway, Germany, Bohemia. From this ore the white oxide of arsenic is principally obtained.

Third species. Orpiment.

Red orpiment is of an aurora-colour, of different degrees of intensity: it occurs massive, disseminated in membranes, and also chrysalitzed in oblique four-sided and six-sided prisms. It is transparent, but the crystals are transparent, is very soft, yields a lemon or orange-coloured streak, and is easily frangible. It is found both in primitive and floetz mountains, and is produced in Germany, France, Italy, and the West Indies. It is used as a pigment.

Yellow orpiment is of a perfect lemon-yellow colour, occurs massive, and in very minute crystals, is found in large, coarse, and small angular granulated distinct concretions, is translucent, very soft, sectile, and common flexible. It occurs principally in floetz mountains, in several parts of Germany and the East.

Fourth species. Arsenic brome.

The colour is a reddish-white and snow-white; it occurs as a coating, in small balls, &c. and in very delicate capillary shining crystals, is translucent on the edges, very soft, easily frangible, and soils. It is produced in rents of a granite rock, and hitherto has only been discovered in Swabia.

SEVENTEENTH GENUS. Scheele.*

First species. Tungsten.

The colour is usually yellowish and greyish-white, which pass into several other neighboring shades; it occurs massive, disseminated, and frequently chrysalitzed. Internally it is shining, with a vitreous lustre; is more or less translucent, soft, not very brittle, and uncommonly heavy; yields a yellow or yellowish-grey streak. It is found in primitive mountains, and belongs to the oldest metamorphic formations, and is produced in Cornwall, Sweden, Saxony, and Bohemia.

Second species. Wolfram.

Is of an intermediate colour between dark greyish-black, and brownish-black; it occurs massive, and also chrysalitzed in broad six-sided prisms, and rectangular four-sided tables; and is found in fortification-wise curved bimetallic distinct concretions. It is opaque, yields a reddish-brown streak, is soft, brittle, and uncommonly heavy. It is produced in the primitive mountains, almost always accompanied with tin, in Cornwall, and some other countries.

EIGHTEENTH GENUS. Menachine.

First species. Menachpine.

Is of a greyish-black colour, inclining to iron-black, occurs only in small flattish angular grains. Internally is glistening, with an adamantine lustre, is perfectly opaque, soft, brittle, retains its colour in the streak, is easily frangible, and moderately heavy. It is attractable by the magnet, and is found in Cornwall, accompanied by fine quartz-sand, in the isle of Providence in America, and at Botany Bay.

Second species. Orpiment.

Is of a dark red-brown colour, of various degrees of intensity; it occurs always chrysalitzed, and that in very acute octahedrons. It is chiefly translucent, and semitransparent, sectile, brittle, and borders on heavy. It is found in Dauphiny, and appears from accurate experiments to be an oxide of menachine mixed with silica.

Third species. Rutile.

Is of a dark blood-red colour, of various degrees of intensity; it occurs always chrysalitzed in four-sided and six-sided prisms, and in compressed acicular and capillary crystals. Externally it is shining, internally splendent, translucent in a slight degree, hard, easily frangible, and not very heavy. It is found imbedded in drusy cavities of granite, &c. in different parts of Germany, France, Spain, Siberia, and South Carolina.

Fourth species. Nigrine.

Is of a dark brownish-black colour, passing to velvet-black; it occurs in larger and smaller angular grains, and in rolled pieces. Externally moderately glittering, internally the same, with an adamantine lustre, is opaque, sectile, hard, and yields a yellowish-brown streak. It is found in alluvial hills in several parts of Germany, and also in Ceylon.

Fifth species. Irisine.

Is of an iron-black colour, somewhat inclining to brownish-black; it occurs usually in small oblique angular grains, and in rolled pieces, internally glistening, with a semimetallic lustre, is completely opaque, hard, brittle, and retains its colour in the streak. Hitherto it has been found only in the stream of the river in Germany, from which it receives its appellation. It bears a great resemblance to iron-sand.

NINETEENTH GENUS. Uran.

First species. Pitch ore.

Is usually of a velvet-black colour; it occurs almost always massive and disseminated, is uncommonly heavy, and completely infusible without addition. It is found in veins of primitive mountains along with lead and silver ores, and is produced in Saxony and Norway.

Second species. Uran mica.

The principal colour is a grass-green, passing into various allied shades; it occurs sometimes in membranes, but commonly chrysalitized in rectangular four-sided tables. It has a fracture which is followed, the fragments and distinct concretions are too minute to be determined. It is more or less translucent, soft, sectile, easily frangible, and is found in iron-stone veins in Cornwall, Saxony, and France.

Third species. Uran ochre.

Fribale uranium or ochre is usually of a straw-yellow colour; it generally occurs as a coating or efflorescence on pitch ore; is friable, and composed of dull dusty particles, which feel meagre, and are not particularly heavy.

Indurated uranium or ochre is of the same colour as the preceding; occurs massive and disseminated, is generally dull, internally opaque, soft, brittle, and soils a little, and is found along with the other ores of uranium.

TWENTIETH GENUS. Sylcom.

First species. Native sylcom.

Is of an intermediate colour between white and silver-white: it occurs massive and disseminated, and also chrysalitized in four and six-sided prisms, in small three-sided pyramids, in cubes, and in short acicular crystals. It is soft, not very brittle, easily frangible, and heavy; and before the blowpipes melts as easily as lead, burning with a light green colour, and emitting a sharp, disagreeable colour. Hitherto it has only been found at Face-bay, in Transylvania.

Second species. Graphite ore.

Its colour is a light steel-grey; it occurs massive and chrysalitized; externally is splendent, internally glistening. When massive, it shows a tendency to fine granular distinct concretions; it is soft, brittle, sectile, and heavy, and is worked as an ore of gold in Transylvania, where alone it has yet been found.

Third species. Yellow Sylcom ore.

Is of a silver-white colour, inclining to brass-yellow: it occurs disseminated, and chrysalitized in very small and rather broad four-sided prisms, soft, rather friable, and uncommonly heavy. It is found along with the other species of the genus, and contains a considerable portion both of gold and silver.

Fourth species. Black Sylcom ore.

Is of an intermediate colour between iron-black and blackish lead-grey; it occurs massive, and in small, thin, and longish six-sided tables, which are usually imbedded. Externally it is splendent; internally shining, soils a little, is very soft, sectile, splits easily, and in thin leaves is common flexible. It melts easily before the blowpipe; occurs in veins filling with other minerals, but is only found in Transylvania, where it is worked for; the gold and silver it contains.

TWENTY-FIRST GENUS. Chrome.

First species. Acicular, or Needle ore.

Its colour is dark steel-grey; occurs in innumerable dazides, and is commonly imbedded with a metallic lustre, is soft, not very brittle, heavy, and is always accompanied with chrome ochre, and sometimes with native gold. It is found in Siberia.
Second species. Chrome Ochre.

Mint. See Mentha.

MIN. 8. See Mentha.

27. Octahedron, with bevelled angles. By Auction Bon.

28. Cube, with the angles acuminated by three planes which are set on the lateral planes.

29. Cube, with the angles acuminated by three planes which are set on the lateral planes.

30. Rectangular four-sided prism acuminated by four planes, which are set on the lateral planes.

31. Equiaangular six-sided prism acuminated by both extremities by six planes, which are set on the lateral planes.

32. Four-sided prism, acuminated on both extremities by four planes, which are set on the lateral edges.

33. Six-sided prism, acuminated on both extremities by three planes, which are set on the alternate lateral edges.

34. Six-sided prism, acuminated on both extremities by three planes, which are set on the alternate lateral edges.

35. Double eight-sided pyramid, acuminated on both extremities by four planes, which are set on the alternate lateral edges.

MINIMUM, in the higher geometry, the least quantity attainable in a given case.

MINOR, in law, is an heir, either male or female, before they arrive at the age of twenty-one; during the minority of such, they are usually incapable of acting for themselves.

MINOR, in logic, the second proposition of a regular syllogism.

MINOR, in music, signifies less, and is applied to certain concords or intervals which differ from others of the same denomination by half a tone; thus we say a third minor, meaning a less third; a sixth major and minor.

MINT, the place in which the public money is coined. See COINING.

The officers of the mint are, 1. The warder of the mint, who is chief; he oversees the other officers and receives the bullion, 2. The master worker; who receives the bullion from the warder, causes it to be melted, delivers it to the moneymen, and when it is coined, receives it again. 3. The compounder, who is the overseer of all the moneymen, and sees that all the money is made to the just assay. 4. The assay-master; who weighs the gold and silver, and sees that it is according to the standard. 5. The assayer, who takes the accounts. 6. The surveyor of the melting; who, after the assay-master has made trial of the bullion, sees that it is cast out, and not altered after it is delivered to the melter. 7. The engraver, who graviates the stamps and devices for the coinage of the money. 8. The clerk of the issues, who sees that the issues are current and fit to work with. 9. The moneymen; who receive the bullion before it is coined. 10. The provost of the mint; who provides for, and oversees all the moneymen. 11. The blanckers; who anneal and clean the money. 12. The moneyers; some of whom forge the money, some shear it, some round and mill it, and some stamp or cut it. 13. The porters, who keep the gate of the mint.

MINUA STIA, a genus of the triandra trignia class and order. The cal. is 5-leaved; cor. none; caps. 1-celled, 3-valved. There are five styles, herbs of Spain.

MINUTIUS, in geometry, the sixtieth part of a degree of a circle.

Minutes are denoted by one acute accent, thus (9); as the second, or sixtieth part of a minute, is by two such accents, thus (9); and the third by three, thus (9).

Minutes of time, the sixtieth part of an hour.

MIRABILIS, marvel of Peru; a genus of the monoqorn order, in the pentandria class of plants, and in the natural method ranking with those of which the order is doubtful. The corolla is funnel-shaped above; the calyx inferior, the nectarian globular, containing the gymnos. The most remarkable species are, 1. The jalapa, or common marvel of Peru. Of this there are varieties, with white flowers, with yellow flowers, with purple flowers, with red flowers, with white and yellow flowers, purple and yellow flowers, red and yellow flowers. 2. The lungwilla, or long-flowered mirabilis, with all the branches and shoots terminated by white flowers in clusters, having very long tubes, budding downward. 3. The dichtoma, dichotoma, or forked mirabilis, with smallish red flowers at the axillas, singly and close-sitting.

The roots of all these plants are purgative; but require to be given in a small quantity to operate equal to the true jalapa, which is a species of convolvulus. See CONVOLVULUS.

MIRROR, a speculum, looking-glass, or any polished body, whose use is to form the images of distinct objects by reflection of the rays of light.

Mirrors are either plane, convex, or concave. The first sort reflects the rays of light in a direction exactly similar to that in which they fall upon it, and therefore represents bodies of their natural magnitude. But the convex ones make the rays diverge much more than before reflection, and therefore exhibit to view the images of those objects which they exhibit; while the concave ones, by collecting the rays into a focus, not only magnify the objects they shew, but also burn very fiercely when exposed to the rays of the sun; and by them, a burning mirror.

In ancient times the mirrors were made of some kind of metal; and from a passage in the mosaic writings we learn, that the mirrors used by the Jewish women, were made of brass; a practice doubtless learned from the Egyptians.

Any kind of metal, when well polished, will reflect very powerfully; but of all others, silver reflects the most, though it has always been too expensive a material for common use. Gold is also very powerful; and all metals, or even wood, gilt and polished, will act very powerfully as burning mirrors. Even polished ivory, or straw nicely plaited together, will form mirrors capable of burning, if on a large scale.

Some of the more remarkable laws and phenomena of plane mirrors are as follow:

The spectator will see his image of the same size, and erect, but reversed as to right and left, and as far beyond the specular as he is before it. As he moves to or from the
speculum, his image will, at the same time, move towards or from the speculum also on the other side. In like manner if, while the spectator is at rest, an object be in motion, its image behind the speculum will be seen to move at the same rate. Also when the spectator moves, the images of objects that are at rest will appear to approach or recede from him, after the same manner as when he moves towards real objects.

2. If several mirrors or several fragments or pieces of mirrors, be all disposed in the same plane, they will only exhibit an object once.

3. If two plane mirrors, or speculars, meet in any angle, the eye, placed within that angle, will see the image of an object placed within the same, as often repeated as there may be perpendiculars drawn determining the places of the images, and terminated without the angle. See Optics.

MISCHINA, or MISINA, the code or collection of the civil law of the Jews. The Jews pretend, that when God gave the written law to Moses, he gave him also another not written, which was preserved by tradition among the rabbis. This, till rabbi Judah, surmised the Holy, seeing the danger they were in, through their dispersion, or departing from the traditions of their fathers, judged it proper to reduce them to writing.

The misna is divided into six parts: the first relates to the distinction of seeds in a field, to trees, fruits, tythes, &c. The second regulates the manner of observing festivals; the third treats of women, and matrimonial cases; the fourth of losses in trade, &c. The fifth is on obligations, sacrifices, &c. and the sixth treat of the several sorts of purification. See Talmud.

MISDEMEANOUR. A crime or misdemeanor is an act committed or omitted, in violation of a public law, either forbiolding or commanding it.

MISLETIE. See Viscum.

MISNOMER, the using of one name for another.

Where a person is described so that he may not be certainly distinguished and known from other persons, the omission, or in some cases, of the name shall not avoid the grant. 11 Rep. 20.

If the christian name is wholly mistaken, this is regularly fatal to all legal instruments, as well declarations and pleadings as grants and obligations.

The mistake of the surname does not vitiate, because there is no repugnancy that a person shall have different surnames; and therefore, if a man enter into an obligation by a particular name, it is implied that the same name in the deed, and his real name brought in by an alias; and then the name in the deed he cannot deny, because he is estopped to say any thing contrary to his own deed. 12 R. & A. 146.

MISPRISION, is generally understood to be of all such high offences as are under the degree of capital, but bordering thereon, and it is said that a misprision is contained in every treason and felony whatever, and that if the kind of plea, or the offender may be procured against for the misprision only. 4 Black. 119.

MIS-RECEITAL, in deeds, is sometimes injurious, and sometimes not, if a thing be referred to time, place, and number, and that is mistaken, all is void.

MITCHELLA, a genus of the trumonion monogynia class and order. The cor. is 1-petalid; stigmas 4; berry trid, 2-seeded. There is 1 species, an herb of N. America. MITCHELLA, a small shrub, equal to about one third part of a farthing. It also denotes a small weight used by the moneyers. It is equal to the twentieth part of a grain, and is divided into twenty-four lots.

MITE. See ACARUS.

MITELLA, bastard American sanicle: a genus of the digynia order, in the decanaria class of plants; and in the natural method ranking under the 13th order, succulent. The calyx is quinqued, the corolla pentapetalid, and inserted into the calyx; the petals planifid; the capsule unilocular and bivalved, with the valves equal. There are two species, both natives of North America, rising with annual herbaceous stalks from five to six or eight or nine inches in height, and producing spikes of small whitish flowers, whose petals are fringed on their circumference.

MITHRIDATEA, a genus of the monandria monogynia class and order. The cat. is four-foil; cor. none; fruit globular, depressed. There is one species, a tree of Madagascar.

MITHIMUS, a writ by which records are transferred from one court to another. This word is also used for the precept directed to a gaoler, under the hand and seal of a justice of the peace, for the receiving and safe keeping a felon, or other offender, by him committed to gaol.

MIZEN, in the sea-language, a particular mast or sail. The mizen-mast stands in the sternmost part of the ship. Its length is by some accounted the same with the height of the main-topmast, from the quarter-deck; or half the length of the mainmast, and half as thick. The sail which belongs to the mizen-mast is called the mizen-sail: and when the word mizen is used at sea, it always means the sail.

MINAS, a genus of the hexandria monogynia class and order. The cat. is 1-leaved, 3-parted; cor. 1-petalid, 3-parted; anthera 4-longercor; germ 3-lobed; stigma 3.

MINAS, a genus of the hexandria monogynia class and order. The cat. is 4-parted, superior; cor. none; seed 1. There is one species, an herb of New Zealand.

MINIUM, a genus of the mineral order of musel, belonging to the cryptogamia class of plants. The anthera is opeculated; the calyptra smooth, the female capitulum naked and powdery, remote. There are 24 British species, but none have any remarkable property except the two following: 1. The fontanum is an elegant moss, frequent in bogs, and on the borders of cold springs. It is from two to four inches high; the stems simple at the base, and armed with a rusty down; but higher up are red, and divided into several round, single, taper branches, which proceed nearly from the same point. The leaves are not more than fifth of an inch long, lanceolate and acute, of a whitish-green colour, and so thinly set, that the red stalk appears between them. This moss, as it may be seen at a considerable distance, is a good mark to lead to the discovery of clear and cold springs. Dr. Withering informs us, that it never grows near the banks of the second or third, has its tips inversely egg-shaped, nodding, and bright yellow. If the fruit-stalk is moistened at the base with a little water or steam, the head makes three or four revolutions; if the head is moistened, it turns back again.

MOAT, or DRICH, in fortification, a deep trench dug round the rampart of a fortified place, to prevent surprizes.

The brink of the moat, next the rampart, is called the scarpe; and the opposite one, the counterscarpe.

A dry moat round a large place, with a strong garrison, is preferable to one full of water, because the passage may be disputed inch by inch; and the besiegers, when lodged in it, are continually exposed to the bombs, shot, stones, and other missiles, which are thrown incessantly from the rampart into their works. In the middle of dry moats there is sometimes another small one, called a cuttice; which is generally dug so deep, till they find water to fill it. The deepest and broadest moats are counted the best, but a deep one is preferable to a broad one: the ordinary breadth is about twenty fathoms, and the depth about sixteen.

To drain a moat that is full of water, they dig a trench deeper than the level of the water, to let it run off; and then throw hurdles upon the mud and slime, covering them with earth or bundles of rushes, to make a sure and firm passage.

MODE, in logic, called also syllogistic mood, a proper disposition of the several propositions of a syllogism, in respect of quantity and quality.

As in all the several dispositions of the middle term, the propositions of which a syllogism may be either universal or particular, affirmative or negative; the due determination of these, and putting them together, according to any disposition of the middle term, in order to arrive at a just conclusion. There are two kinds of moods, the one direct, the other indirect.

The direct mood is that wherein the conclusion is drawn from the premises directly and immediately. "Every animal is a living thing, every man is a living animal; therefore every man is a living thing." There are fourteen of these direct moods, four of which belong to the first figure, four to the second and six to the third. They are denoted by so many artificial words framed for that purpose, viz. 1. Barbarum, or darth, darf, ferique. 4. Baralia, cebat, dabbis, fapiamo, friseon. 2. Cesare, camastures, fessio, harno. 3. Durapi, felapton, dia-
Mold, in music, a particular system, or collection of notes, by which the octave is divided into certain intervals, according to the genus. The doctrine of the antients respecting modes is rendered somewhat obscure, by the difference among their authors in the definitions, divisions, and names of their modes. Some place the specific variations of modes, or modes, in the manner of division, or order of the concentric parts; and others merely in the different tension of the whole: i.e., as the whole series of notes are more acute or grave, or as they stand higher or lower in the great scale of sounds.

Model, in a general sense, an original pattern, proposed for any one to copy or imitate. This word is particularly used in building for an artificial pattern made in wood, stone, plaster, or other matter, with all its parts and proportions, in order for the better conducting and executing some great work, and to give an idea of the effect it will have in large. In all great buildings, it is the most surest way to make a model in relief, and not to trust to a bare design or draught. There are also models for the building of ships, &c. and for extraordinary circumstances.

They also use models in painting and sculpture; whence, in the academies, they give the term model to a naked man or woman, disposed in several postures, to afford an opportunity to the scholars to design him in various views and attitudes.

Models in imitation of any natural or artificial substance, are most usually made by means of moulds composed of plaster of Paris. For the purpose of making these moulds, this kind of plaster is much more fit than any other substance, on account of the power it has of absorbing water, and soon condensing into an hard substance, even after it has been rendered so thin as to be of the consistence of cream. This happens in a shorter or longer time, as the plaster is of a better or worse quality; and its good or bad properties depend very much upon its age, to which, therefore, particular regard ought to be had. It is sold in the shops at very different rates, being made use of for casts, and the middling sort for moulds. It may be very easily coloured by means of almost any kind of powder excepting what contains an alkaline salt; for this would chemically decompose the substance of it, and render it unfit for use, the gypsum of plaster being a substance which would alone be composed by the alkalies of the lime. A very considerable quantity of chalk would also render it soft and useless, but too hard to have its great degree. The addition of common salt is like to render it much harder than if mere water is made use of. In making either moulds or models, however, we must be careful not to make the mixture too thick at first; for if this is done, and more water added to this, the composition must always prove brittle, and of a bad quality.

The particular manner of making models (or casts, as they are also called) depends on the form of the subject to be taken. The process is easy where the parts are elevated only in a slight degree, or where they form only a right or obtuse angle with the principal surface from which they project; but where the parts project in smaller angles, or form curves in the upper surface, the work is more difficult. This observation, however, holds good only with regard to hard and inelastic bodies; for such as are soft may often be freed from the mould, as though they themselves were not mentioned. But though this is the case with the soft original substance, it is not so with the inflexible model when once it is cast.

The moulds are to be made of various designs. To make the case of the model to be cast; and may be from half an inch to an inch, or, if very large, an inch and a half. Where a number of models are to be taken from one mould, it will likewise be necessary to have it of a stranger texture than where only a few are required for very obvious reasons.

It is much more easy to make a mould for any soft substance than a rigid one, as in any of the viscera of the animal body; for the fluidity of that substance makes it easily accommodate itself to the projecting parts of the substance; and as it is necessary to inflate these substances, they may be very easily extracted again, by letting out the air which distends them.

When a model is to be taken, the surface of the original is first to be greased, in order to prevent the plaster from sticking to it; but if the substance itself is slippery, it is the case with the internal parts of the human body, this need not be done: when necessary, it may be laid over with limed oil by means of a painter's brush. The original is then to be laid on a smooth table, previously greased, or covered with a cloth, to prevent the plaster sticking to it; then surround the original with a frame dipped in the putty, at such a distance from it as will admit the plaster to rest upon the table on all sides of the subject for about an inch, or as much as is sufficient to give the proper degree of strength to the model. A sufficient quantity of plaster is then to be placed as uniformly as possible over the whole substance, until it is everywhere covered to such a thickness as to give a proper substance to the mould, which may vary in proportion to the size. The whole must then be suffered to remain in this condition till the plaster has attained its hardness; when the frame is taken away, the mould may be inverted, and the subject removed from it; and when the plaster is thoroughly dry, let it be well scour.

Having formed and seasoned the moulds, they must next be prepared for the casts by greasing the inside of them with a mixture of olive oil and lard in equal parts, and then filled with fine plastic, and the plane of the mould formed by holding the surface of the table, covered to a sufficient thickness with coarse plaster, to form a strong basis or support for the cast where this support is requisite, as is particularly the case where the thin and membranous parts of the body are to be represented. After the plaster is poured into the mould, it must be suffered to stand until it has acquired the greatest degree of hardness it will receive; after which the mould must be removed: but this is attended with some difficulty when the shape of the subject is unapproachable; and in some cases the mould must be separated by means of a small mallet and chisel. If this method does not procure any parts of the model should be broken on in the mould, it may be rendered somewhat stronger by making the two surfaces to be applied to each other quite wet; then interposing between them a little liquid plaster; and lastly, the joint smoothed, after being thoroughly dry, by small brushes made in the mould can be filled up with liquid plaster, after the sides of them have been thoroughly wetted, and smoothed over with the edge of a knife.

In many cases it is altogether impracticable to make a mould of one piece for a whole subject; and therefore it must be considered how this can be done in such a manner as to divide the mould into the fewest pieces. This may be effected by making every piece cover as much of the pattern as possible, without surrounding such projecting parts, or running into such hollows as would not admit a separation of the mould. Where any internal pieces are required, they are to be made in the outer pieces, after the former have become hard.

Besides the models which are taken from inanimate bodies, it has been frequently attempted to take the exact resemblance of people while living, by using their face as the pattern to be made in a mould; and the operation, however disagreeable, has been submitted to by persons of the highest rank in life. A considerable difficulty occurs in this, however, from the person's being apt to shrink and distort his features when the liquid is poured upon him; neither is he altogether without danger of suffocation, unless the operator well understands his business.

To avoid the former inconvenience, it will be proper to mix the plaster with warm instead of cold water, by which means the person will be under no temptation to shrink; and to prevent any danger of a fatal accident, the following method must be practised: The subject is to lie on his back, the head must first be raised by means of a pillow to the exact position in which it is naturally carried when the body is erect; then the parts to be represented must be very thinly covered over with flour of almonds, by means of a painter's brush; the
The nose is then to be first covered with fine fluid plaster, beginning at the upper part of the foremost lip, or nostrils, which are to be kept close, that the plaster may not come in contact with the globe; yet, not closed so strongly as to cause any unnatural wrinkles. Cover then the nose and ears, pushing first up the meatus and with conical, and the nostrils with a small quantity of tow rolled up, of a proper size to exclude the plaster. During the time that the nose is thus stopped, the person is to breathe through the mouth; in this state the fluid plaster is to be brought down low enough to cover the upper lip, observing to leave the roll of tow projecting out of the plaster. When the operation is thus far carried on, the plaster must be covered to harden; after which the tow may be withdrawn, and the nostrils left free and open for breathing. The mouth is then to be closed in its natural position, and the plaster brought down to the extremity of the chin. Begin then to cover that part of the breast which is to be represented, and spread the plaster to the outsides of the arms and upwars, in such a manner as to meet and join that which is previously laid on the face: when the whole operation has acquired its pliable consistence, it is to be cautiously lifted, without breaking or giving pain to the person. After the mould is constructed, it must be seasoned in the manner already directed; and when the case, it is to be separated from the model by means of a small mallet and chisel. The eyes, which are necessarily shown closed, are to be carved, so that the eye-lids may be represented in an elevated posture; the nostrils hollowed out, and the back part of the head, from which, on account of the hair, no mould can be taken, must be finished according to the skill of the artist. The edges of the model are then to be neatly smoothed off, and the bust fixed on its pedestal.

MODULATION, in music, the art of conducting harmony, in composition, or temporary performance, through those keys and modes which the rule of art, or fundamental, or original key. Though every piece, as is well known, has its principal or governing key, yet, for the sake of contrast and relief, it is not only allowable but necessary that it be sometimes thrown from mode to mode; to assume different sharps or flats, and lead the ear through those transitions of tone and harmony which interest the feelings and delight the ear. But though in grand compositions there is no quality of a greater importance than that of a masterly modulation, it is not easy to lay down rules for its accomplishment. Sometimes a gradual and almost insensible evolution of harmony is requisite to the composer's object; at other times, a bold and sudden change can alone produce the necessary effect.

MODULAR ARCHITECTURE. MODUS DECIMANDI, in law, is where money, land, or other valuable consideration, has been given, true out of mind, to the minister or parish of any certain place, in the room of tithe. A clergyman may sue in a spiritual court for money, land, goods, chattels that is depicted there, or a custom is to be tried, the trial thereof belongs to the courts of common law. When lands are converted to other uses, as in the case of hay-ground turned into tillage, the tithe may be discharged, and the tithes paid again in kind.

MOERHINGIA, mossy chickweed, in botany, a genus of the oxtidria digynia class of plants, the flower of which is composed of four short, undivided petals; and its fruit is a subglabrous capsule, with one cell, in which are contained numerous roundish seeds. There is one species.

MOLE. See ZAPPA.

MOLLUGO, African chickweed; a species of the tryginess order, in the triandria class of plants; and in the natural method ranking under the 24th order, carycophylii. The calyx is pentaphyllous; there is no corolla; the capsule is trilocular, and trivalved. There are six species, annuals of the Cape, and of the E. and W. Indies.

MOLUCCELLA, in botany, a genus of the dicynthium-gynaec-petumpia class of plants, the flower of which is monopetalous and labi-ated; the upper lip being entire, and the lower one divided; the seeds are turbinated, and contained in the bottom of the cup. One annual species.

MOLYBDATAS. These salts, composed of molybdic acid combined with the alkalies and earths, were formed by Scheele; but their properties are still almost completely unknown. The supermolybdat of potass alone has been described with some detail. It is formed by detonating one part of sulphuret of molybdenum and three parts of nitre in a crucible. By dissolving the reddish mass which remains after this operation, and filtering, a solution is obtained of potass and molybdat of potass is obtained. By evaporating the solution, the sulphat of potass is separated; when sulphuric acid is dropped into the remaining liquid, supersupraborau of potass is precipitated. This salt is soluble in water. Its solution crystallizes by evaporation in small rhomboidal plates inserted into each other. They are bright, and have a metallic taste. When exposed to the blowing air, and melted without swelling, and are converted into small globules, which are quickly absorbed by the charcoal. When melted with a mixture of phosphat of soda and of ammonia (or micromosic salt), they communicate a green tinge. Hot water dissolves them completely, and purifies of potass occasions in this solution a reddish brown precipitate. When a solution of nutria of tin is poured upon them, they acquire a blue color.

MOLYBDENUM. The Greek word ρυλοβδεν, and its Latin translation plumbago, seem to have been employed by the ancients to denote various oxides of lead; but by the moderns they were applied indiscriminately to all substances possessed of the following properties: Light, irridelescent, and soft, of a dark color and greasy feel, and which leave a stain upon the fingers. Scheele first examined these minerals with attention. He found that two very different substances had been confounded together. To one of these, which is composed of carbon and iron, he appropriated the word plumago; the other he called molybdio.

Molybdio composed of scaly particles adhering slightly to each other. Its color is bluish, very much resembling that of lead.

Scheele analysed it in 1778, and obtained sulphur and a whitish powder, which possessed the properties of an acid, and which, therefore, he called a kind of molybdina. Bergman suspected this acid, from its properties, to be a metallic oxide; and at his request, Scheele, in 1782, undertook the laborious course of experiments by which he succeeded in obtaining a metal from this acid. His method was to form it into a paste with melted oil, and then to apply a very strong heat. This process he repeated several times successively. To the metal which he thus obtained he gave the name of molybdum. The experiments of Scheele were afterwards repeated by Pelletier, Bismarck, and Meyer: and not only fully confirmed, but discovered many new facts, and the metallic nature of molybdic acid was put beyond a doubt: though, in consequence of the very violent heat necessary to fuse molybdum, only very minute grains of it have been hitherto obtained in the state of a metal.

MOYSDYUNUM. This oxide, having the properties of an acid, is known by the name of molybdic acid.

From the experiments of Mr. Hatchet, it follows that molybdium is capable of combining with four different proportions of oxygen, and of forming four oxides; namely, 1. The black; 2. The blue; 3. The green, to which Mr. Hatchet has given the name of molybdous acid; and 4. The yellow or white, the molydine. Molybdenum combines readily with sulphur and the compound has exactly the properties of molydina, the substance which Scheele decompoundled. Molybdenum is therefore sulphuret of molybdium. The reason why from molybdic acid was, that the metal was isolated with oxygen during his process. Sulphuret of molybdium may be formed also by dissolving...
MOMORDICA. Of these are very scarce, having been found only in India, Germany, Ceylon, among the Alps, near Tuscany, and in the island of Lewis, in Scotland. The only species known is mollybdema, which is found commonly massive; sometimes, however, it is crystallized in hexagonal tables. Colour light yellow; sometimes with a shade of red. Streak blue-grey, metallic. Powder blueish-black, flexible. Species hexaerial. Marks bluish-black. A piece of resin rubbed with this mineral becomes positively electric. Insoluble in sulphuric and muriatic acids. Composed of molybdolum. 60 molybdolum 40 sulphur.

100

MOMENT, in the doctrine of infinites, denotes the same with infinitesimal.

MOMENT, momentum, in mechanics, signifies the same with impetus, or the quantity of motion in a moving body; which is always equal to the quantity of matter, multiplied into its velocity; or, which is the same thing, it may be considered as a rectilinear angle under the quantity of matter and velocity.

MOMORDICA, male balsam apple; a genus of the syneogene order, in the monotypic family; and in the natural method ranking under the 34th order, cucurbitaceae. The male calyx is quiquefid; the corolla sexpartite; the filaments are three in number. The female calyx is trifid; the corolla quiquepartite; the stile tristis; the fruit is an apple, partially asperous with a spring. There are eight species, the most remarkable of which are, 1. The Balsamina, or male balsam apple. This is a native of Asia; and has a trailing stalk like those of the cucumber or melon, with smooth leaves, cut into several segments, and spread open like a hand. The fruit is oval, ending in acute points, having several deep angles, with sharp tubercles placed on their edges. Colour yellow or yellowish orange when ripe, opening with elasticity, and throwing out its seeds. 2. The calidus, wild or sporting cucumber, has a large fleshy root, somewhat like briony, whence come forth, every spring, several thin, rough, trailing stalks. The flowers come out from the wings of the stalks: these are male and female, growing at different places on the same plant like those of the common cucumbers; but are much less tall and of a dull yellow colour, with a yellowish bottom; the male flowers stand upon thick, short, foot stalks, but the female flowers sit upon the young fruit; which, after the flower is faded, grows into an oval form, an inch and a half long. Leaves, of a grey colour, like the leaves, and covered over with short prickles. This species has one of its names from the property of casting out its seeds, together with the sweet juice in which the seeds are bathed, with a violent force, if touched with a white tip. The first species is famous in Syria for curing wounds. The natives cut open the unripe fruit, and infuse it in sweet oil, which they expose to the sun for some days, until it becomes red, and then present it for use. Dropped on cotton, and applied to a fresh wound, the Syrians reckon this oil the best vulnerary next to balsam of Mecca, having found by experience that it often cures large wounds and ulcers. The leaves and seeds of this plant are used for abatours or bowers. The calidus of the shops is the fruit, or rather the inspisated fructis, of the juice of the unripe fruit of the wild cucumber. It is usually sent from Spain and the South parts of France, where the plant is common. We receive it in small, flat, whitish lumps, or cakes, that are dry, and break easily between the fingers. It is of an acrid, nauseous, bitter taste; and gives a strong offensive smell when newly made; but these, as well as its other properties, it loses, after being kept for some time. It is a very violent purge and vomit, and is now but seldom used.

MOMOTUS, a genus of birds of the order peris. The generic character is, bill strong, slightly curved, serrate at the edges; nostrils feathered; tongue feathered; tail wedge; feet formed for walking. There is but one species, the Brasilien, that inhabits Brazil; size of a black and eighteen inches long, lives solitary in unfrequented forests; building a nest of dry grass on the ground, or in holes abandoned by the armadillo, and lays two eggs; feeds on insects and raw flesh, the fragments of which it maccrates in water, which it drinks violently after its bill. Its voice is harsh, weak, tremulous.

MONADELPHIA, (from monos alone, and adelphos a brotherhood) is a "single brotherhood." The name of the 16th class in Linnaeus's sexual system, consisting of plants with hermaphroditic flowers; in which all the stamens, or male organs of generation, are united below into one body or cylinder, through which pass the pointal or female organ.

MONANDRIA, (from monos alone, and andros a man or husband;) The name of the first class in Linnaeus's sexual system; consisting of plants with hermaphroditic flowers, which have only one stamen or male organ.

MONARDA, Indian horbedow; a genus of the monogyonia order, in the diandria class of plants; and in the natural method ranking under the 41st order, verticillate. The corolla is unequal, with the upper lip flat, linear, toothed at the base; the flower is about half an inch in length. There are seven species; the most remarkable is the didyma, a native of North America. It is herbaceous. The flowers, which are of a bright red, surround the stalk in wheels, each wheel containing about 14 flowers; and are succeeded by four small kidney-shaped shining seeds, lodged in the bottom of the permanent flower-cup. The Indians superstition believe that a fragment of this plant is efficacious for driving away the devil.

MONAS, a genus of vernes, order infrusoria. The generic character is worm invisible to the naked eye, most simple, pelliculate, resembling a point. There are two species; the terminal, the most minute, simple gasteron: point is to be found in most animal and vegetable infusions: of all animals the most minute, being so extremely delicate and transparent, as to elude the most highly magnifying powers, blending in a manner with the water in which it swims.

MONETIA, a genus of the class and order tetrandria monogynia. The cal is four-lobed; petals four; berry two-seeded: seeds solitary, a species, a shrub of China and India.

MONEY. The era of the invention of money is not easy to be settled. There is no room to doubt, but that in the earliest ages the ordinary way of traffic among men was by trucking or exchanging one commodity for another; but in course of time it was found necessary, in the way of commutative justice, to have some common measure or standard, according to which all things should be estimated.

Money is usually divided into real and imaginary. Real money includes all coins, whether of gold, silver, copper, or the like; such as guineas, crowns, pistoles, pi ces of eight, ducats, &c. for an account of which we refer the reader to the article Coin. Imaginary money, or money of account, is that which never existed, or, at least, which does not exist in real specie; but is a denomination invented or retained to facilitate the stating of accounts, by keeping them still on a footing analogous to current coin.

No person is obliged to take in payment any money which is not lawful metal, that is, of silver and gold, except for sums under sixpence. 2 fl 577.

But it was decided in Hilary term, 1790, that bank notes were considered as money, and therefore a proper tender in payment.

English Money of account, is the pound, shilling, and pence; the pound contains twenty shillings, and the shilling twelve pence.

The old Scotch Money of account was the pound, shilling, and penny; the pound containing twenty shillings, being equivalent to one shilling and eightpence English; and the shilling containing twelve pence, equal to a penny English. There is also among them an account of marks, the mark being equivalent to one shilling 1½ penny English: this last kind they had formerly a silver coin.

French Money of account, is France, sous, cent, &c.
Dutch Money of account, is kept at Amsterdam and Rotterdam, the two chief trading places in guilders, schillings, and pence; so that though goods are sold for other species, such as livre de gros, &c., yet all are reduced to the above denominations for the entries into their books. The exchanges are made with us in some shilling to a pound sterling, though in most other places in deniers-de-gros.

Spanish Money of account, is at Cadiz kept in rials of p.t.e and its fractions; at Castile, in maravedis; at Vall-eac'h, in livres or dollars, suedois and ducors; of which last twelve make a suelde, and twenty sueldos a livre or dollar. Seventeen quartos, at Cadiz and Castle, make two rials vellon, which is now an imaginary coin, though formerly it was the principal one of the kingdom. A maravedis is another imaginary species, of which seventeen is reckoned to a real vellon. The ducor is also a fictitious coin of eleven rials of plate in purchases, sales, and other mercantile transactions, except in exchanges, in which they are reckoned at sixteen times the value of the real.

Portuguese Money of account, is kept in rrs, or reis, making a separation at every hundred, thousand, &c. 800 reis go to a moidore.

German and Swiss Money of account. At Coningberg, Elbing, and Danitz, accounts are kept in rixdollars and gros, or in Polish guilders, gros, and deniers, or pennies. They exchange on Amsterdam in Polish gros for a livre de gros of six guilders current money of Amsterdam, and on Hamburg for the rixdollar. At Luebec, accounts are kept in marks, schellings, and deniers or pennies, in which their exchanges are made. At Breslaw, accounts are kept in rixdollars and silver gros and pennies; in the first of which species exchanges are made on Amsterdam for a certain number of silvers, bank money, and on Hamburg for rixdollars of Breslaw against rixdollars of Hamburg bank. Hamburg accounts are kept in marks, schellings, and deniers or bank money, by those who have cash in the bank, but by those who have not, their books are generally kept in rixdollars, and marks only.

At Bremen, accounts are kept in rixdollars and gros, and it exchanges on Amsterdam rixdollars of seventy gros for rixdollars of fifty silvers banco. At Leipsie and Naunbourg, accounts are kept in rixdollars, crowns, gros, and pennies. At Berlin, and in all this kingdom, accounts are kept in guilders, gros, and pennies. At Zurich, accounts are kept in rixdollars, schillings, and hellers; reckoning the 9 dollars (worth about 4s. 6d. sterling) at 10s. of their cruziers. At Frankfort on the Main, and Hanau, accounts are kept in rixdollars and cruziers. At Vienna, accounts are kept in guilders, cruziers, and pennies, reckoning eight pence to a cruzier, and sixty cruziers to a guilder. At Nuremberg and Augsburg, accounts are kept in guilders, cruziers, and hellers; at Liége, in livres, sous, and deniers.

In the custom of St. Gall, in Switzerland, accounts are kept in guilders, cruziers, and pennies; or under the same denomination with the coins of the empire. In the canton of Basel, accounts are variously kept, some in rixdollars, schillings, and deniers; some in shillings, pounds, and pence, and in schellings, escudi, and pesetas; and some in cruziers, guilders, and pennies; and in guilders, cruziers, and pennies.

Italian Money of account. At the cities of Genoa and Novi, accounts are kept in livres, soldi, and denari; or in dollars of 100 soldi. At Milan, accounts are kept in livres, deniers, and sols, equal counted like pounds, shillings, and pence, viz. twenty denari to a soldo, &c. At Rome, accounts are kept in crowns, juliets, and bajocches, or grains and quarts; the crown is divided into ten juliet, and the juliet into ten bajocches. At Leghorn, accounts are generally kept in dollars, soldi, and denari. At Florence, they keep their books and accounts in crowns, soldi, and denari, picciol or current money. At Naples, accounts are kept in dukats, florins, and grains. The accounts in Sicily are kept the same as at Naples. At Lucca they keep their accounts in crowns, livres, soldi, and denari; the crown is worth 7 livres 10 soldi; the livre, 20 soldi; and the soldo, 12 denari. At Bologna, accounts are kept in livres, soldi, and denari, picciol or current money; but the bank-entries are in livres, soldi, and gros; both the current and bank-ducat of Venice make 24 soli, or six livres and 4 picciolo. At Bologna, accounts are kept in livres, soldi, and denari; the livre being 20 soldi, and the soldo 12 denari. At Bergum, the money of account is the same as at Bologna, and its proportions the same. In Urbino, accounts are kept in crowns, soldi, and denari; the crown is 20 soldi, and the soldo 20 denari. At Modena and Mantua, accounts are kept in livres, soldi, and denari. In Savoy and Piedmont, accounts are kept in livres or livres, soldi, and quarts. In Flanders, accounts are kept in crowns, soldi, and denari of mark; of which 12 denari make a soldo, and 20 soldi the crown. In the island of Sardinia, accounts are kept as in most parts of Italy, in livres, soldi, and denari. In the island of Malta, the money of account is the same with that of Sicily. In the island of Candia, the account is the same as at Venice.

Russian, Swedish, Danish, and Polish Money of account. In the tracing places, the king of the Low Empire keeps accounts in rixdollars, crowns, gros, and pennies; and the English money is kept in rixdollars and gros and it exchanges on Amsterdam rixdollars of seventy gros for rixdollars of fifty silvers banco. At Leipsie and Naunbourg, accounts are kept in rixdollars, crowns, gros, and pennies. At Berlin, and in all this kingdom, accounts are kept in guilders, gros, and pennies. At Zurich, accounts are kept in rixdollars, cruziers, and hellers; reckoning the 9 dollars (worth about 4s. 6d. sterling) at 10s. of their cruziers. At Frankfort on the Main, and Hanau, accounts are kept in rixdollars and cruziers. At Vienna, accounts are kept in guilders, cruziers, and pennies, reckoning eight pence to a cruzier, and sixty cruziers to a guilder. At Nuremberg and Augsburg, accounts are kept in guilders, cruziers, and hellers; at Liége, in livres, sous, and deniers.

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Moneys of account of other islands and countries of India. Throughout Malabar, and at Gou, they use tansas, vintins, and pattir-xepin; the tanga is of two kinds, viz. of good and bad alloy; hence their custom is to count by good or bad money; the tanga of good alloy is better by one-fifth than the bad, so that 4 tanguas being equal to the good dollar, there will be required 5 of the bad; 4 vintins good make a tanga likewise good; 15 barusas, a vintin; a good baruco is equal to a Portuguese ree, a French ducat, or one-thirteenth of a penny sterling.

The small coin of the island of Java they use the santapac, lardos, and catas; which last money, together with the lados, is used throughout all the East Indies; the lota is 200 caxas, or little pieces of that country, hung on a string, and is equal to eleven-twelfths of a penny sterling; five santas make the supa on. The tanga is equal to 2s. 6d. sterling; the catas to 20 tals; the lados to 8s. sterling. There are islands, cities, and states, of the East Indies, whose monies of account are not here expressed, partly because reducible to some of the
MONKEY. See Simia.

MONOCHORD, a musical instrument, composed of one string, used to try the variety and proportion of sounds.

It is formed of a rule, divided and subdivided into several parts, on which there is a moveable string stretched upon two bridges at each extreme. In the middle between these is a moveable bridge, by means of which, in applying it to the different divisions of the scale, the sounds are found to bear the same proportion to each other as the division of the line, cut by the bridge. There are also monochords with forty-eight fixed bridges. The following is the account of a monochord given by Earl Scudamore:

1. The wire is not made either of brass or iron, but of steel, which is very far superior. For, steel wire does not keep continually lengthening, as brass and iron wires do when they are stretched considerably.

2. The monochord does not, as usual, pull downwards on the bridges, but the whole wire forms one straight and horizontal line, by which means the moveable bridge, which determines the exact length of the wire, can be moved without altering the tension of the wire. This is not the case when the wire pulls downwards on the bridges.

3. The ends of the wire are not twisted round the two stout steel pins which keep it stretched; but each end of the wire is soft-soldered in a long groove formed in a pair of steel chisel-shaped corresponding pins. This is a great improvement.

4. One of those two steel pins is strongly fastened on a brass slider, which is moved by means of a screw with very fine threads, which screw has a large micrometric head minutely divided on its edge, and a corresponding notch; so that the tension of the wire may be adjusted with the greatest precision, in order to obtain its exact pitch.

5. A slider is fixed across the top of the moveable bridge, and is moved by means of another screw with very fine threads; so that the length of the wire may be regulated with the greatest nicety in all cases.

The above-mentioned slider, which is on the top of the moveable bridge, is adjusted to the steel rod or scale, not by sight, or by the coincidence of lines, but by means of mechanical contact against projecting pieces of steel firmly fixed on the bridge, which in the present instrument is incomparably more correct.

Each bridge carries a metallic finger, which keeps the wire close to the top of the bridge, whilst the wire is made to vibrate. The vibrations of the wire are produced by touching it with a piece of cork, with the same elastic force, and on the very same spot each time, namely, at the distance of one inch from the immovable bridge.

MONNIESIA, a genus of the class and order Delphina, the calf is five-parted; corolla stellata; stamens 3, capsules 5, 1-seeded. There is one species, an American annual.

MONOCULOS. Monoculus, a genus of the order Aperta; the generic character is, feet formed for swimming; body covered by cuticular segments; eyes, in most species, approximated, and imbedded in the shell.

Of the monoclous, by far the largest are very small water-insects, requiring the assistance of a microscope for the investigation of their particular organs; some however are so large as to require the use of an ordinary glass. There is one species in particular, (if, indeed, it can be allowed to stand with propriety in the genus) is of a size so gigantic, that it is generally considered as the largest of the crustaceous tribe.

This animal is the monocus polyphemus of Linnaus, commonly distinguished by the title molucca or king-crab. Specimens are sometimes seen of two feet in length, exclusive of the shell. It is a native of the Indian ocean, and is said to be generally found in pairs, or male and female swimming together. The colour of the whole animal is a yellowish-brown; the shell is very convex, rounded in front, and lunate behind, where it joins the lower part of the body; this, which is of the same crustaceous nature, is marked on each side by several spiny incisions; the legs, which are seven on each side, are situated beneath the concavity of the large or rounded part of the shell; and are each terminated by a double claw, those of the lowest pair having some additional processes: the branched, or respiratory, organs are disposed in the form of several flat, rounded, imbricated lamelle on each side the lower part of the body; the tail, which is stratified, triangular, and of the same crustaceous nature with the rest of the shell, is equal in length to the whole body, and gradually tapers to a sharp point. The eyes in this species, instead of being approximated, and of the same character, are extremely distant from each other, being situated towards the sides of the shell; they are of a semicircular form, and the surface is divided into a great number of minute conical convexities; this part however should be considered as only constituting the concave or exterior covering of each eye; the organs themselves being, according to the observations of Mr. Petiver, in the Philosophical Transactions, placed on a pedicle beneath each of the above-mentioned semicircular cornea. Petiver's words are these. "The whole structure of this animal is very remarkable, and particularly his eyes, viz. between the fourth and last pair of claws on each side, reckoning from his mouth, and excluding the small pair thereof, there are, are inserted the rudiments of another pair, or a claw broken off on each side at the second joint or elbow; on these are six eyes, like those of the hands of snails, but under the skin, they are thick and opaque shell. Nature in that place has wonderfully contrived a transparent lantern, through which the light is conveyed, whose superficies very exactly resembles the great eyes of one of the larger limpets or abalone, which have the naked eye phanically perceived to be composed of an immeasurable globule: these, like them, are oblong, and guarded by a testaceous superciliar clique."

Of the European monoclous, by far the largest is the monocus apus, which, when full-grown, measures nearly an inch and three quarters from the front to the end of the body, exclusive of the forked divisions of the tail. It is found in muddy stagnant waters, but is a rare species in this country, having been only observed in a few particular situations. In its general shape, it is considerably allied to the large exotic species before described, but the animal is not of more length in proportion, with the hinder part naked, and divided into numerous joints: the branchiæ, or respiratory organs, are large, and are distributed into numerous imbricated rows on the under side of the body. There is a pair of joined, thin arms, extending on each side to a considerable distance; the eyes are placed near each other in front of the shell; the tail is terminated by a pair of long forks or ctenes, processes. The colour of the whole is a pale greenish-brown above, and reddish beneath. We are informed in vol. 40 of the Philosophical Transactions that this insect has been found in great plenty in a pond on Twickenham Common, in Kent. It is also added, that the same pond, having been perfectly dried, and being suddenly filled during a heavy thunder-storm, swarms of the same animal were again observed in it within the space of two days after.
the tenth of an inch, but it is sometimes seen considerably larger: its shape is oval, somewhat truncated in front, and sharply pointed behind: the body is inclosed in a bivalve, transparent by the microscope, appears finely reticulated: on each side the head is a strong transparent jointed arm, reaching into two divisions, and terminating in several venous branches: the tail, which is generally inclosed within the shell, is occasionally protruded in the form of a strong curved and pointed process; the eyes of this animal are of a singular construction; they are large in proportion to the insect, placed very near each other, appear to consist of many separate globules, of a black colour united under a common skin.

MONODON MONOCRÆOS, UNICORN NARWHAL, is a native of the northern seas, where it is sometimes seen of the length of more than twenty feet from the mouth to the tail; and is at once distinguishable from every other kind of whale by its very long, ivory-like tooth, which is perfectly straight, of a white or yellowish-white colour, and wreathed throughout its whole length, and gradually tapering to a sharp point. It measures from six to nine or ten feet in length, and proceeds from a socket on the one side of the upper jaw, and in each eye at the base or root, running through the greater part of the whole length. In the young animals and occasionally even in the full grown ones, more especially in the males, there are two of these teeth, sometimes but very small, and sometimes very unequal in this respect: they are seated very close to each other at the base, and as their direction is nearly in a straight line, they diverge but little in their progress towards the extremities. The head of the narwhal is short, and convex above: the mouth small; the spiral or breathing-hole doubled within; the tongue long; the pectoral fins small; the back, finless, wide, convex, becoming gradually acuminiated towards the tail, which, as in other whales, is horizontal. The general form of the animal is rather long than thick in proportion to its size. The colour, when young, is said to be nearly black, but lightens as the animal advances in age, it becomes marbled or variegated with black and white on the back and sides, while the belly is nearly white. The skin is smooth, and there is a considerable depth of oil on the under side. The narwhal chiefly inhabits the northern parts of Davis's Straights. Its food is said to consist of the smaller kind of flat-fish, as well as of actinids, medusæ, and many other marine animals. It is principally seen in the small open or unfrozen spots towards the coasts of the northern seas. To such places it resorts in multitudes, for the convenience of breathing, while at the same time it is sure of finding near the shores a due supply of food, and is very rarely seen in the open sea. It is taken by means of harpoons, and its flesh is eaten by the Greenlanders, both raw, boiled, and dried: the intestines and oil are also used as a food; the tendons make a good thread, and the teeth serve the purpose of hunting-horns as well as the more important ones of building tents and houses: but before this animal became distinctly known to the naturalists on account of their being in high estimation as the supposed horns of unicorns. Various medical virtues were also attributed to them, and they were even numbered among the articles of magnificence. A throne made for the Danish monarchs is said to be still preserved in the castle of Rosenberg, which is composed of narwhal's teeth; the ivory material being antiently considered as more valuable than gold.

A specimen of this whale, measuring about sixteen feet, exclusive of the horn or tooth, and at some time stranded on the coast of Labrador, at a great distance from Boston, and was said to have been taken alive.

2. Monodon spurious, spurious narwhal. A species most allied to the narwhal, but not perhaps, strictly speaking, of the same genus: no teeth in the mouth, but from the extremity of the upper mandible project two minute, conic, obtuse teeth, alike, curved at the tips, weak, and not above an inch long: body elongated, cylindrical, black. Besides the pectoral fins, and horizontal tail, is also a minute dorsal fin. It must be numbered among the rarities of the whales. Its flesh and oil are considered as very purgative: inhabits the main ocean, seldom coming towards shore: feeds on the polipo: has a spiral like other cetacea. There is no doubt of both these animals, but not without apprehension, for the reason already mentioned.

MONODON narwhal, a genus of mammalia of the order ceteæ; the generic character is, teeth two in the upper jaws, extending straight forward, long, spiral: a plate on the fore and upper part of the head. It inhabits the Atlantic, swims rapidly, and is from 18 to 40 feet long and 12 broad. Skin white, spotted on the back with black; dorsal fins: pectoral, two small: head small: eyes very minute: what are commonly exhibited as the unicorns horns. See Plate Nat Hist. fig. 269.

MONOCÉRIA, from monos alone, and ceras, a horn; the name of the 21st class of Linæus's sexual method. See BOTANY.

MONOGYNIA, from monos alone, and gynos, a woman; the name of the first order or subdivision in the 13 classes of Linæus's sexual method; consisting of plants, which, besides their agreement in their classic character, generally derived from the number of the stamens, have only one style: or female organ. See Botany.

MONOGRAM, a character or cypher, composed of one, two, or more letters interwoven: being a kind of abbreviation of a name, antiently used as a seal, balze, arms, &c.

MONOPOLY, is an allowance by the king, by his grant, commission, or otherwise, to any person or persons, bodies politic or corporate; or of, or for, the sole buying, selling, making, working, or using of any thing, whereby any person or persons, bodies politic or corporate, are sought to be restrained of any freedom or liberty they had before, or hindered in their lawful trade. 3 Inst. 181.

But it seems that the king's charter, imposing particular persons to trade to and from such place is void, so far as it gives such persons an exclusive right of trading, and debarring all others; and it seems now agreed, that nothing can exclude a subject from trade but out of his own consent. Plut. 480.

MONOPOLY, is a genus of the fishes of the order aepodicæ; the generic character is, body anguilliform: nostrils placed between the eyes: fin caudal.

1. The Monopterus Javanicus, the only animal of this genus hitherto discovered, is, thus described by the Count de la Cama, from the manuscripts of Comerson, by whom it was considered as a species of Micrurus. The body is serpentiniform, viscosus, and destitute of conspicuous scales; the head thick, compressed, angling towards the back part, and terminated in front by a rounded muzzle: the gape is rather wide; the upper jaw scarcely projecting beyond the lower; both being furnished with close teeth; the gill membrane has only three rays, and the branchial are only three in number on each side; the lateral line, which is nearer the belly than the gills, extends from the gills to the extremity of the tail, and is almost of a golden colour; the skin is of a livid brown or blackish colour. This fish is a native of the Indian seas and is very common about the coasts of Java, where it is considered an excellent food.

MONOSIA, a genus of the dodecaandria order, in the polypetalous class of plants. The calyx is pentamericulous; the corolla pentapetalous and irregular; the stamina are 15 in number; and coiled into five filaments; the style bifid; the capsule pentagonous. There is one species.

MONSOON. See WIND.

MONTH, the twelfth part of a year. See CHRONOLOGY.

MONTIA, water chickweed, a genus of the order, in the triquetra class of plants; and in the natural method ranking with those two of which the order is doubtful. The calyx is diphylous; the corolla monopetalous and irregular; the capsule unicellular and invexed. There is one species.

Mood, or Mode, in grammar, the different manner of conjugating verbs, serving to denote the different affections of the mind. See MOOD.

MOONSTONE. This is the purest felspar hitherto found. It occurs in Ceylon and Switzerland; and was first mentioned by Mr. Poni. Specific gravity, 2.599. Colour white; sometimes with a shade of yellow, green, or red; it is surface sometimes streaked. A specimen of it analysed by Vaucquelin, yielded,

<table>
<thead>
<tr>
<th>Substance</th>
<th>Weight</th>
</tr>
</thead>
<tbody>
<tr>
<td>64 silica</td>
<td>100</td>
</tr>
<tr>
<td>20 alumina</td>
<td>14 potash</td>
</tr>
<tr>
<td>2 lime</td>
<td></td>
</tr>
</tbody>
</table>

The whitish felspar, called petunze, yielded to the same chemist.

74.0 silica
14.5 alumina
5.5 lime
94.0

MOORING, in the sea-language, is the laying out the anchors of a ship in a place where she can ride secure. Moorings are used, to lay out on each side; and mowing along, is to have an anchor in a river and a hawser on shore. When ships are laid up in ordinary, or are under orders of fitting for sea, the mooms are laid out in bays; and consist of claves, pendant chains, cables, bridles, anchors, swivels, jers-lars, buoys, and chains.
MORDELLA, a genus of insects of the order coleoptera. The antennae are thread-shaped and serrated; the head is deflected under the neck: the pappi are elevated, compressed, and obliquely blunted; and the elytra have a few hairs near the apex. There are six species.

MORFA, a genus of the monogynia order, in the triandria class of plants; and in the natural method ranking under the 45th order, aggregatea. The corolla is hexagonal; the three interior petals, patent; the rest like those of the iris. There are 17 species, beautiful exotics, resembling the iris.

MORRAS, a genus of the monogynia order, in the triandria class of plants; and in the natural method ranking under the 45th order, aggregatea. The corolla is unequal; the calyx of the fruit is monoplylous and dehiscent; the calyx of the flower bud; there is not seed under the calyx of the flower. There is one species.

MORNA, a genus of the monogynia order, in the pentandria class of plants; and in the natural method ranking under the 45th order, aggregatea. The corolla is tetratape lateral; the one pistil; the berry has a hard bark, laminolar, polygonal, smooth, unmarked, uncolored. There is one species, a tree of South America.

MORNYRUS, a genus of fishes of the branchiostegous order, the generic character is, head smooth; teeth numerous, notched; aperture of the gills linear, without a cover; gill membrane with one ray; body small. There are three species. The kumu of the tail, obtuse; dorsal fin with 63 rays. It inhabits the Nile; body whitish and much compressed.

MORROCO, maroquin, in commerce, a fine kind of leather prepared from the skin of an animal of the goat kind, and imported from the Levant, Barbary, &c.

The pelts only taken from the kingdom of Morocco, whence the manner of preparing it was borrowed, which is thus: the skins being first dried in the hair, are steeped in water three days and nights; then stretched on a tanner's horse, beaten with a large knife, and steeped afresh in water every day: they are then tawed into a large vat in the ground, full of water, where quinoline has been skaked, and there lie fifteen days; whence they are taken, and again returned every night and morning. They are next thrown into a fresh vat of lime and water, and shifted night and morning for fifteen days longer; then rinsed in clear water, and the hair taken off the leg with the knife, returned into a third vat, and shifted as before for eighteen days; steeped twelve hours in a river, taken out, rinsed, put in pans, where they are pounded with wooden pe-ties, changing the water twice; then laid on the horse, and the flesh taken off; retained in water, tawed, and dipped in the hair-side-scarped; returned into fresh pans, taken out, and thrown into a pail of a particular form, having holes at bottom: here they are beaten for the space of an hour, and fresh water poured on from time to time; then being stretched on the leg, and scraped on either side, they are returned into pans of fresh water, taken out, stretched and sewed up all around in manner of bags, leaving out the hinder legs as an aperture for the conveyance of the water; and then hung. The skin thus sewed are put in lukewarm water, where dogs excrements have been disposed. Here they are stirred with long poles for half an hour, last at rest a dozen, taken out, rinsed in fresh water; and filled the same way with a preparation of water and suinate, mixed and heated over the fire till ready to boil; and, as they are filled, the leg-kinds are sewed up to stop the passage. In this state they are let down into the vessel of water and suinate, and kept stirring for four hours successively; taken out and hanged on one another; after a little time their sides are changed, and thus they continue an hour and a half tied drained. This done, they are boiled, and filled a second time with the same preparation, sewed up again, and kept stirring two hours, piled up and drained as before. This process is again repeated, with this difference, that the skins are left in the water one hour; after which they are let till next morning, when they are taken out, drained on a rack, unvished, the suinate taken out, folded in two iron head to tail, the hair-side outward; laid over each other on the breast, to perfect their draining, stretched out and dried; then trampled under foot by two and two, stretched on a wooden table, what flesh and suinate remain scraped off, the hair-side rubbed over with a handful of rushes, to squeeze out as much of the oil remaining as possible. The first course of back is now laid on the hair-side, by means of a lock of hair twisted and steeped in a kind of black dye, prepared of sour beer, wherein pieces of old rusty iron have been thrown. When half-lined in the air, they are stretched on a table, rubbed over every way with a panelle, or wooden-toothed instrument, to raise the hair, and that part of the skin which is on the couch of water, then seckled by rubbing them with rushes prepared for the purpose. Thus seckled, they have a second course of black, then dried, laid on the table, rubbed over with a panelle of cocoa, to raise the grain again; and, after a light couche of water, seckled over anew; and to raise the grain a third time, a panelle of wood is used. After the hair-side has received all its preparations, the skin is pared with a sharp knife for the purpose: the hair-side is strongly rubbed over with a wooden cap, having before given it a gloss with barberries, citron, or orange. The whole is finished by raising the grain lightly, for the last time, with the panelle of cocoa; so that they are now fit for the market.

Manor of preparing red Morocco: after steeping, stretching, scraping, beating, and raising the skins, as before, they are at length prepared; and that they are ready for market, after each other into water where alum has been dissolved. Thus alanned, they are left to drain till morning, then wrung out, pulled on the leg, and folded from head to tail, the flesh forwards.

In this state they receive their first dye, by passing them over another into a red liquor prepared with laque, and some other ingredients, which the maroquiniers keep a secret, and they never agin, then the skins have got their first colour: then they are raised in clear water, stretched on the leg, and left to drain twelve hours, thrown into water through a sieve, and stirred incessantly, for a day with long poles taken out, hung across the water all night, white against red, and red against white, and in the morning the water stirred up, and the skins returned into it for twenty-four hours.

MORTALITY, Bible, s., accounts of the numbers of deaths or burials in any parish or district. The establishment of registers of this kind in Great Britain, was occasioned by the plague, and an abstract of them was published weekly, to show the increase or decrease of the disorder, that individuals might judge of the necessity of removal, or of taking other precautions against it, and government be informed of the propriety or success on any public measures relating to the disorder. On 21st Dec., 1594, and on the 21st of the same month, who also appointed a proclamation to be made by the clergy, in which, among other things, they promise to keep the register-book in a proper manner. One of the canons of the church of London, in which manner entries are to be made in the parish-registers, and orders an attested copy of the register of each successive year to be annually transmitted to the bishop of the diocese or bishoprick, and to be preserved in the bishop's registry. These registers have only been occasionally communicated to the public, and that without sufficient particulars to supply much information; but in London, and the surrounding parishes, the parish-clerks are required to make a weekly return of burials, with the age and disease of which the person died; a summary of which account is published weekly; and on the Thursday following the last day of the week, who also appoint the register is made up for the whole year. These accounts of christenings and burials, taken by the company of parish clerks of London, were began 21st Dec., 1592, but were not made public till 1604; and to this day, in the following year, upon the ceasing of the plague, they were discontinued; at this time the London bills of mortality comprehended but 109 parishes. In 1603, the weekly bills of mortality were reduced, and have been regularly continued ever since; the number of parishes included in them has been increased at different times, and at present is 148.

Bills of mortality, especially such as give the ages of the dead and the disorders of which they died, furnish much useful information; they shew the different degrees of healthness of seasons or districts, the progress of population, and the probabilities of the duration of human life in any part of the usual habitations; and the observations on which all tables of the value of annuities on lives, or depending on survivorship, have been constructed.

In 1693, Mr. John Granatt published some ingenious observations on the London Bills
of Mortality, which were much enlarged in subsequent editions. Dr. William Hooper, in 1653, made considerable use of the information afforded by them, in his Political Arithmetic. In 1742, Mr. T. Simpson published his Treatise on Annuities, in which he inserted a table formed of ages and years, derived from the London bills of mortality, with some corrections which appeared necessary: in 1746, Mr. De Parteux, in an Essai sur les Probabilités de la Vie humaine, made some objections to Mr. Simpson’s deductions in the London bills, but without sufficient foundation; and in 1757, Mr. Simpson, in a supplement to his Treatise on Annuities, made use of the same table from the London bills, but adapted to a different radix. In 1789, Dr. Price remarks, that in every place which just supports itself in the number of its inhabitants, without any recruits from other places, for a whole period of all ages, there has been no increase or decrease, the number of persons dying every year at any particular age, and above it, must be equal to the number of the living at that age. The number of females dying every year, at all ages, from the beginning to the utmost extremity of life, must, in such situation, be just equal to the whole number born every year. And for the same reason, the number dying every year at any particular age and upwards, at two years of age and upwards, at three and upwards, and so on, must be equal to the numbers that attain to those ages every year, or, which is the same, to the numbers of the living at those ages. It is obvious, that unless this happens, the number of inhabitants cannot remain the same; it follows, therefore, that in a town or country, where there is no increase or decrease, bills of mortality as at which place will shew the exact number of inhabitants; and also the exact law, according to which human life was in that town or country. In order to find the number of inhabitants, the number dying every year at any particular age and upwards, must be taken as given by the bills, and placed under one another in the order of the second column: see Table, art. expectation. These numbers will be the numbers of the living at 1, 2, 3, &c. years of age; and, consequently, the sum, diminished by half the number born annually, will be the whole number of inhabitants.

The bills of mortality, in some parts of Great Britain, are known to be materially defective; the deficiencies may chiefly be ascribed to the following circumstances: 1. Many congregations of dissenters, inhabiting towns, have their own peculiar burying-grounds, as have the Jews, and the Roman Catholics, who reside in London. 2. Some persons, from motives of poverty or convenience, inter their dead without any religious ceremony; this is known to happen in the most populous towns of France, and in a few other large towns. 3. Children who die before baptism are interred without any religious ceremony, and consequently are not registered.

Although after breach of the condition, an absolute fee-simple is vested at common law in the mortgagee; yet a right of redemption being still inherent in the land, till the equity of redemption is foreclosed, the same right shall descend to, and be invested in, such successors, or assigns of the original person, if any, as shall have been no mortgage or incumbrance whatsoever; and as an equitable performance as effectually defeats the interests of the mortgagee, as the legal performance does at common law, the case is still hanging over the estate until the equity is totally foreclosed; on this foundation it is held that a person who comes in under a voluntary conveyance, may redeem a mortgage; and though such right of redemption is inherent in the land, yet the party claiming the benefit of it, must not only set up such right, but also shew that he is the person entitled to it. Hard. 495.

But if a mortgage is forfeited, and thereby the estate absolutely vested in the mortgagee at common law, yet a court or equity will consider the real value of the tenements, compared with the sum borrowed. And if the estate is of greater value than the sum lent thereon, they will allow the mortgagee many reasonable time to recall or redeem the estate, paying to the mortgagee his principal, interest, and costs. This reasonable advantage, allowed to the mortgagee, is called the equity of redemption. 2 Bl. Com. 123.

It is a rule established in equity, analogous to the statute of limitation, that after twenty years possession of the mortgagor, he shall not be disturbed, unless there are extraordinary circumstances; as when the mortgagor is covert, infants, and the like. 3 Atk. 313.

MORTISE, or Mortise, in carpentry, &c. a kind of joint, wherein a hole of a certain depth is made in a piece of timber, which is to receive another piece called a tenon.

MORTMAIN, signifies an alienation of lands and tenements, to any guild, corporation, or fraternity, and their successors, as bishops, parsons, vicars, &c. which may not be done without licence, and the lord of the manor; or of the king alone, if it is immediately held of him.

But in order to prevent any imposition in respect to the disposal of lands to charitable use, which might arise from a testator’s last will, and testament, construed from circumstances, from the money, goods other personal estate whatsoever, to be laid out or disposed of in the purchase of any lands, tenements, or hereditaments, shall be given, limited, or appointed by will, to any person or persons, bodies politic or corporate, or otherwise for any estate or interest whatsoever; or any ways charged or incurred by any person or persons whatsoever, in trust, or for the benefit of any charitable use whatsoever; but such gift shall be by deed indentured, witnessed by the presence of two or more credible witnesses, twelve calendar months at least before the death of such donor, and be enrolled in the high court of chancery within six calendar months.
thoughtful purposes. The wood of the mulberry-tree is yellow, tolerably hard, and may be applied to various uses in turning and carving; but in order to separate the bark, which is rough, thick, thickened, and fit for being made into ropes, it is proper to steep the wood in water.

Mulberry-trees are noted for their leaves affecting the principal food of the silkworm. The leaves of the alba, or white species, are preferred for this purpose in Europe; but in China, where the best silk is made, the works are said to be fed with those of the nigra variety. However, the valuations of white mulberry-trees are not confined to the nourishment of worms: they may be cut every three or four years like sauls and popular trees, to make faggots; and the sheep eat their leaves in winter, before they are burnt. This kind of food, of which they are extremely fond, is very nourishing; it gives a delicacy to the flesh, and a fineness and beauty to the wool.

The papyrifera, or paper-mulberry, is so called from the paper chiefly used by the Japanese being made of the bark of its branches. The leaves of this species also serve for food and the silkworm, and it is now cultivated with success in some of the most fertile districts of Japan. The white mulberry, which grows faster than the common mulberry, and at the same time is not injured by the cold, M. de la Bouvriere affirms that he procured a beautiful vegetable silk from the bark of the young branches of this species of mulberry, which he cut while the tree was in sap, and afterwards beat and steeped. The women of Louisiana procure the same kind of production from the shoots which issue from the stock of the mulberry at the beginning of the season, and which are four or five feet high. After taking off the bark, they dry it in the sun, and then beat it that the external part may fall off; and the internal part, which is fine bark, remains entire. This is again beaten, to make it still finer: after which they bleach it with dew. It is then spun, and various fabrics are made from it, such as nets and fringes; they even sometimes weave it, and make it into cloth. The finest sort of cloth is made of the branches of Otahite and others of the South Sea islands, is made of the bark of this tree.

The tinctoria is a fine timber-tree, and a principal ingredient in most of our yellow dyes, for which it is chiefly exported into Europe. The berries are sweet and wholesome; but not much used, except by the winged tribe, by whose care it is chiefly planted.

MOSAIQ, or mosaic-work, an assemblage of little pieces of glass, marble, precious stones, &c. of various colours, cut square and cemented on a ground of stucco, in such a manner as to imitate the colours of painting.

MOSCHUS, musk, a genus of quadrupeds of the order Carnivora: the generic character, bears none; from teeth in the lower jaw eight; tusks solitary, in the upper jaw scs.

1. Moschus moschiferus, Tibetan musk. The musk is one of those quadrupeds whose true form and natural history appear to have continued in great obscurity long after the introduction and general use of the celebrated perfume which it produces. To the antients it was unknown, and was first mentioned by the Arabians when used in their practice. The animal was by some considered as a kind of goat, by others as a species of deer or antelope, and was of course supposed to be a horned animal; nor was it till about the thirteenth century that a tolerably accurate description of the figure was to be found.

The size and general appearance of this animal resemble those of a small roebuck. It measures about three feet three inches in height, about two feet three inches in length, and four feet six inches from the top of the shoulder to the bottom of the foreshoof, and two feet nine inches from the top of the hock to the bottom of the hind foot. The upper jaw is considerably longer than the lower, and is furnished on each side with about two inches long. These tusks are of a different form from those of any other quadruped; being sharp-edged on their inner or lower side, so as to resemble, in some degree, a pair of small crooked knives: their substance is a kind of ivory, as in the tusks of the babirusa and some other animals.

The general colour of the whole body is a kind of deep iron-grey; the tips of the hairs being of a ferruginous cast, the remainder blackish, growing much paler or whitish towards the roots. See Plate Nat. Hist. fig. 279.

The female is smaller than the male, and wants the tusks: it has also two small testes.

The male supplies their well-known perfume: which is contained in oval receptacles about the size of a small egg, hanging from the middle of the abdomen, and peculiar to the animal. This receptacle is found constantly filled with a thick, pungent, brownish substance, the most powerful and penetrating smell; and which is no other than the perfume in its natural state. As soon as the animal is killed, the hunters cut off the receptacle or musk-bag, and tie it up ready for sale. The animals must of necessity be extremely numerous in some parts, since we are assured by Tavernier, the celebrated merchant and traveller, that he purchased, in one of his Eastern journeys, no less than seven thousand six hundred and seventy-three musk-bags.

So violent is the smell of musk, when freshly taken from the animal, or from quantities put up by the merchants for sale, that it has been known to force the blood from the nose, eyes, and ears, of those who have immoderately inhaled its vapours.

As musk is an expensive drug, it is frequently adulterated with various substances; and we are frequently at a loss to detect the admixture, which is often found in some of the receptacles, inserted in order to increase the weight. The smell of musk is so remarkably diffusive, that every thing in its neighbourhood becomes strongly infected with it; even a silver cup that has held musk in it does not part with the scent, though other odours are in general very readily discharged from metallic substances.

As a medicine it is held in high estimation in the Eastern countries, and has now been introduced into pretty general use among ourselves, especially in those disorders which are commonly termed nervous; and in convulsive and other cases, it is often exhibited in pretty large doses with great success.

2. Moschus moschiferus, or Indian musk, this species is said to be rather larger than the common or Tibetan musk, of the colour mentioned in the specific character, with the head character, skin, and eyes of a horse, upright oblong ears, and slender legs. See Plate Nat. Hist. fig. 280.

3. Moschus pygmaeus, or the pygmy musk, is considerably smaller than a domestic cat,
measuring little more than nine inches from the nose to the tail. Its colours is bright bay, white beneath and on the insides of the thighs. Its shape is beautiful, and the legs are so slender as not to be visible from the front; the head is rather large, and the aspect mild. It is a native of many parts of the East Indies and the Indian islands, and is said to be most common in Java, where the natives catch great numbers in seines, and sell the young to the market-men for sale. According to Mr. Pennant they may be purchased at so low a rate as two pence halfpenny a piece. There are three other species.

**MOSQUE.** A temple or place of religious worship among the Mahometans.

All mosques are square buildings, generally built with stone; before the chief gate there is a square court, paved with white marble, and low galleries round it, whose roof is supported by marble pillars. In these galleries the Turks wash themselves before they go to prayer, and on each side of the court there are a great number of lamps; and between these hang many crystal rings, ostrich's eggs, and other curiosities, which, when the lamps are lighted, make a fine show. As it is the custom of the Moslem to wear shoes or stockings on, the pavements are covered with pieces of stuff sewed together, each being wide enough to hold a row of men kneeling, sitting, or prostrate. The women are not allowed to enter, but stay in the porches without. About every mosque there are six high towers, called minarets, each of which has three little open galleries, one above another: these towers, in each of which mosques are, cover the head, and adorned with gliding and other ornaments; and from thence, instead of a bell, the people are called to prayer by certain officers appointed for that purpose. Most of the mosques have a kind of hospital belonging to them, in which travellers, of whatever religion soever, are entertained during three days. Each mosque has also a place called turbe, which is the burying-place of its founder, who is often a rich man, of long feet, long covered with green velvet or satin, at the ends of which are two tapers, and round it several seats for those who read the koran, and pray for the souls of the deceased.

**MOSS.** See **Muscus.**

**MOTACILLA.** The wagtail and swarb, a genus of birds of the order of passerines, distinguished by a straight weak bill of a subulated figure; a tongue lacertated at the end, and very slender legs.

1. The alba, or white wagtail, frequents the sides of ponds and small streams, and feeds on insects and worms. The head is black; in some the chin is white, and the throat marked with a black crescent. The breast and belly are white. The tail is very long, and always in motion. Mr. Willughby observed, that this species shifts its quarters in the winter, moving from the north to the south of England during that season. A thing and amongst it is a constant attendant on the plough, for the sake of the worms thrown up by that instrument.

2. The flava, or yellow wagtail, migrates in the north of England, but in Hampshire continues the whole year. The male is a third of great beauty; the breast, belly, thighs, and vent-feathers, being of a most vivid and lovely yellow. The colours of the female are far more obscure than those of the male: it wants also those black spots on the abdomen.

3. The regulus, or gold-crested wag, is a native of Europe, and of the correspondent latitudes of Asia and America. It is the most of all the European birds, weighing only a single drachm. Its length is about four inches and a half, and the wings when spread out measure little more than six inches. On the top of its head is a beautiful orange-coloured spot, called its crest, which it can hide at pleasure; the rest of the crest is yellow, and it ends in a pretty broad black line; the sides of the neck are of a beautiful yellowish-green; the eyes surrounded with a white circle; the neck and back of a dark green mixed with yellow. In America it associates with the titmice, running up and down the laths of lofty ouths with them, and collecting its food in their company, as if they were all of one breed. It feeds on insects, lodging itself in large trees in a torpid state. It is said to sing very melodiously.

4. The sutoria, or taylor-bird, is a native of the East Indies. It is remarkable for the passion with which it goes about building its nest in order to secure itself and its young, in the most perfect manner possible, against all danger from voracious animals. It picks up a dead leaf, and sews it to the side of a living green stem, and the neck, and its sheathing thread is formed of some fine fibres; the lining is composed of feathers, gossamer, and down. The colour of the bird is light yellow; its length three inches, and its weight only three-sixteenths of an ounce; so that the materials of the nest and its own size are not likely to draw down a habitation depending on so slight a tenure.

5. The hicina, or nightingale, exceeds in size the hedge-sparrow. The bill is brown; the irides are hazel; the head and back pale tawny, dished with olive; the tail is of a deep tawny red; the under parts pale ash-colour, growing white towards the vent; the quills white, the tail-feathers brown and white. The male and female are very similar. This bird, the most famed of the feathered tribe for the variety, length, and sweetness of its notes, is supposed to be migratory. It is met with in Siberia, Sweden, Germany, France, Italy, and Greece. Hasteloupe speaks of it as being in Palestine, and Fryer ascertain its being found about Chulminor in Persia; it is also spoken of as a bird of China, Kamtschatka, and Japan; at which last place they are much esteemed, and sell dear: as they are also at Aleppo, where they are "in great abundance kept tame in houses, and let out at a small rate to such as choose it in the city, so that no entertainment is made in the spring without a concert of these birds."

They are solitary birds, neither uniting into even small flocks; and in respect to the nests, it is very seldom that two are found near each other. They are very different from some low bush or quickset edge, well covered with foliage, for such only this bird frequents; and lays four or five eggs of a greenish-brown. The nest is composed of dry leaves on the outside, mixed with a few hair, lined with hair and down, though not always alike. The female alone sits on and hatches the eggs, while the male not far off regales her with his delightful song; but as soon as the young are hatched, he commonly leaves off singing, and joins in the task of providing for and feeding them. After the young can provide for themselves, the old female provides for a second brood, and the song of the male recommences. They have been known to have three broods in a year, and in the hot countries even four. These birds are often brought up from the nest for the sake of their song. They are likewise caught at their first coming over; but these old birds, though brought to be kept in conveiment, and to sing equally with those brought up from the nest. None but the bilov epipeic, as Mr. Latham remarks, would think of eating these charming songsters; yet we are told that their flesh is equal to that of the ortolan, and they are fattened in Gascony for the table.

6. The medularis, or hedge-sparrow, a well-known bird, has the back and wing-coverts of dusky; the rump and rump-furrows, a greenish-brown; the throat and breast of a dull ash-colour; the belly a dirty white; and the legs of a dull flesh-colour. The note of this bird would be thought pleasant if it were not rendered unpleasant by the approach of winter; beginning with the first frosts, and continuing till a little time in spring. It often repeating the word tit, tit, tit, has occasioned its being called titling; a name it is known by in many places.

7. The plenicurus, or redstart, is somewhat less than the redbreast; the forehead is white; the crown of the head, hind part of the neck, and back, are deep blue-grey; the cheeks and throat black; the breast, rump, and sides, red; and the belly is white; the two middle tail-feathers are brown; the rest red; and the legs are black. The wings are brown in both sexes.

This bird is migratory; coming hither in spring, and departing in autumn about October. It is not so shy as many birds in respect to itself; for it approaches habitations, and frequently makes its nest in some hole of a wall where numbers of people are frequently at home, yet no one meddles with the nest. This bird frequently vags its tail; but does it sideways, like a dog, when he is pleased, and not up and down like the wagtail. It is with difficulty that these feathers are kept in a cage; nor will they submit to it by any means if caught old. Their song has no great strength; yet it is agreeable enough; and they will, if taught young, imitate the notes of other birds, and sing by night frequently as well as in the daytime.

8. The rubecula, or redbreast, is universally known. It abounds in Burgundy and Lorraine, where numbers are taken for the table, and thought excellent. It builds not far from the ground if in a bush; though sometimes it fixes on an out-house, or retired part of some old building. The nest is composed of dried leaves, mixed with hair and moss, and lined with feathers. The eggs are of a dusky white, marked with brown and reddish spots; and are from three to seven in number.

The young, when full-feathered, may be taken for a different bird, being spotted all over. The first rudiments of the red break forth on the breast about the end of August; but it is quite the end of September before they come to the full colour. **Insects** are
their general food; but in defect of these they will eat many other things. No bird is so tame and familiar as this; closely attending the heels of the gardener when he is using his spade, for the sake of worms; and frequently in winter entering houses where windows are open, when they will pick up the crumbs from the table while the family is at dinner. Its familiarity has caused a petty name to be given it in several countries. The people about Bornholm call it Tommi-iden; in Norway, Peter-rummad; the Germans, Thomas-girder; and we, the Robin-red-breast.

9. The emmata, or wheatear, is in length five inches and a half. The top of the head, hind part of the neck, and back, are of a bluish grey; and over the eye a streak of white; the under parts of the body yellowish-white: the breast is tinged with red; and the legs are black. This bird is met with in most parts of Europe, even as far as Greenland, and the Bermudas have also been received from the East Indies. It visits England usually in the middle of March, and leaves us in September. It chiefly frequents heaths. The nest is usually placed under shelter of some turf, clod, stone, or the like, always on the grassy side of a road, in the recess of a seat or the retired rabbit-burrow. It is composed of dry grass or moss, mixed with wool, fur of the rabbit, &c. or lined with hair and feathers. The eggs are from five to eight in number, of a beautiful light green colour, with a deep purple circle at the large end. The young are hatched in the middle of May. In some parts of England these birds are in vast plenty. About Eastbourne in Sussex they are taken in snares made of horsehair placed beneath a long turf, being very timid birds, the motion of a cloud, or the appearance of a hawk, will drive them for shelter into these traps, and so they are taken. The numbers annually ensured in that district alone amount to about 18,000, which usually sell at sixpence per dozen. Quantities of these are eaten on the spot by the neighbouring inhabitants; others are picked, and sent up to the London porkers. Their flesh is very delicate; but as much esteemed in England as the ortolan on the continent. Their food is insects only; though in rainy summers they feed much on earth-worms, whence they are fatter in such seasons.

10. The cyanas, or superb warbler, a most beautiful species, is five inches and a half long. The bill is black; the feathers of the head are long, and stand erect like a full crest; from the forehead to the crown they are of a bright blue; thence to the nape, black like velvet; through the eyes from the bill there runs a line of black; and beneath the eye springs a tuft of the same blue feathers; beneath which, and on the chin, it is of a deep blue, almost black, and feeling like velvet. The hind part of the neck, and upper parts of the body and tail, are of a deep blue-black, the under pure white; the wings are dusky; the shafts of the quills chestnut; the legs are dusky brown; the claws black. It inhabits Van Diemen's Land, the most southern part of New Holland. The female of this species, is discovered to be entirely destitute of all the fine blue, the pale and dark, by which the male is adorned, except that there is a very narrow circle of azure round each eye, apparently on the skin only.

11. The troglodytes, or wren, is a very small species, in length only three inches and three quarters, though some have measured four inches. It generally carries the tail erect. The minute bird is found throughout Europe; and in England it dures our severest winters. Its song is much esteemed, being, though short, a pleasing warble, and much louder than could be expected from the size of the bird. It is divided into nine sorts.

The sylvia builds in low bushes, and lays five pale-green eggs, sprinkled with reddish spots. See Plate Nat. Hist. fig. 271.

Above 150 other species, besides varieties, are enumerated by the ornithologists.

MOTTE, in law-books, signifies court, meeting, or convention, as a war-nodto, burgh, mott, swain-mott, &c.

MOTH. See Phalena.

MOTION, has been defined to be a "change of place," or the act by which a body corresponds with different parts of space at different times. We are principally acquainted with two sorts of motion in the beings that surround us; one is the motion by which an entire body is transferred from one place to another, as if the body of a ship under sail. It is this species of motion which most frequently comes under our observation, and with which we are best acquainted. But, besides this, there is another kind of motion, which, though not so obvious, is yet not less common nor important. This is a motion of the parts of bodies among themselves, which though sometimes the object of our senses, yet in other cases we require the aid of reflection to trace it. It is by this imperceptible motion that plants and animals grow, and by which the greatest number of the compositions and decompositions throughout the globe take place. We may form some idea of this, by observing the continual motion of the light particles which sometimes float about in water, when it is held in the rays of the sun, which proves, that the parts of the water themselves are in constant motion. If we employ our senses, we shall discover that the particles of the most solid bodies are also continually changing their situations. Heat, expans, and cold contracts, the size of all bodies; now, we know from experience, that the temperature of bodies is constantly varying, consequently, the particles must be in continual agitation, in order to adapt themselves to the size of the body.

The communication of motion from one body to another, though a fact with which we are well acquainted, we are equally incapable of accounting for. It is, however, of the utmost importance in mechanics, which is indeed an art derived from the study of its laws. In considering motion, several circumstances must be attended to: 1. The force which impresses the motion. 2. The quantity of matter in the moving body. 3. The velocity and direction of the motion. 4. The time in which the motion is going over this space. 5. The time employed in going over this space. 6. The force with which it strikes another body that is opposed to it. In a mechanical sense, every body, by its inertia, resists all change of state. If at rest, it will not begin to move of itself; and if motion is communicated to it by another body, it will continue to move for ever uniformly, except it is stopped by an external agent. It is true, we do not see any instances of bodies continuing to move for ever, after being once put in motion; but the reason of this is, that all the bodies which we see are acted upon in such a manner, as to have their motion gradually destroyed by friction, or the rubbing of other bodies upon them. For if you diminish the friction by any means, the motion will continue much longer; but as it is impossible to destroy it entirely, it diminishes, and at last destroys, all motions on the surface of the earth. To put a body in motion, therefore, there must be a sufficient cause. These causes are called motive powers, and the following are those generally used in mechanics; the action of men and other animals, wind, water, gravity, the pressure of the atmosphere, and the elasticity of fluids and other bodies.

The velocity of motion is estimated by the time employed in moving over a certain space, or by the space moved over in a certain time. To assign time, we divide it into degrees of this swiftness or velocity, the space covered must be divided by the time. For example: suppose a body moves over 1000 yards in 10 minutes, its velocity will be 100 yards per minute. If we would know the velocity of two bodies A and B, of which A moves over 54 yards in 9 minutes, and B 93 yards in 6 minutes, the velocity of A will be 6 to that of B, in the proportion of 6 (the quotient of 54 divided by 9) to 10 (the quotient of 96 divided by 6).

To know the space run over, the velocity must be multiplied by the time; for it is evident, that if either the velocity or the time is increased, the space run over will be greater. If the velocity is doubled, then the body will move twice the space in the same time; or if the time is twice as great, then the space will be doubled; but if the velocity and time are both doubled, then will the space be four times as great.

It follows from this, that when two bodies move over unequal spaces in unequal times, their velocities are to each other as the quotients arising from these spaces run over by the times. If two bodies move over unequal spaces in the same time, their velocities will be in proportion to the spaces passed over. And if two bodies move over equal spaces in unequal times, then their respective velocities will be inversely as the time employed; that is, if A in one minute, and B in two minutes, run over 100 yards, the velocity of A will be to that of B as 2 to 1. A body in motion must vary instantaneously to some particular point. It may either tend always to the same point, in which case the motion will be in a straight line; or it may be continually changing the point to which its motion is directed, and this will produce a curvilinear motion.

If a body is acted upon only by one force, or by several in the same direction, its motion will be in the same direction in which the forces are tending. If a body is acted upon by a boat which a man draws to him with a rope. But if several powers, differently directed, act upon it at the same time, as it cannot obey them all, it will move in a direction somewhere between them.

This is what is called the composition and
MOTION.

resolution of motion, and is of the utmost importance in mechanics.

Suppose a body A (Plate Miscel. fig. 163) to be acted upon by two forces, and another body in the direction AB, while at the same time it is impelled by another in the direction AC, then it will move in the direction AD; and if the lines AB, AC, are made of lengths proportional to the forces, and the lines CD, DE, drawn parallel to them, so as to complete the parallelogram ABDC, then the line which the body A will describe, will be the diagonal AD; and the length of this line will represent the force with which the body will move. It is evident, that if a body is impelled by equal forces acting at right angles to each other, that it will move in the diagonal of a square; but whatever may be the direction, or degree of force by which the two powers act, the above method will always give the direction and force of the moving body.

It follows from this, that if we know the effect which the joint action of two powers has upon a body, and the force and direction of one of them, we can easily find that of the other. For, suppose AD to be the direction and force with which the body moves, and AB to be one of the impelling forces, then, by completing the parallelogram, the other power AC is found.

Instances in nature of motion produced by several powers acting at the same time, are innumerable. A ship impelled by the wind and tide is one well known. A paper kite, acted upon by the wind and the string, is another.

Motion is said to be accelerated, if its velocity continually increases; to be uniformly accelerated, if its velocity increases equally in equal times.

Motion is said to be retarded, if its velocity continually decreases; and to be uniformly retarded, if its velocity decreases equally in equal times.

If you suppose a body to be put in motion by a single impulse, and moving uniformly, to receive a new impulse in the same direction, its velocity will be augmented, and it will go on with the augmented velocity.

If at each instant that it receives a new impulse, the velocity will be continually increasing; and if this impulse is always equal, the velocity will be uniformly accelerated.

The regularly increasing velocity with which a body falls to the earth, is an instance of accelerated motion, which is caused by the constant action of gravity. To illustrate this, let us suppose the time of descent of a falling body to be divided into a number of very small equal parts; the impression of gravity, in the first small instant, would make the body descend with a proportionate and uniform velocity; but in the second instant, the body receiving a new impulse from gravity, in addition to the first, would move with twice the velocity as before; in the third in- stant, it would have three times the velocity, and so on.

To illustrate the doctrine of accelerated motion, let us suppose that, in the triangle ABC (fig. Miscel. 164), AB expresses the time which a body takes to fall, and BC the velocity acquired at the end of the fall. Let AB be divided into a number of equal parts, indefinitely small, and from each of these divisions suppose lines, as DE, drawn parallel to BC; it is evident from what has been said, that those lines will express the velocities of the falling body in the several respective times; and it is required, using the same reasoning, by which a body falling, in the time expressed by AB, with an uniformly accelerated velocity, of which the last degree is expressed by BC, will be represented by the area of the triangle ABC.

Let us now suppose that gravity ceased to act, and that the body moved during another portion of time, BF, equal to AB, with the acquired velocity represented by BC. As the space moved over is found by multiplying the force by the time, the rectangle CF will represent the space moved over in this second portion of time, which is twice the triangle ABC, and consequently twice the space is moved over with the accelerating velocity in the same time.

But if we suppose gravity still to act, besides the space CF, which it would have moved over by its acquired velocity, we must add the triangle CFI, for the effect of the constant action of gravity; therefore, in this second portion of time, the body moves over three times the space as the first. In like manner, it may be easily seen by the figure, that in the next portion it would move over five times the space; in the next seven times, and so on, in arithmetical progression. And as the velocities of falling bodies are in proportion to the spaces run over, it follows, that the velocities in each instant increase, as the numbers 1, 3, 5, 7, 9, &c.

It follows from this, that the space run over is as the square of the time; that is, in the first instant, a body moves over one time the velocity; in the third, twice the velocity, &c.; for, in the first time, there was but one space run over; the square of 1 is 1; at the end of the second time there are four spaces run over, one in the first, and three in the second; the square of 2 is 4; at the end of the third time there are nine spaces run over; the square of 3 is 9: and so on.

This may be seen in the figure.

It is found by experiment, that a body falling from a height, moves at the rate of 16½ feet in the first second; and, as has been shewn above, acquires a velocity of twice that, or 33½ feet in a second.

At the end of the second second, it will have fallen 63½ feet, the space being as the square of the time; the square of 2 is 4, and 4 times 16½ is 64½. By the same rule you may find, that in the third second it will fall 114¼ feet; in the next 250 feet, and so on. It is to be understood, however, that by this velocity is meant what bodies would acquire, if they were to fall through a space where there was no air; for its resistance considerably diminishes their velocity in falling.

It has already been shewn, that if two forces act uniformly upon a body, they will cause it to move in a straight line; but if one of the forces is not uniform, but either accelerating or retarding, the moving body will describe a curve line. If a ball is projected from a cannon, which, if there was no resistance from the air, and if it was not acted upon by gravity, would cause it to move always in a straight line; but as soon as it leaves the mouth of the cannon, it is acted upon, and makes it change its direction. It then describes a curve, called a parabola. This is the foundation of the theory of projectiles, and the art of gunnery; but it is not now considered to be of so much importance as it formerly was, as it is found that the resistance of the air, and other causes, have so much effect upon projected bodies, that they describe curves very different from what they ought to do according to this theory; and therefore it is much less applicable to practice than otherwise it would be.

The force with which a body moves, or which it would exert upon another body opposed to it, is always in proportion to its velocity, and its mass. This force is called the momentum of the body: for if two equal bodies move with different velocities, it is evident that their forces, or momenta, are as their velocities; and the greater the velocities move over, the greater their force, or momentum; their moments are thus the quantities of matter; therefore, in all cases, their moments must be as the products of their quantities of matter, and their velocities. This rule is the foundation of mechanics.

In consequence of the vis inertiae of matter, all motion produced by one force only acting upon a body, must be rectilinear; for it must receive some particular direction from the power that impressed it, and must retain that direction until it is changed by some other power. Whenever, therefore, we see a body moving in a curvilinear direction, we may be certain that it is acted upon by two forces at least. When one of the two forces ceases to act, the body will move again in a straight line. Thus a stone in a sling is moved round by the hand, while it is pulled towards the centre of the circle, which it describes, by the string: but when the string is let go, the stone flies off in a tangent to the circle.

Every body moved in a circle has a tendency to fly off from its centre, which endeavour of receding is called the centrifugal force; and it is opposed to the centripetal force; or that which, by drawing bodies towards the centre, makes them revolve in a curve. These two forces are called together centripetal forces.

The centre of gravity of a body is that point about which all the parts of a body do go in any situation exactly balance each other.

Hence, if a body is suspended or supported by this point, the body will rest in any position in which it is put. Also, whatever support bears the weight of the whole body; and while it is supported, the body cannot fall. We may therefore consider the whole weight of a body as centred in this point.

The common centre of gravity of two or more bodies is the point at which they would equilibrate, or rest, in any position. If the centre of gravity of two bodies, A and B, (Plate Miscel. fig. 165) is connected by the
right line AB, the distances AC and BC, from the common centre of gravity C, are reciprocally as the weights of the bodies A and B, that is AC : BC = B : A.

In the direction from the centre of gravity of a body, perpendicular to the horizon, it is called the line of direction; because it is the line that the centre of gravity would describe if the body fell freely.

It is the property of this line, that while it falls within the base upon which the body stands, the body cannot fall; but if it falls without the base, the body will tumble. Thus the inclining body ABCD, (fig. 160) whose centre of gravity is E, stands firmly on its base CDIIK, because the line of direction EL falls within the base. But if a weight, as ABII, is laid upon the top of the body, the centre of gravity of the whole body and weight together is raised to L: and then, as the line of direction LD falls without the base at D, the centre of gravity is not supported, and the whole body and weight will tumble down together.

It appears the absurdity of people’s rising hastily in a coach or boat, when it is likely to overseat; for by that means they raise the centre of gravity so far as to endanger throwing it quite out of the base, and if they do, the vehicle will inevitably tumble. Whereas, had they clapped down to the bottom, they would have brought the line of direction, and consequently the centre of gravity, farther within the base, and by that means saved themselves.

The broader the base, and the nearer the line of direction is to the middle or centre of it, the more firmly does the body stand. On the contrary, the narrower the base, and the nearer, or the line of direction is to the side of it, the more easily may the body be overthrown, a less change of position being sufficient; to remove the line of direction out of the base in the latter case than in the former. And hence it is, that a sphere is so easily, as it were, rolled upon a horizontal plane; and that it is so difficult, if not impossible, to make things which are sharp pointed to stand upright on the point.

What has been said, it plainly appears, that if a plane CD on which a heavy body is placed, was elevated at C, the body would slide down upon the plane, whilst the line of direction falls within the base; but it would stand, or the line of direction is to the side of it, the more easily may the body be overthrown, a less change of position being sufficient to remove the line of direction out of the base in the latter case than in the former.

Hence it is, that a sphere is so easily, as it were, rolled upon a horizontal plane; and that it is so difficult, if not impossible, to make things which are sharp pointed to stand upright on the point.

The line of direction falls within the base of our feet, we stand, and most firmly when it is in the middle; but when it is out of that base, we immediately fall. And it is not only pleasing, but even surprising, to reflect upon the various methods and postures which we use, to retain this position, or to recover it when lost, without our being sensible of it. Thus we bend our bodies when we rise from a chair, or when we go up stairs; and for this purpose a man leans forward when he carries a burden upon his back, and backward when he carries it on his breast, and to the right or left side as he carries it on the opposite side.

If a body is suspended freely from different centres its centre of gravity will be in the intersection formed by lines drawn from those centres perpendicular to the horizon. Hence we obtain an easy practical method of finding the centre of gravity of any irregular plane figure. SUSPEND it by any point, with the plane perpendicular to the horizon, and from the points where it hangs, and draw a line upon the body where the string passes over; do the same for any other point of suspension, and where the two lines intersect must be the centre of gravity; for the centre of gravity being in each line, it must be at the point where they intersect.

Motion, spontaneous or muscular, is that performed by the muscles at the command of the will.

Motion, natural or involuntary, that effect, without any such command, by the mere mechanism of the parts, such as the motion of the heart, pulse, &c.

Motion, intestinal, the agitation of the particles of which a body consists.

Motion, in music, the manner of beating the measure, to hasten or slacken the time of the words or notes.

MOUVEMENT, in mechanics, a machine that is moved by clockwork. See Clockwork.

MOULDINGS. See Architecture.

MOUNTAINS. Elevations consisting chiefly of clay, sand, or gravel, are called hills. Those which consist chiefly of stone are called mountains. Mountains are divided into primeval, that is, of equal date with the formation of the globe, and secondary or alluvial. Among primeval, those of granite hold the first place. The highest mountains and most extensive ridges throughout the globe are of that kind; as the Alps and Pyrenees in Europe; the Altiscanah, Uralian, and Caucasus, in Asia; and the Andes, in America. The highest of them never contain metallic ores; but some of the lower contain ores of copper and tin. The granite next the ore always abounds in mica. Petrifactions are never found in these primeval mountains.

That the formation of these mountains preceded that of vegetables and animals, is justly inferred from their containing no organic remains, either in the form of petrifaction or impression. Naturalists are agreed, that granites were formed by crystallization. This operation probably took place after the formation of the atmosphere, and the gradual separation of the dry bed of the ocean, which is now the dry land appeared. For, by means of the separation of the aëridiform fluids which constituted the atmosphere, the evaporation of part of the water into the atmosphere, and the gradual retreat of the remainder, the various species of earths, before dissolved or diffused through this mighty mass, were disposed to coalesce; and among these the silicious must have been the first, as it is the least soluble; but as the silicious earth has an affinity to the other earths with which it was mixed, some of these must have united in various proportions, and thus have formed, in distinct masses, the sandstone, siltstone, and mica, which compose the granite. Calcareous earth enters very sparingly into the composition of this stone; but as it is found in school, which is frequently a component part of granite, it follows that it must be one of the primitive earths, as derived from the primeval ocean, as some have supposed. Quartz can never be supposed to be a product of fire; for

in a very low heat it bursts, cracks, and loses its transparency, and in the highest degree of heat that we can produce, is insubstantial, so that in every essential point it is different from the other parts of granite, which we have compared it. As granite contains calcareous masses, we may conclude, that all the simple earths are original. This, however, is no proof that they are in reality simple and uncompounded; or that they are simples, but they must be considered as such in the present state of our knowledge. Though water undoubtedly dates from creation, yet late experiments have shown it to be a compound, as was formerly stated.

Mountains which consist of limestone or marbles of a granular or scaly texture, and not disposed in strata, seem also to have preceded the creation of animals, for no organic traces are found in them. Some of those which consist of argillaceous stones, and some of the silicious, contain also no organic remains. These often consist of parallel strata of unequal thickness; and the lower are harder and less thick than the upper, and therefore seem to have been formed earlier than the upper.

Alluvial mountains are evidently of posterior formation, as they contain petrifactions and other vestiges of organic substances, and these are always stratiﬁed.

Mountains, as to structure, are entire, stratified, and confused. Entire mountains are formed of huge masses of stone, without any regular fissures, and are mostly homogeneous.

They consist chiefly of granite, sometimes quartz, schistus, felspar, sandstone, limestone, gypse, porphyry, or trap. Some in Sweden and Norway consist of iron ore.

The stratified mountains are those whose mass is regularly divided by joints or fissures; these are called horizontal, rising, or dipping. Homogeneous stratified mountains consist chiefly of stones of the argillaceous genus, or of the ﬁssile compound species of the silicious genus, as metallic rock; sometimes of limestone of a granular or scaly texture, in which vestiges of animal or vegetable life are preserved upon the argillaceous or silicious strata; sometimes the argilaceous are covered with masses of granite, sometimes of lava. These mountains, particularly those of Greece, metallic rock, and homogenous, are the chief seat of metallic ores. When covered with limestone, the ore is generally between the limestone and the argilaceous stones. These ores are in veins, not in strata. Petrifactions are found upon, but not in, these mountains.

Heterogeneous, or compound stratified mountains, consist of alternate strata of various species of stones, earths, sands, &c. The limestone here is always of the laminar, and not of the granular or scaly kind; and when it contains any ore, it is placed between its lamine. Stones of the silicious genus seldom form strata in these mountains, except laves; but the strata are frequently interrupted by silicious masses, as Jasper, porphyry, &c. Coal, bitumen, petrifactions, and organic impressions, are found in these mountains; also salts and calamine.

There are other mountains, which cannot properly be called stratified, as they consist of three immense masses, the lowest granite, the middle limestone, and the upper limestone. Metallic ores are found in
the argillaceous part, or between it and the limestone.

Confused mountains consist of stones heaped together without order, their interspaces filled with clay, sand, and nica. They scarcely ever contain any ore.

Besides these, there are many mountains in different parts of the world, which derive their origin from volcanoes; but of these it will be necessary to treat in a succeeding article.

The height of mountains is usually calculated by means of the barometer. For this purpose two columns of mercury, or barometers, are prepared, and one is kept at the foot of the mountain while the other is carried to its summit. The degree of heat, if not equal, is reduced by calculation to an equality, and for this purpose a thermometer is attached to each of the barometers. The degree of height to which both are reduced is 55°, if, however, either of the barometers stands at 30 inches, and the annexed thermometer at 55°, no reduction is to be made in the determination of the barometer; but if either of them is at 30°, and the thermometer below 55°, we must add the expansion of the mercury in the barometer which a temperature at the height of 35° should produce, to the expansion above 55°, and must abstract the degree of expansion which it gains by that heat. Every degree of Fahrenheit's scale produces an expansion of 0.0034 of the barometrical column; when the barometer is at 35°, and the thermometer at 11°, we must add the increment in the former, and subtract the latter case, eleven times that number from the barometrical height. In the same manner it may be calculated, whatever is the height of the barometer. When this matter is ascertained, the height is easily found by comparing the two barometers, and calculating the density of the air in the higher regions according to the principles of geometrical progression.

The highest mountains are those which are situated at or near the equator; and the Andes are generally allowed to be the highest of these. Catopoxi, one of the Andes, which rises above 15,000 feet, was discovered by a French academician, was found to be some miles above the level of the sea; whereas the highest point of the Alps is not above a mile and a half. Mount Caucasus approaches nearest to the height of the Andes, of any of the Asiatic mountains. The Peak of Teneriff, which has been so much celebrated, is about a mile and a half in height. It is an extraordinary circumstance, that the moon, which is a body so much smaller than our earth, should have been thought to exceed it in the irregularities of its surface; some of the mountains in that planet being formerly supposed to exceed nine miles in height: but Dr. Hertzel has proved that the highest of them is not equal to one mile.

The line of congelation, or of perpetual frost, on mountains, is calculated at 13,400 feet, at or near the equator; at the entrance of the temperate zone, or on the plains, and towards the pole, it is calculated at 8,000 to 10,000 feet; in the 41st degree, 10,000 feet; in the 52d, 7,540 feet. On the Andes, vegetation ceases at 14,697 feet; and on the Alps, at 9,958. The air is so dry in these elevated situations, that M. d'Arcet observed, that on the Pyrenees, salt tarfar remained dry for an hour and a half, though it immediately moistened in the same temperature at the bottom of the mountain.

Mounting, in military affairs, signifies going upon duty. Thus, mounting a breach, is running up to it; mounting the guard, is going upon guard; and mounting the trenches, is climbing over or into the trenches; but mounting a cannon, mount, &c. is the setting it on its carriage, or the raising its mouth.

MOUNTAIN. See ANATOMY.

MUCILAGE, a glutinous matter obtained from vegetables, transparent and tasteless, soluble in water, but not in spirit of wine. It chiefly consists of carbon, hydrogen, and a small quantity of oxygen. See GLUTEN.

MUCILAGINOUS GLANDS. See ANATOMY.

MUCOR, in botany, a genus of the order of fungi, in the cryptogamous class of plants. The fungus has vesicular heads supported by foot-tails. There are 17 British species; the most remarkable of which are: 1. The spherical, which is a common mould, growing upon rotten wood, and sometimes upon decayed plants and mosses. The stalks of this are generally black, about a line in height, bearing each at the top a spherical ball, about the size of a pin's head; its coat or rind is covered with a grey powder, and containing within a black or fuscous spongy down. The coat bursts with a ragged, irregular margin. 2. The lichenoides, or little, black, putrid-pus. This fungus grows in groups near to each other, in masses of the backs of old trees, and upon old park-pales. The stalks are black, about two or three lines in height, bearing each a single head, sometimes a double or treble one, of the size of mustard or poppy seeds, of a roundish figure at first, but when burst, often flatish or truncated, and of a black colour. The internal powdered down is black, with a tinge of red. 3. The annulatus, a common grey mould, grows on bread, fruits, plants, and other substances, in a putrid state. It grows in clusters; the stalks a quarter of an inch high, pellicid, hollow, and cylindrical; supported by the feathery stalk, at first transparent, afterwards dark-grey; which bursts with elastic force, and ejects small round seeds discoverable by the microscope. 4. The glaucus, or grey cluster-headed mould, is found on rotten apples, melons, and other fruits; as also upon decayed wood, and the stalks of wheat. These are of a pellicid grey colour; the stalks are generally single, supporting a spherical ball, which, when burst, sends forth a spongy powder, covered with numerous, fine, moniliform, necklace-like radii. 5. The crustaceus, or fingered mould, is frequent upon corrupted food of various kinds. It is of a white aequous colour; the stalks single, each supporting at the top four or five necklace-like radii, diverging from the same point or centre. 6. The septicus, or yellow frothy mould, is found on the leaves of plants, such as ivy and beech, &c. sometimes spreading externally upon the tan or bark in hot-houses. It is of no certain size or figure, but of a fine yellow colour, and a substance resembling at first cream beaten up into froth. In the space of 24 hours, it becomes grey-brown, because so dry, and full of a powdy adhering to downy threads. The seeds under the microscope appear to be globular. Haller ranks it under a new genus, which he terms fuligo; the characters of which are, that the plants contained under it are sot, and like butter at first, but soon change into a black sooty powder.

MUCOUS ACID. See SALICATIC ACID.

MUCOUS GLAND. See ANATOMY.

MUCUS, a fluid secreted by certain glands, and serving to lubricate many of the internal cavities of the body. In its natural state it is generally limpid and colourless; but from certain causes, will often assume a thick consistence and whitish colour like pus. As it is sometimes of very great importance in medicine to distinguish the two fluids from each other, this was lately proposed as the subject of a prize disputation by the Esculapian Society of Edinburgh. The prize was gained by Mr. Charles Darwin, student of medicine from Litchfield.

The conclusions drawn from his experiments were, 1. Pus and mucus are both soluble in the vitriolic acid, though in very different proportions, pus being by far least soluble. 2. If the putrid pus is exposed to the action of these compounds, it decomposes itself into a mucus thus separated, both in the mixture, or forms large floculi in it; whereas the pus falls to the bottom, and forms, on agitation, an uniform turbid mixture. 3. Pus is diffusible through a diluted vitriolic acid, though mucus is not. The same also occurs with water, or with a solution of sea-salt. 4. Nitric acid dissolves both pus and mucus. 5. This latter produces a precipitate, and the fluid above becomes clear and green, while water and the solution of mucus form a turbid dirty-coloured fluid. 6. Alkaline lixivium dissolves, though sometimes with difficulty, mucus, and generally pus. 6. Water precipitates pus from such a mixture, but does not mucus. 7. Where alkaline lixivium does not dissolve pus, it still distinguishes it from mucus, as it does not produce its different plant to the solution of pus. 8. Coagulable lymph is neither soluble in concentrated nor diluted vitriolic acid. 9. Water produces no change on a solution of serum in alkaline lixivium, until after long standing, and then only a slight sediment appears. 10. Corrosive sublimate coagulates mucus, but does not pus.

From the above experiments, it appears that strong sulphuric acid and water, diluted sulphuric acid, and caustic alkaline lixivium and water, will serve to distinguish pus from mucus; that the vitriolic acid can separate it from coagulable lymph, and alkaline lixivium from serum. Hence, when a person has any pain or matter, excreting from the sores of which he wishes to ascertain, let him dissolve it in vitriolic acid, and in caustic alkaline lixivium; and let him add pure water to both solutions. If there is a fair precipitation in each, he may be assured that some pus is present. But if there is a precipitation in neither, it is a certain test that the mixture is entirely mucus. If the matter cannot be made to dissolve in alkaline lixivium by time and weather, we have also reason to believe that it is pus.

MUCUS, NASAL: this name is given to a liquid which is secreted in the cavities of the nose, and is discharged outwardly, either by the nostrils in the form of drops, or in that of masses more or less thick; or by the faucets.
when it descends by the posterior part of the nasal cavities, in which it is thrown out by spitting. This liquid is separated from the blood by the arteries, and appears to be formed in particular crypts, which we find abundantly in the nasal cavities. It is also collected also from all the frontal sinuses. It is also mixed with the lachrymal juice, which descends by the channel which pases through the eye or oculus, and dilutes the thickened nasal mucus.

We must particularly consider both the abundance and the characters of this liquid in the catarh, improperly called catarh of the brain, in which the nasal mucus is separated in larger quantity, and remains a longer time in its ducts. "It is," says M. Forcroy, "especially under this circumstance, that citizen Vaquinel and myself have examined it, as we then procured it with great facility. We have also availed ourselves of the considerable discharge of mucus which is produced by the contact of the oxidated muriatic acid gas, in order to obtain a sufficient quantity of it for the experiments adapted to that end, and will acquiesce with its nature. It has several times happened to citizen Vaquinel, who is very sensible to the action of the oxidated muriatic acid gas, that he has collected by its effect of grammes of it in less than an hour. Any means of these circumstances we have been enabled to determine its nature in a considerably exact manner. It is known that this liquid is very abundant in children, that it is a little heavier, turns yellow, and adheres to most bodies, even the most punished.

The nasal mucus is at first liquid, clear and transparent, a little viscid and adhesive, without smell, of a salpy and acrid taste, which irritates the most delicate part of the skin; it is then really the phlegma vitium of the arteries. When exposed to the air and to the fire, it comport itself in the same manner as the tears, from which it differs only by the abundance of its praeuna, which is thicker, and frequently more coloured. It affords crystals of carbonate of soda, of soda in the state of carbonate, and of phosphates of lime and of soda; the last are much more abundant than the first, and are especially united with the yellow flowers green, by its sall: we also find in it, an animal matter which is not albuminous, but quickly becomes thick and concrete by the oxigen of the air and of the oxidated muriatic acid; it then acquires opacity, and a yellow or greenish colour, swells considerably, and becomes filled with bubbles by the action of fire, leaving but little residue upon the ignited coal. This animal matter, which is much abundant than the tears, appears to be of the same nature in both.

This liquid, being always exposed to the air, which continually passes through the nostrils, is continually thicker, more viscid, and more adhesive, than the tears; and the carbonate of soda which it contains, whilst the latter contains only soda, announces that the air departs it in a part of the carbonate of soda, and that it is reduced out of the lungs. Consequently, it then renders the solutions of bar, tellurium, and of lime, very sensibly united. In the nostrils, the heat of the plan, especially in catarh, and the air, which is necessarily a little thick, contribute also to thicken it. The mucus of the nasal humour, when it becomes thick in the air, frequently assumes in it the form of small, dry, bright, and, as it were, mucous plates. If it has dripped in very thin layers, it quickly resembles those bright and light marks which smuts leave behind it on any solid body whatever it may crawl. The nasal mucus experiences no real putrefaction in the air; we should almost be induced to say that it was unalterable and improuctible, when we see it remain without changing any bad smell, even in the midst of water, and at a considerably elevated temperature. However, this property of preservation does not extend so far as to communicate itself to other bodies that are immersed in it.

Water does not dissolve the mucus of the nose. It is known that this matter remains viscid in that fluid, and that it cannot be diluted in water without much difficulty, even without changing any bad smell, even in water, by the midst of mucus, and at a considerably elevated temperature. It is known that this insolubility is owing to the fixation of the oxygen. Neither has it the property of rendering oils miscible with water, nor of effecting their suspension by turbidation, as a separate and delicate liquid. It is on this account that when we wash, or even boil, this thick humour in water, the salts which it contains are dissolved and separated, without affecting the mucus which constitutes its base.

The acids thicken the nasal mucus when they are concentrated and employed in small proportions; but when we add a larger quantity, they redissolve and give it different shades of color. The sulphuric acid turns it purple, and renders it very liquid, forming however some flakes in it which sink to the bottom. The nitriue acid, when rather strong, dissolves it also into yellow colour. The muriatic acid is that which gives its solution the most easily and the most completely of all, giving it a violet-colour. The alkali, or earthy salts, do not cause it to undergo any alteration, nor do they dissolve it. The mucus of the nostrils being especially distinguished from all the other animal liquids by the viscid mucus which it contains in considerable abundance, it is evidently from the presence of this principle that we seek to use its function which it performs in the animal economy. Besides the kind of evacuation, sometimes very abundant, which it procures; and the proportion of the evacuated matter compared with that of the other excreta, it contains much of the other body, which it carries out of the body; this liquid maintains the softness of the membraneous sides of the nasal cavities, and prevents that dryness which the air gets in continual streams through these cavities tends to produce in them. It modifies the too great sensibility of the nervous pipe and which are spread out upon the effusive membrane; it stops and cures the odoruous blood, and their too great activity; it purifies the air that is inspired, by taking from it the putrefactive particles which it carries along with it, and which would be more injurious in the lungs. Being always contained in a lot, hot, and not pure, these circumstances which would so eminently promote putrefaction, protect nature has given it a property which opposes the scum which would have exposed man and the animals to a multitude of dangerous vitious and nuisances.

It is known that the mucus of the nostrils is used in preparing various medicines, in consuming various properties, in the most affections. It thickens, becomes yellow, orange-coloured, or greenish, frequently tinged with a very lively green cast by drying upon it; it can form places, the secretion of the presence of copper; and sometimes it exhibits a nauseous or least smell. In some affections it becomes so acrid that it seems to corrode the membrane of the nostrils, and produces evolutions round their orifices, as well as upon the upper lip. Lastly, it is sometimes liquid like water, at othersropy like oil: in several cases thick, viscid, and always transparent, like jelly; in other circumstances, congecent, and white, yellow, or green, like a perquisite humour. None of these changes have yet been chemically examined, and hardly even has the attention which they deserve been bestowed upon them.

MUFTI, or MUPPTI, the chief of the ecclesiastical order, or primatie, of the mamluk religion. The authority of the mufti is very great in the Ottoman empire; for even the sultan himself, if he would preserve any appearance of religion, cannot, without hearing his opinion, put any person to death, or so much as inflict any corporal punishment.

In all actions, especially criminal ones, his opinion is required by giving him a writing, in which the case is stated; the affected names, which he subscribes with the words, He shall, or shall not, be punished. Such outward power is paid to the mufti, that the grand seignior himself rises up to him; and advances seven steps to meet him, when he comes into his presence. The election of the mufti is solely in the grand seignior, who presents him with a vest of rich sables, &c. If he is convicted of treason, or any great fault, he is put into a house of correction for that purpose in the Seven Towers at Constantinople, and sound to death.

MUGGLETIONS, a religious sect, which arose in England about the year 1657; so denominated from their leader Lodowick Muggleton, a journeyman tailor, who, with his associate Reeves, asserted, that they were the two last witnesses of God that should appear before the end of the world.

MUGIL, mullet, a genus of fishes of the order Amonoidei. The generic character is, lips membranous; the hinder orca cutaneous within: teeth none; at the corner of the mouth an inflated callus; gill-membrane with six curved rays; body fleshy; scales large; dorsal fins two.

1. Mugil cephalus, common mullet. This fish, the most numerous of the ancient Romans, is a very common inhabitant of the Mediterranean and northern seas, frequenting chiefly the shallow parts near the shores, and feeding on the smaller kind of worms, and small fish. Its average length is from 12 to 16 inches, and the colour blueish-grey, darker on the back, and silvery on the abdomen; the sides are marked, like those of the grayling, with several dusky stripes, according to the rows of scales,
which are large and rounded; the fins are blueish; the dorsal fin, which is placed on the middle of the back, consists of four very strong rays; the second dorsal fin is placed opposite the anal, and has only soft rays; the base of the dorsal and anal fin, as well as the tail, is scaly, and the tail is forked or lunate.

The mullet is found not only in the European seas, but in the Indian and Atlantic oceans. It is observed to assemble frequently in small schools near the shore, to gorge itself with food, burrowing into the soft mud, and leaving the trace of its head in the form of a round hole.

In the spring and early summer months, this fish, like the salmon, ascends rivers to a considerable distance; and when preparing for these expeditions, is observed in schools near the surface of the water, at which time the fishermen endeavour to avail themselves of the opportunity of surrounding them with their nets, which the fish are said to show great address in escaping from.

The mullet is considered as an excellent fish for the table, though not a fashionable one on account of its small size. Bloch informs us, that it is generally eaten with the addition of oil and lemon-juice. The size is often prepared into an inferior kind of caviar, called botargo, by drying and salting it; in which manner also the fish itself, in plentiful seasons, is occasionally preserved. See Plate Nat. Hist. fig. 272.

2. Mugil crenilabis, crenated mullet. Size of the common mullet; length about twelve inches; colour greenish, but varies rather large, and marked by a dusky streak; upper lip gaping, lower incised within, and both lips crenulated on the edges; has glaucous, white, the pectoral marked at the base by a round black spot; tail forked: native of the Red Sea.

There are seven other species.

MUG-WORT, in botany. See ARTEMESIA.

MUHLEBERGIA, a genus of the class and order triandra dioica. Has two ovules; one, to each, lateral; corolla two-valved. There is one species, a grass of America.

MUÍD, a large measure in use among the French, for things dry; this vessel is no measure, but an estimation of several other measures, as the septier, minot, minot, busel, &c.

Muid is also one of the nine casks, or regular vessels, used in France, to put wine and other liquors in. The mud of wine is divided into two demi-muids, four quarter-muids, and eight half-quarter-muids, containing 30 septiers.

MUG-BERRY. See MORUS.

MULE, in zoology, a mongrel kind of quadruped, usually generated between an ass and a mare, and sometimes between a horse and a she-ass; but the signification of the word is commonly extended to every kind of animal produced by a mixture of two different species. There are two kinds of these animals: one from the he-ass and mare, the other from the horse and the she-ass. We call them indifferently mules, but must distinguish them by proper apppellations. The first kind are the best and most esteemed, as being larger, stronger, and having least of the ass in their disposition. The largest and stoutest asses, and the fairest and finest mares, are chosen in those countries where these creatures are most in use; as in Spain, Italy, and Flanders. In the last especially, they succeed in having very stately mules from the size of their mares, some of them ten and some hands high, which are used as the horses in the army. But since the Low-countries are no longer under the dominion of Spain, they breed fewer mules. These creatures are very much commended for their being stronger, surer-footed, going easier, being more cheaply maintained, and lasting longer, than horses. They are commonly of a black brown, or quite black, with that shining list along the back and cross the shoulders which distinguishes asses. In former times they were much more common in this country than at present, being often brought over in the days of popery by the Italian princes. They continued longest in the service of millers, and are yet in use among them in some places, on account of the great loads they carry on their back. As they are capable of being trained for riding, bearing burdens, and for draught, there is no doubt that they might be made serviceable in different services.

But they are commonly found to be vicious, stubborn, and obstinate to a proverb; which whether it occurs or is produced by the ill usage they meet with, is a point not easily settled. Whatever may be the case of these asses, it is allowed that mules are larger, fairer, and more serviceable, in mild than in warm climates. In the British American colonies, both on the continent and in the West Indies, they are much more used and esteemed; so that they are frequently sent to them from hence; suffer less in the passage, and die much seldomer, than horses; and commonly yield, when they arrive, no inconsiderable profit.

It has commonly been asserted, that animals produced by the mixture of two heterogenous species, are incapable of generating, and thus perpetuating the monstrous breed: but this, that the learned M. Buffon, is now discovered to be a mistake.

MULIES, among gardeners, denote a sort of vegetable monsters produced by putting the barley fecundans of one species of plant on the capsule of another. It is generally said, that the Romans practised a singular refinement in luxury, by first bringing the fish alive to the table in a glass vessel, in order that the guests might enjoy the pleasure of contemplating the beautiful and various characters of the fish, and the splendid colours during the time of its gradual expiration; after which it was prepared for their repast.

Mullus surmuletus, striped mullet, of similar size and general appearance with the preceding, but marked on each side by two and sometimes three longitudinal yellow stripes: native of the Mediterranean, but found occasionally in the Atlantic and other seas; usually on the smaller fishes, worms, the Romans practised a singular refinement in luxury, by first bringing the fish alive to the table in a glass vessel, in order that the guests might enjoy the pleasure of contemplating the beautiful and various characters of the fish, and the splendid colours during the time of its gradual expiration; after which it was prepared for their repast.

Mullus indicus, Indian mullet. Size and habit of the common or red mullet; colour extremely beautiful in the living fish, but fading very soon after death; upper part of the head and back dark changeable purple, growing faint on the sides, which are marked by a few longitudinal azure and golden bands, and by other occasion the fish being turned on each side; the first situated about the middle of the body, smallish, and of an opaline or changeable golden and white colour; the second situated near the tail, larger; and of a dark purple; abdomen white; dorsal fin
purple, streaked with light blue; pectoral and anal pink-colour: native of the Indian seas: observed by Dr. Russel near Vigapata:- inferior as a food to the red mullet, and not much esteemed.

4. Mullus barbatus, inhabits the European, Mediterranean, and Pacific seas: body, when deprived of its scales, red. Nothing can be more beautiful than the colours of this fish, when in the act of dying; and nothing more delicious than its flesh. The Romans held it in such repute, that prodigious sums were given for them: they were frequently bought at their weight in pure silver. See Plate Nat. Hist. fig. 273. There are two other species.

MULTIPLIER, in geometry, is applied to those figures which have more than four sides or angles, more usually called polygons.

MULTINOMIAL, or Multinomial Roots, in mathematics, such roots as are composed of many names, parts, or members: as, \( a + b + d + c \), &c. See Root.

MULTIPLE, in Arithmetic, a number which comprehends some other several times, thus \( a \) is a multiple of \( 2 \).

MULTIPLE RATIO, or Proportion, is that which is between multiples. If the less term of the ratio is an aliquot part of the greater, the ratio of the greater to the less is called multiple, and, that of the less to the greater, submultiple. A submultiple number is that contained in the multiple; thus, the numbers 1, 2, and 3, are submultiples of 9. Dupile, triple, &c. ratio, as also submultiples, submultiples, &c. are so many species of multiple and submultiple ratio. See Ratio.

MULTIPLICATION. See Arithmetic, and Algebra.

MULTIPLYING GLASS. See Optics.

MUM, a kind of malt liquor, much drunk in Germany, and chiefly brought from Brunswick, which is the place of most note for making it.

MUMMY. See Embalming.

MUNCHausia, a genus of the class and order Polyplacodida Polyplacida. The ca-
yx is six-rayed; claws; staminia in six bade; pistil superior. There is one species, a tree of Java.

MUNICIPAL, in the Roman civil law, an appellation which signified invested with the rights and privileges of Roman citizens. Thus the municipal cities were those whose inhabitants were capable of enjoying civil offices in the city of Rome.

Munipal, among us, is applied to the laws that obtain in any particular city or province; and those are called municipal officers who are elected to defend the interest of cities, to maintain their rights and privileges, and to preserve order and harmony among the citi-
gens; such as mayors, sheriffs, &c.

MUNTINGIA, a genus of the class and order Polytropia monogyne. The calyx is five-parted; corola five-petalled; berry five-
ecled; seeds many. There is one species, a shrub of Mexico.

MURENA, a genus of fishes of the order Apodai. The generic character is, body oval-shaped; pectoral fins none; spiracle on each side the neck.

1. Murana, Roman murena. This fish, the celebrated favourite of the ancient Romans, who considered it as one of the most luxurious articles of the table, is found in considerable plenty about several of the Mediterranean coasts, where it arrives at a size at least equal, if not superior, to that of an eel. It is of a dusky greenish-brown, rather thickly variegated on all parts with dull-yellow subangular marks or patches, which are disposed in a somewhat different manner in different individuals, and are generally scattered over with smaller speck-
lings of brown, the whole forming a kind of obscurely reticular pattern. The murena is capable of living with equal facility both in fresh and salt water, though principally found at sea. In its manners, it much resembles the eel and the conger, being extremely voc-
acious, and preying on a variety of smaller animals. The ancients, who kept it in reservoirs appropriated for the purpose, are said to have sometimes tamed it to such a degree as to come at the signal of its master in order to receive its food. Pliny records a most disgusting and barbarous instance of tyranny practised by one Vedius Pollio, who was in the habit of causing his offending slaves to be thrown into the sea in which he killed his murena: expressing a savage delight in thus being able to taste in an improved state their altered remains. The emperor Augustus, according to Seneca, honoured this man with his presence at one of his entertain-
ments; when a slave happening to break a valuable chrysal vase, was immediately or-
dered to be thrown to the murena; but the poor boy, lying to the feet of Augustus, re-
qusted rather the death than that he should be made the food of fishes. The emperor,
being informed of this extraordinary mode of punishment, immediately ordered all the chrysal vessels in the house to be broken before his face, and the ponds of the barba-
rous owner to be completely filled up; at the same time giving the slave his freedom, but sparing the life of the offender in considera-
tion of former friendship. See Plate Nat. Hist. fig. 276.

2. Murena obis, spotted murena. Observed by Forskål; native of the Red Sea; has a rising callus between the eyes, gold-
colouraid rings, upper lip shorter than the lower, and the dorsal and anal fins united at the tail. See Plate Nat. Hist. fig. 277.

3. Mureana catenata, chain-striped mu-
rena. This species, of which the individuals hitherto described appear to be of the size of a smallish eel, is of a brown colour, crossed by large chalikide white bands, somewhat irregular in their form on different parts of the animal, and marked by numerous brown spots and freckles. This fish is a native of Surinam.

4. Murena reticulata, reticulated murena. In size and general form, this resembles the preceding species, but differs in colours and in the disposition of the dorsal fin, which commences immediately at the back of the head, and is continued round the tail, where it unites with the vent-fin. Native of the Indian seas.

5. Murena conger, conger eel; inhabits the European seas and rivers; is extremely voracious, feeding on other fish, crabs in their soft state, and particularly crabses. It grows to a vast size. See Plate Nat. Hist. fig. 274. There are four other species.

MURDER, or Murther. See Homi-
cide.

MUREX, in natural history, a genus of univalve or simple shells, without any hinge, formed of a single piece, and beset with tub-
bercles or spines. The mouth is large and oblong, and has an expanded lip, and the clavicle is rough.

The clavicle of the murex is in some spec-
ies elevated, in others depressed; and the mouth is sometimes dentated, and at others smooth; the lip also in some is digitated, in others elated, and in some laciniated; and the columella is in some smooth, in others rugose.

Murex, in zoology, a genus of insects be-
longing to the order of Verses testacea. This animal is of the snail kind: the shell consists of one spiral valve, rough, with men-
braunaneous furrows; and the aperture termi-
nates in an entire canal, either straight, or somewhat ascending. There are 60 species, particularly distinguished by peculiarities in their shells, &c. See Plate Nat. Hist. figs. 277, 278.

In the accounts of a Spanish philosopher it is mentioned, that on the coasts of Guayquil and Guatimala, in the month of July it is also
found. The shell which contains it adheres to the rocks that are washed by the sea. It is of the size of a large walnut. The liquor may be extracted two ways: some kill the animal after they have driven it out of the shell, then press it with a knife from head to tail, separate from the body the part where the liquor is collected, and throw away the rest. When this operation, after being repeated on several snails, has afforded a cer-
tain quantity of fluid, the thread intended to be dyed is dipped in it, and the process is finished. The colour, which is at first of the whiteness of milk, becomes afterwards green, and is not purple till the thread is dry. Those who disapprove of this method draw the fibre partly out of the shell, and, squeezing it, make it yield a fluid which serves for dyeing: they repeat this operation four times at differ-
ent intervals, but always with the same success. If they continue it, the fish dies. No colour at present known, says the Abbé Raynal, can be compared to this, either as to lustre, live-
feness, or duration. It succeeds better on cold than on hot.

MURIAT, green sand of Peru. This ore, which was brought from Peru by Don-
beay, is a grass-green powder, mixed with grans of quartz. When thrown on burning coals, it communicates a green colour to the flame. It is soluble both in nitric and mu-
ricic acids without effervescence. The so-
lution is green. This mineral was first proved to contain mucric acid by Berthollet. Af-
terward Proust analyzed it. But Vaunquen announced that he considered it merely as an oxide of copper mixed with common salt. However, a subsequent examination con-
vinced him that his opinion was unfounded; and that the mineral was really a carbonat, as had been affirmed by Berthollet and Proust. This conclusion has been confirmed by Klappow, who found the green sand of Peru composed of

7.3 per cent of copper
10.1 mucric acid
16.9 water.

100.0
MURRIN, or GARGLE, a contagious disease among cattle, principally caused by a hot dry season, or rather by a general perturbation of the air, which beget inflammation of the blood, and a swelling in the throat, that soon proves mortal, and is communicated from one to another, though it generally does not farther than to those of the same kind.

The symptoms of this disease are, a hanging down and swelling of the head, abundance of gum in the eyes, rattling in the throat, a short breath, palpitation of the heart, a lingering, a hot breath, and a shining tongue.

MURRAYA, a genus of the class and order decidua Montgomery. The calyx is five-parted; corolla bell-shaped, with a nec- tum encircling the germ; berry one-seeded. There is one species, a tree of the East Indies.

MUS, the rat, a genus of quadrupeds of the order glires. The generic character is, upper-front-teeth wedge-shaped; grinders on each side three, sometimes only two; clavicles or collar-bones in the skeleton.

This numerous tribe constitutes a formid-able phalanx against which man is not unacquainted.

1. Muriatic acid is an invisible elastic fluid, resembling common air in its mechanical properties. Its specific gravity, according to the experiments of Mr. Kirwan, is 0.00315, or nearly double that of common air. It is not in contact with common air, it forms with it a visible white smoke. If a bottle of it is drawn into the mouth, it is found to be excessively acid; much more so than vinegar.

2. Animals are incapable of breathing it, and when plunged into jars filled with it, they die instantaneously in convulsions. Neither will any combustible burn in it. It is remarkable, however, that a considerable effect upon the flame of combustible bodies; for if a burning taper is plunged into it, the flame, just before it goes out, may be observed to assume a green colour, and the moment that appears next time the taper is lighted.

3. A little water is let up into a jar filled with this gas, the whole gas disappears in an instant, the mercury ascends, fills the jar, and pushes the water to the very top. The reason of this is, that there exists a strong affinity between muriatic acid gas and water; and, whenever they come in contact, they combine and form a liquid, or, which is the same thing, the water absorbs the gas. Hence the necessity of making experiments with this gas over mercury.

4. In the water cistern not a particle of gas would be procured. Nay, the water of the trough would rush to the retort and fill it completely. It is this affinity between the gaseous gas and water which occasions the white smoke that appears when the gas is mixed with common air. It absorbs the vapour of water which always exists in common air. The solution of muriatic acid gas in such uncertainly denominated simply muriatic acid by chemists.

5. Muriatic acid gas is capable of combining with oxygen. To obtain the combination, we have only to put a quantity of the black oxide of manganese in powder into a retort, and pour over it liquid muriatic acid. Heat is then to be applied to the mixture, and the acid of the retort plunged under water. An effervescence takes place, and a green-coloured gas comes out at the bottom of the retort, which may be received in the usual manner in jars. This gas has been ascertained to be a compound of muriatic acid and oxygen. It is called muriatic acid, and will come under our consideration hereafter.

6. It does not appear from any experiments that have been hitherto made, that any of the simple combustibles are capable of combining with muriatic acid gas. Dr. Priestley found, that sulphur absorbed slowly about the fifth part of it. What remained was inflammable air, burning with a blue flame, and not absorbed by water. He found, however, that phosphorus smoke absorbed a sensible quantity of it, and that charcoal absorbed it very fast. Hydrogen gas does not produce any sensible change in it. Neither does it seem capable of being affected by azotic gases.

Muriatic acid is capable of combining with two doses of oxygen only. With the first dose, it forms oxymuriatic acid; with the second, hyperoxymuriatic acid. The first of these, fumes of it, is called hydrochloric gas, to be termed an oxide rather than an acid.

MURIATS. The muriats are a genus of salts which have been long known, and from which indeed the whole of the class have borrowed their name; for to them belongs com- mon salt, the most important and the most indispensably necessary of all the salts. They may be distinguished by the following properties:

When heated, they melt, and are volatil- ized, at least in part, without undergoing de-composition. Of these parts, the portions which fly off contain an excess of acid.

Not in the least altered by combustibles, even when assisted by heat. Soluble in water. For the most part they raise the boiling-point of water.

Effervesce with sulphuric acid, and white acid fumes of muriatic acid are disengaged. When mixed with nitric acid, they exhale the odour of oxymuriatic acid.
1. Mus zibethicus, musk rat. In the Memoirs of the French Academy of Sciences for the year 1725, there is a complete and excellent description of this animal by Mons. Sarrazin, at that time king’s physician at Quebec. From the above description it appears that the count de Buffon has drawn upon the major part of his own account, and indeed it does not appear possible to add any new material to what Mons. Sarrazin has delivered. This animal is of the size of a small rabbit, and is extremely common in Canada. Its head is short, like that of a water-rat; the eyes large; the ears very short, rounded, and covered externally as well as internally with hair. It has, like the rest of this tribe, four very strong cutting teeth, of which those in the lower jaw are near an inch long; those in the upper somewhat shorter: the fur on the whole body is soft and glossy, and beneath is a fine fur, or thick down, as in the beaver; the toes on all the feet are simple, or without membranes, and are covered with hair; the tail is nearly as long as the body, and is of the same form with that of the sorenus muschatus, being laterally compressed; it is nearly naked, into which are inclosed with small scales intermixed with scattered hairs. The general colour of the animal is a reddish brown; of the tail ash-colour. In its general appearance, this animal so greatly resembles the beaver, except in size, and in the form of its tail. It has also similar instincts and dispositions; living in a social state in the winter, in curiously-constructed huts or cabins, built mostly of sticks, and covered with mud or lake or river. These huts are about two feet in height, and nearly three feet in diameter, plastered with great neatness on the inside, and covered externally with a kind of basket-work, of rushes, &c. interlaced together, so as to form a compact and secure guard, impervious by water. During the winter these receptacles are generally covered by several feet of snow, and the animals reside in them without being incommoded by it; several families commonly inhabiting each cabin. It is added that the outer shells of these receptacles are furnished with a series of steps, to prevent them from being injured by inundations. These animals do not lay up a store of grain like the beaver, but form subterraneous passages beneath the ground, round their cabins, to give themselves an opportunity of procuring occasional supplies of roots, herbage, &c. According to Mons. Sarrazin, the animal is particularly calculated by nature for its subterraneous habits, having a great muscular force in its skin, which enables it to contract its body occasionally into a small volume; it has also a great supple- ness in the false ribs, which easily admit of contraction, so that it is enabled to pass through holes impervious to much smaller animals than itself. During the summer these creatures wander about in pairs, feeding voraciously on herbs and roots. Their odour, which resembles that of musk, is so strong as to be perceived at a considerable distance; and the skin, when taken from the body, still retains the peculiar odour. This odour is owing to a whitish fluid deposited in certain globules situated near the origin of the tail. It has been supposed that the calamus aromaticus, or sweet flag (acorus calamus, Lin.), which these animals select as a favourite food, may contribute to their fragrant smell. They walk and run in an awkward manner, like the beaver, and their movements are so readily as that animal, their feet being furnished with webs. Their voice is said to resemble a groan. The females produce their young towards the beginning of summer, and have five or six at a birth; they are also, if taken early, are easily tamed, and become very active and playful; and it is remarkable that the tail, which in the full-grown animal is as long as the body, is at that period very short.

The fur of this species is greatly esteemed as a commercial article, resembling that of the beaver. Linnaeus, in the twelfth edition of the Systema Naturae, ranked the animal under the genus castor; and Mr. Pennant has followed his example. Mr. Schreber, however, considers it as belonging to the proper genus. See Plate Nat. Hist. fig. 279.

2. Mus decumanus, Norway rat. This domestic species, which is now become the common rat of our own island, and is popularly known by the name of the Norway rat, is supposed to be a native of India and Persia, from which countries it has been imported into England; it seems to have made a natural conquest over the black rat, which is now become rare in comparison. The brown rat is larger than the black rat, measuring nine inches from the nose to the tail, which is of the same length, and marked on the back into about 200 rings or circular spaces; the colour of the animal is a pale tawny-grey, whitish beneath; the feet have four toes, with a claw in place of a fifth. It is a bold animal, and possesses great havoc in granaries, &c. Sometimes it takes up its residence in the banks of waters, and swims occasionally with almost as much facility as the water rat, or mus amphibius. In its general manner of life it appears to agree with the black rat; and not only devours grain and fruits, but preys on poultry, rabbits, and various other animals. It is a very prolific species, and produces from ten to twelve or fourteen, of a size and shape similar to the brown rat, in the course of a single year. When closely pursued, it will sometimes turn upon its adversary, and bite with great severity. It seems to have made its first appearance in England about seventy years ago, and is still much less frequent in France and some other parts of the Continent than the black rat.

3. Mus ratus, black rat. This species, like the former, though now so common in most parts of Europe, is supposed to have been originally introduced from India and Persia. Its general length from nose to tail is seven inches, and of the tail eight inches; the colour of the head and whole upper part of the body is a dark blackish grey; the belly is of a dull ash-colour; the legs are dusky, and very slightly covered with hair; the fore feet, as in the brown rat, have only four toes, with a small claw in place of a fifth; the tail is nearly naked, coated with a scaly skin, and marked into numerous divisions or rings. Like the former species, this animal breeds freely, and commonly breeds about six or seven young at a time. Sometimes they are enabled to overstock the place of their abode, in which case they fight and devour each other. It is said that this is the reason why these animals, after being extremely troublesome, sometimes disappear suddenly. Various are the methods made use of for the expulsion of rats from the places they frequent; among which none is more regular than to employ a skilful animal, who tells us he had been informed that if a rat is caught and a bell tied round its neck, and then set at liberty, it will drive away the rest wherever it goes. This expedient appears to be occasionally practised in modern times with success. A gentleman travelling through Mecklenburgh, about 30 years ago, was witness to the following curious circumstance in the post-house in New Curzon. After dinner, the landlord placed on the floor a large dish of soup, and gave a loud whistle. Immediately there came into the room a manitou, a fine Angora cat, an old raven, and a remarkably large rat, with a bell about its neck. The four animals went to the cat, and without disturbing each other, fed together; after which the dog, cat, and rat, lay before the fire, while the raven hopped about the room.

The landlord, after accounting for the familiarity which existed among the animals, informed his guest that the rat was the most useful of the four, for the noise he made had completely freed the house from the rats and mice with which it was before infested.

4. Mus musculus, common mouse. The mouse and aperea are so universally known, that it seems almost unnecessary to particularise it by a formal description. It is a general inhabitant of almost every part of the Old Continent, but is doubtless originally a native of America, though now so abundantly common in many parts of the New World, as well as in many of its scattered islands. The mouse, though wild and extremely timid, is not of a ferocious disposition, but may be easily tamed, and so after it has been taken, will begin to feed without fear, in the immediate presence of its captors. The white variety is frequently kept in a tame state, and receives an additional beauty from the bright red colour of its eyes; a particularity which generally accompanies the white varieties, not only of this tribe, but of many other quadrupeds.

The mouse is a prolific animal: the experiment of Aristotle is well known, and often repeated. A pregnant mouse in a vessel of grain, and after having been found in it no less than the number of 120, all of which, he concluded, were the descendants of the mouse he had inclosed.

The fur of the mouse is remarkably soft and elegant, and the structure of the hair in this animal, as well as in the rat, and probably in many others of this genus, is singularly curious; each hair, when microscopically examined, appearing internally divided into a kind of transverse partitions, as if by the continuation of a spiral structure; a structure very different from that of the hair of most other animals, and of which the particular nature seems not very distinctly understood.

Dorchain, in his Physio-theology, conceives that this mode of formation of spiral fibre may serve for the "gentle evacuation of some humour out of the body;" and adds, that this perhaps the hair serves as well for the conveyance of the blood of hairy animals as to fence against cold and wet. Whatever it be, is the real nature or use of the above structure, its appearance cannot fail to excite astonishment in those who take the pains of examining
...ing it with a good microscope, by which they will obtain a clear idea of this curious appearance.

In Aldrovandus, who relates the circumstance from Gesner, we meet with a direction for changing as it were, a mouse into a cat, by making it the incessant persecutor and enemy of the rest of its species. This is to be effected by placing several mice together in a vessel without food, when, after a certain time, they will be so stimulated by hunger as to destroy each other: the surviving animal being then liberated, will, according to this author, become the most destructive enemy of his own tribe, and will kill every one he meets. Another singular and most cruel experiment is quoted by Aldrovandus from Mizzadas, who tells us, that if two or three mice are shut up in an earthen pot, and placed over a fire, the shrill cries which they utter will attract the mice in the other parts of the house, and cause them to precipitate themselves into the fire. Whatever there may be in this experiment, it is certain that, on the shrill cry of distress uttered by one of these animals kept with several others in a cage, the rest will frequently utter the same cries.

5. Mus Sylvaticus, wood mouse. This animal chiefly frequents dry and elevated grounds, and is found in woods and fields in great plenty. It appears to be common in all the temperate parts of Europe, and even in Russia. It sometimes varies in size, individuals being occasionally met with which exceed the rest in magnitude, though differing in no other respect. Its general length is about four and a half feet from the tail, and the tail, which is slightly covered with hair, measures four inches. The colour of the animal is a yellowish brown above and whitish beneath; the colours being pretty distinctly marked or separated; the eyes are full and black, and the snout rather blunt. These animals retire into holes among bushes, wood, and under the trunks of trees, where they amass great quantities of acorns, nuts, and herbage. When the wheat is sown, a whole bushel has sometimes been found in a single hole. These holes are about a foot or more under ground, and are often divided into two apartments; the one for living in alone with a provision, and the other for the management of provisions. Considerable damage is often done to plantations by these animals, which carry off new-sown acorns, &c. The count de Buffon affirms, that in France more mischief is done by these creatures than by all the birds and other animals put together; and adds, that the only way to prevent this is by laying traps, at ten paces amongst the general extent of the sown ground. No other apparatus, he says, is necessary than a roasted walnut, placed under a stone supported by a stick; the animals come to eat the walnut, which they prefer to acorns; and as the walnut is fixed to the stick, whenever they touch it, the stone falls and kills them. The same expedient may be as successfully used for the destruction of the short-tailed field mouse, which likewise commits great havoc in fields and meadows. The first person who first practised this experiment, he desired that all the field mice thus taken in traps might be brought to him, and found with astonishment, that above 100 were taken each day from a piece of ground consisting only of about 40 of our acres. From the 13th of October, 1769, above 9000 were destroyed in this manner. When the frost becomes severe, they retire into their holes, and feed on the stores they have collected. They abound, like many other small animals, in summer, and are far less common in the spring. For it is possible they fall ill in the winter, it is thought that they destroy each other: a circumstance which is known occasionally to occur in mice, in places frequented by species of these animals.

The long-tailed field mouse is a very prolific animal, breeding more than once a year, and often producing litters of ten at a time. In one of their holes have been found two females, with 20 young. Specimens have sometimes been seen perfectly white, with red eyes.

6. Mus musculus, harvest mouse. This small species seems to have escaped the notice of British naturalists till it was observed by the late Mr. Gilbert White, of Selborne in Hampshire, in which county it is frequent. Mr. White, in the year 1767, communicated the animal to Mr. Pennant, who introduced it into the British Zoology.

"These mice," says Mr. White, "are much smaller and more slender than the mus domesticus medius of Ray, and have none of the squirrel or dormouse colour; their belly is white; a straight line along their sides divides the shades of their back and belly. They never enter into houses, are carried in racks and barns with the sheaves, and are abundant in harvest, and build their nest amidst the straw of corn above ground, and sometimes in thistles. They breed as many as eight at a litter, in a little round nest composed of the blades of grass or wheat. One of these nests was procured in the autumn of 1767, most artificially platted, and composed of the blades of wheat, perfectly round, and about the size of a cricket-ball, with the aperture at one side, in which there was not a discovery to what part it belonged. It was so compact and well filled, that it would roll across the table without being decomposed, though it contained eight little mice that were dead and blind; and when this nest was perfectly full, how could the dam come at her litter respectively, so as to administer a teat to each? Perhaps she opens different places for that purpose, adjusting them again when the business is over; but she could not possibly be contained herself in the hall with her young, which moreover would be daily increasing in bulk. This wonderful precauent cradle, an elegant instance of the effect of instinct, was found in a wheat-field, suspended in the head of a thistle.

Mr. White adds, that "though these animals hang their nests for breeding up amidst the straws of standing corn, above ground, yet in the winter they burrow deep in the earth, and make warm beds of grass; but their grand rendezvous seems to be in corn-ricks, into which they are carried in harvest." A neighbour of Mr. White's housed an oat-rick, in which were some hundred and eighty mice concealed under the thatch. The measure of the animal is just two inches and a quarter from nose to tail, and the tail is just two inches long. 'Two of them in a scale just weighed down a copper halfpenny, which was out the third of an ounce avoidipos'; so that they may be considered as the smallest of the British quadrupeds.

7. Mus minutus, house mouse. This species, according to Dr. Pallas, is frequent in the birch-woods of Siberia, as well as in many of the temperate parts of Russia, frequenting corn-fields and barns. Its general colour is a deep fawn above and white below; the nose is sharpish and of a dusky color, with a whiteness at the corners of the mouth; the ears are laid in the fur; the feet grey; the length from nose to tail is little more than two inches, and the weight about half a dram. Those found in Siberia are of a richer or more fulvous colour than those of other regions. This animal, Dr. Pallas says, is very frequent in autumn and winter in barns and about granaries, and is often found intermixed with the mus agrarius, inhabiting similar places. It seems extremely nearly allied to the harvest mouse, and it is not impossible that it may in reality be the same animal, the other species appearing almost too slight for a specific distinction.

8. Mus ambulatorius, water rat. The water rat is a general inhabitant of the temperate, and even the colder, parts of Europe and Asia, and occurs also in North America, frequenting rivers and stagnant waters, and forming its burrows in the banks. It is of a thicker and shorter form than many others of this genus, and has somewhat of the shape of a beetle. Mr. Ray, a beaver of the country of Wiltshire, describes it as having the fore-feet webbed; and Linnaeus, in his Systema Naturae, characterizes it from that very circumstance, but acknowledges that he had not himself examined the animal. In reality, however, there is no such appearance in the feet of the water rat, and the notion seems to have been hastily adopted from observing the small fish with which it swims and dives. The general length of the water rat is about seven inches, and the tail about five. Its colour is blackish-ferruginous above, and deep cinereous beneath; the nose is thick and blunt, and nearly as long as the eye. The ears rounded and held in the fur. In colour it appears to be a different species, being sometimes nearly black, and sometimes paler than usual. It also varies as to size, and the varieties have been considered as distinct species. This animal never frequents houses, but confines itself to the banks of waters, and is supposed to live on fish, frogs, &c. and probably on various roots and other vegetable substances. Dr. Pallas, however, is unwilling to admit that it preys at all upon fish, though reported so to do by the count de Buffon and others. At some seasons of the year it is observed to have a musky scent. The female produces her young, which are born in April, and generally brings about five or six at a time. The measure of this species, as given by Mr. Schreber, are as follow, viz. from nose to tail six inches and a half, and of the tail three inches.

9. Mus Lemmus, lemming rat. The wonderful migrations of these species have long rendered it celebrated in the annals of natural history. It is remarkable, however, that no accurate figure of it was published till Dr. Pallas caused it to be engraved in his excellent work on the Gites. The first description of the lemming seems to have been Olaus Magnus, from whom...
several of the other naturalists have copied their accounts. Afterwards Woransus gave a  
more particular description; and, indeed, as Leach, in his Natural History of  
Transquana, in the Acts Holmienesis, and Dr. Pallas, in his publication before  
mentioned, have still further elucidated its history and manners. See Plate Nat. Hist. fig. 280.

The lemming differs in size and colour according to the regions it inhabits: those  
which are found in Norway being almost as large as a water rat, while those of Lapland and Siberia are scarce larger than a field mouse; the Norwegian inhabiting more than five inches from nose to tail, while those of Lapland and Siberia scarce exceed three.

The colour of the Norwegian kind is an elegant variegation of black and tawny on the upper parts, disposed in patches and clouded markings; the sides of the head and the under parts of the body being white, the legs and tail greyish. In the Lapland kind the colour is chiefly a tawny brown above, with some indistinct dusky variegations, and the cheeks and ears of a dull white; the claws are also smaller than in the Norwegian animal. The head of the lemming is large, short, thick, and well furred: the snout very obtuse; the ears very small, set in the fur; the eyes small; the neck short and broad; the body thick; and the limbs short and stout, especially the fore legs; the fore-feet are broad, furnished with five toes, which have strong, crooked claws, and the hind feet, to which belong two dull white claws, of which the middle three are longer than the rest; on the hind-feet are also five toes, with smaller claws than those of the fore-feet; the tail is very short, thick, cylindrical, obtuse, and covered with strong hairs, disposed like those of a pencil at the tip.

The natural or general residence of the lemming is in the Alpine or mountainous parts of Lapland and Norway, from which tracts, at particular but uncertain periods, it descends into the plains below in immense troops, and by its incredible numbers becomes a temporary scourge to the country, devouring the grain and herbage, and causing great loss, equal to those caused by an army of locusts. These migrations of the lemming seldom happen oftener than once in ten years, and in some districts still less frequently. They are supposed to arise from an unusual multiplication of the animals in the mountainous parts they inhabit, together with a defect of food; and, perhaps, a kind of instinctive prescience of untoward seasons, for it has been observed that their migrations are made in the autumn of such years as are followed by a very severe winter. The inclination or instinctive faculty which induces them, with one consent, to assemble from a wide region, elect themselves into an army, and descend from the mountains into the neighbouring plains, in the form of a firm phalanx, moving on in a straight line, resolutely surmounting every obstacle, and undismayed by every danger, cannot be contemplated without astonishment. All who have written on the subject agree that they proceed in a direct course, so that the ground along which they have passed appears at a distance as if it had been ploughed; their tails deviated to the very roots, in numerous stripes, or parallel paths, of one or two spans broad, and at the distance of some ells from each other. This army of mice moves hastily by night, or early in the morning, devouring the herbage as they pass, in such a manner that the surface appears as if beaten smooth; and hence it happens in their way have any effect in altering their route; neither fires, nor deep ravines, nor torrents, nor marshes or lakes; they proceed obstinately in a straight line; and if they meet with meadows or marshes, or even perish in the waters, and are found dead by the shores. If a rick of hay or corn occurs in their passage, they eat through it; but if rocks intervene which they cannot pass, they go around, and then resume their former straight direction. If disturbed or pursued while swimming over a lake, and their phalanx separated by oars or poles, they will not recede, but keep swimming directly on, and soon get into regular order again; and have even been sometimes known to endeavour to board or pass over a vessel. On their passage over land, if attacked by men, they will raise themselves up, uttering a kind of barking sound, and, with their fore-feet, or by ramming their heads, and will fasten so fiercely at the end of a stick, as to suffer themselves to be swung about before they will quit their hold; and are with great difficulty put to flight. It is said that sometimes whole regiments have placed in these armies during their migrations, and that the animals thus destroy each other.

In their general manner of life they are not observed to be of a social disposition, but to reside in a kind of scattered manner, in holes beneath the surface, without laying up any regular provision, like some other animals of this tribe. They are supposed to have bred several times in the year, and to a number of five or six at once. It has been observed that the females have sometimes brought forth during their migrations, and have been carrying their young in their mouths, and others on their backs. They are found on the plains of Lapland they are eaten, and are said to resemble squirrels in taste.

It was once believed that these animals fell from the clouds at particular seasons, and some have affirmed that they have seen a lemming in its descent; but an accident of this kind is easily accounted for, on the supposition of a lemming escaping now and then from the claws of some bird which had seized it, and thus falling to the ground; a circumstance which is not very unlikely to take place when the animals are seized by crows, gulls, &c.

10. Mus economicus, economic rat. The economic rat, so named from its provident disposition, and the skill with which it collects its provisions, is a native of Siberia, inhabiting that country in vast abundance, and even extending as far as Kamtschatka. Its curious history has been given with great exactness by Dr. Pallas; he informs us that these little animals construct their burrows with wonderful skill, immediately below the surface, in soft turfy soils; forming a chamber, of a flatish arched form, of a small height, and about a foot in diameter, to which they sometimes add as many as thirty small pipes or entrances, and in them they frequent other caverns, in which they deposit their winter stores; these are said to consist of various kinds of plants, even of some species which are poisonous to man and kind. They gather together in the summer, forage, and live like herds; but when the time arrives, and they sometimes bring them out of their cells in order to give them a more thorough drying in the sun. The chief labour rests on the females; the males during the summer wandering about in a solitary state, inhabiting some old nests occasionally, and living during that period on berries, without touching the hoards, which are reserved for winter, when the male and female reside together in the same nest. They are said to breed several times in the year, the female producing two or three young at a time.

The migrations of this little species are not less extraordinary than those of the lemming, and take place at uncertain periods. Dr. Pallas imagines that the migrations of those inhabitants of Kamtschatka, so frequently observed, arise from some sensations of internal fire in that volcanic country, or from a prescience of some unusual and bad season. Whatever is the cause, the fact is certain. At such periods they gather together, during the season, in surprising numbers, except the few that reside about villages, where they can pick up some subsistence; and this makes it probable that their migrations, like those of the lemming, are rather owing to want of food. The mighty host proceeds in a direct course westward, occasionally swimming with the utmost intrepidity over rivers, lakes, and even arms of the sea. During these perilous adventures, some are drowned, and others destroyed by water-fowl, fish, &c.; those which escape rest a while to bask, dry their fur, and refresh themselves, and then again set out on their migration. It is said that the miners have often seen them in the mines, where they happen to find them in this fatigued situation, treat them with the utmost tenderness, and endeavour by every possible method to refresh and restore them to life and vigour, for the smaller animals are so much esteemed by the Kamtschakians as these, since to their labours they owe many a delicious repast, robbing their hearths in autumn, and leaving there some kind of provision in return, accompanied by some rude but curious presents of way of amends for the theft. As soon as the migrating host of these animals has crossed the river Peschenik, at the head of the gulf of that name, it turns southward, and reaches the rivers Yenisei and Ochot about the middle of July; the space thus traversed appears astonishing, on consulting the map of the country. The flocks during this time are so numerous that it is said to be impossible to see them all pass. Their return into Kamtschatka is in October, and is attended with the utmost festivity and welcome on the part of the natives, who consider their arrival as a sure sign of a good summer and a good season of fishing, and they are said equally to lament their migrations, which are usually succeeded by rainy and tempestuous weather.

This curious species is generally of a tawny colour, darker on the back, and lighter on
more approaching to an ash-coloured whiteness beneath; its usual length is about four inches and an eighth; its body proportions are distinctly human, its limbs are strong; its eyes small, its ears naked, very short and round, and almost hid beneath the fur of the head.

This animal is also supposed to be an inhabitant of Iceland; at least a species which must be necessarily allied to it is found in that country, and is said to be particularly plentiful in the wood of Hussels. In that country, where berries are but thinly dispersed, the little animals are obliged to cross rivers to make their way to the berry-laden excursions, and in their return are obliged to retrace the stream; their manner of performing which is thus related by Mr. Olafsen, from the accounts of others, communicated to himself:

"The party, consisting of from six to ten, select a flat piece of dried cow-dung, on which they place the berries they have collected in a heap, on the middle; and then, by their united force, drawing it to the water's edge, launch it, and embark, placing themselves round it with their feet, and their tails between them; and thus, by the students of the water's current, and their tails pendant in the stream, and serving the purpose of rudders."

11. Mus socialis, social mouse. The social mouse is a native of the Caspian deserts between the Volga and the Yark, and the province of Khiva. It lives in low sandy situations, in large societies; the ground in many places being covered with the little hillocks formed by the earth cast out in forming the burrows, which, when dry, is said to be about a span deep, with eight or more passages. The animals are always observed to live in pairs, or with a family; they are fond of tulip-roots, which form a principal article of their food. They appear chiefly in the spring, when they are very numerous, but are rarely seen in autumn, and are supposed either to migrate in autumn or to conceal themselves among the bushes, &c. in the winter to shelter themselves in burrows. The body of the species is thick, and the nose blunt; the whiskers white; the ears oval and naked; the limbs short and strong, and the tail slender. The upper parts are of a light grey, and the under white.

12. Mus cricetus, hamster. Of the pouched rats, and the hamster is the most remarkable, and indeed is the only European species provided with those peculiar receptacles, which are situated on each side the mouth, and when empty are so far contractile as not to appear externally, but when filled resemble a pair of tumid bladders, having a smooth veinous surface, concealed, however, under the fur or skin of the cheeks, which bulge out extremely in this state. They are so large as to hold the quantity of a quarter of a pint, English measure.

The general size of the hamster is nearly that of a brown or Norway rat, but it is of a much thicker form, and has a short tail. Its colour is a rich reddish brown above, and black beneath. The muzzle is whitish, the cheeks reddish, and on each side the body are three moderately large oval white spots, of which those on the shoulders are the largest; the ears are moderately large and rounded, and the tail almost bare, and about three inches long; on the fore-feet are four toes, with a claw in place of a fifth, and on the hind-feet are five toes. Sometimes the hamster varies in colour, being found either black with a white muzzle and a pale yellowish white. The male is always much larger than the female. On each side the lower part of the back is an almost bare spot, covered only with very short down.

The hamster inhabits Siberia and the south of Russia. It is also found in Poland, as well as in many parts of Germany. They are very destructive in some districts, devouring great quantities of grain, which they carry off in their cheek-pouches, and deposit in their burrows, in order to devour during the autumn. Their habitations, which they dig to the depth of three or four feet, consist of more or fewer apartments, according to the age of the animal; a young hamster makes them hardly a foot deep; an old one sinks them to the depth of four or five feet, and the whole diameter of the residence, taking in all its habitations, is sometimes eight or ten feet. The principal chamber is lined with dried grass, food, and urine; the rest are destined for the preservation of provisions, or which he amasses a great quantity during the autumn. Each hole has two apertures; the one descending obliquely, and the other in a perpendicular line; through this latter that the animal goes in and out. The holes of the females, who never reside with the males, are somewhat different in their arrangement, and have more numerous passages. The females breed once or twice a year, producing five or six, and sometimes as many as sixteen or eighteen. The growth of the young is rapid, and they are soon able to provide for themselves.

The hamster feeds on all kinds of herbs and roots, as well as on grain, and even occasionally on the smaller animals. "In harvest-time (says Mr. Allamand) he makes his excursions for provision, and carries every article he can find into his granary. To facilitate the transportation of his food, nature has provided him with two pouches in the inside of each cheek. On the outside these pouches are membranous, smooth, and shining; and in the inside are a great many glands, which continue rolled up, with all its limbs infllexible, its body perfectly cold, and without the least appearance of life. In this state it may even be opened; when the heart is seen alternately contracting and dilating, but with a motion so slow as to escape observation; not exceeding 15 pulsations in a minute, though in the waking state of the animal it beats 150 pulsations in the same time. It is added that the fat of the creature has the appearance of being pure, and that its intestines do not exhibit the smallest symptoms of irritability on the application of the strongest stimulants, and the electric shock may be passed through it without effect. This lethargy of the hamster has been generally attributed to lack of cold alone; but late observations have proved, that unless at one certain depth beneath the surface, so as to be beyond the access of the external air, the animal does not fall into its state of torpidity, and that the exposure on the surface does not affect it. On the contrary, while dug up out of its burrow, and exposed to the air, it infallibly awakes in a few hours. The waking of the hamster is a gradual operation; he first loses the rigidity of his limbs; then makes provisions for the winter; and occasionally, after this he begins to move his limbs, opens his mouth, and utters a sort of unpleasant rattling sound. After continuing these operations for some time, he at length opes his eyes, and in a short time, about for some time, as if in a state of intoxication, till at length, after resting a small space, he perfectly recovers his usual powers. This transition from torpidity to activity requires more or less of time, according to the temperature of the air, and other circumstances. When exposed to a cold air, he is sometimes two hours in waking; but in a warmer air the change is effected in half the time.

The manners of the hamster are generally represented as far from pleasing. No society appears to exist among these animals. They are naturally very fierce, and make a desperate defence when attacked; they also pursue and destroy every animal which they are capable of conquering, not excepting even the weaker individuals of their own species. They are said to be provided with a large number of the seeds of licorice, and to abound in the districts where that plant is cultivated. According to Mr. Sultzer, they abound to such a degree in Gotta, that in one year 11,564, and in another 8,089 of their skins were delivered in the Hotel de Ville of that capital, where the hamster is proscribed on account of the devastations it commits among the corn.

The common or Canadian rat. - This, which is a species but lately discovered, seems to be the most remarkable of all the pouched rats for the proportional size of the receptacles. It is a native of Canada, and of a much larger size than the common rat, and is of a pale greyish-brown colour, rather lighter beneath; the length to the tail is about nine inches, and that of the tail, which is but slightly covered with hair, is about twenty inches; the ears are short; the forefeet strong, and well adapted for burrowing in the ground, having five claws, of which the three middle ones are very large and long; the interior one much smaller, and the exterior very small, with a large, long, and curved claw. A more faithful representation
is given in Dr. Shaw's excellent work, which is accompanied by an outline of the head, in its natural size, in order to show the teeth and cheek-pouches. The manners of this species are at present unknown; but it may be concluded that it lays in a stock of provisions, either for autumnal or winter food. The pouches of the individual specimen described, when first brought to government Procotol, were filled with a kind of earthly substance; it is, therefore, not improbable that the Indians who caught the animal must have inclosed it thus, in order to preserve it in its utmost extent.

14. Mus typhlus, blind rat. This is perhaps one of the largest and most remarkable of its tribe, measuring between seven and eight inches in length, and being entirely destitute both of eyes and tail; the defect of the former is a very singular circumstance, and the animal perhaps affords the only instance of a truly blind or eyeless quadruped. In the mole, the eyes, however small and deeply seated, are yet perfect in their kind, and are calculated for acute vision; still enable the animal to avoid the danger of exposure; but in the quadruped now under consideration, there are merely a pair of subcutaneous folds of eyes, smaller than poppy-seeds, and of which the animal is probably, however, that even these minute organs are sufficient to give an obscure perception of light, and to enable the animal to consult its safety by generally continuing beneath the surface. The external ears are also wanting, and the formima leading to the internal organs are very small, entirely hid by the fur, and situated at a great distance backward. There is scarce any distinction between the head and neck, and the whole form of the animal, like that of the mole, is calculated for a subterraneous life: the body being cylindric, the limbs very short, and the feet small and weak in comparison with those of moles, yet calculated for digging or burrowing in the ground. The colour of the animal is a greyish brown; the fur, which is very thick, soft, and downy, being composed of long durable roots, and greyish toward the tips; the head is lighter, and the abdomen darker than the other parts; the lower lip is also whitish, and sometimes a white mark extends along the forehead; the front teeth are large, and are not much bare or exserted; the lower pair being much longer than the upper. This singular species is a native of the southern parts of Russia, where it burrows to a great extent beneath the surface, forming several lateral passages, by which it may pass in quest of roots, &c. It is said to feed in particular on the roots of the cheruphyllum bulbosum. In the morning hours it sometimes quits its hold to bask in the sunshine, and if disturbed takes refuge beneath the surface; burrowing with great agility, and frequently in a perpendicular direction. Its bite is very severe when attacked. It has no voice, but emits a kind of roaring sound, and generally, when it becomes alarmed, shows its teeth in a menacing manner, raising its head at the same time. The female is said to produce from two to four young.

15. Mus Capensis, Cape rat. In its general shape, this animal is not unlike the great sand rat first described, and is equally common about the Cape of Good Hope; but it is far inferior in size, measuring about seven inches to the tail, which is very short, nearly white, and flattened; and, though this species is a dusky rosy ash-brown, paler or more inclining to whithen beneath; the end or tip of the nose is naked and black, the remaining white, and on each side of the cheeks, and on the lower sides of the cheeks, and spaces round the eyes, are also white, and on the hind part of the head is an oval white spot; the teeth are naturally exserted or naked, and are similar in shape to the great sand rat. In its manners and way of life, the animal is also similar to that species; and is very destructive to gardens, gnawing up hillocks, and eating various kinds of roots.

MUSA, the plantain tree, a genus of the monoeia order, in the polyandria class of plants, and in the natural method ranking under the 8th order, sclamisium. The calyx of the male hermaphrodite is a spathe or sheath; the corolla is dipetalous; the one petal erect and quinquedentate; the other, petal, a Nigeria doughnut. The female organs are six species, five of which are perfect; one style; the germen inferior and abortive. The female hermaphrodite has the calyx, corolla, filaments, and pistil, of the male hermaphrodite, with only one filament perfect; the berry is oblong, and three-angled below. There are three species:

1. Musa paradisiaca, is cultivated in all the islands of the West Indies, where the fruit serves the Indians for bread; and some of the white people also prefer it to most other things, especially the raise and cassava, or Indian bread. The plant rises with a short stalk 15 or 20 feet high; the lower part of the stalk is often as large as a man's thigh, diminishing gradually to the top, where the leaves come out on every side; these are often eight feet long, and from two to three broad, with a strong along midrib, and a great number of transverse veins running from the midrib to the borders of the leaf, which are thin and tender, so that wherever they are exposed to the open air, they are generally torn by the wind; for as they are large, the wind has great power against them; these leaves come out from the centre of the stalk, and are rolled up in an early stage; but when they are advanced above the stalk, they expand and turn backward. As these leaves come up rolled in this manner, their advance upward is so quick, that their growth may be discovered by the naked eye; and if a fine line is drawn across the top of the leaf, in an hour the leaf will be near an inch above it. When the plant is grown to its full height, the spikes of flowers appear in the centre, which is often near four feet long. The flowers come out in bunches, those in the lower part of the stalk being the largest; the others diminish in their size upward. Each of these bunches is covered with fully a sheath of a fine purple colour, which drops off when the flowers open. The upper part of the spike is made up of male flowers, which are not succeeded by fruit, but fall off with their covers. The fruit or plantain is about a foot long, and an inch and a half or two inches diameter: it is not green, but ripe pale-yellow. The skin is tough; and within is a soft pulp of a delicious sweet flavour. The spikes of the fruit are often so large as to weigh upwards of 40lb. The fruit of this sort is generally cut off before it is ripe, and the heart is roasted in a clear fire for a few minutes, and frequently turned: it is then scraped, and served up as bread. Boiled plantains are not so palatable.

This tree is cultivated on a very extensive scale in Jamaica, without the fruit of which, Dr. Wright says, these scarce be habitable, as no species of provision could supply their place. Even flour or bread itself would be less agreeable, and less able to support the laborious negro, so as to enable him to do his business, or to keep in health. Plantains also fatten horses, cattle, swine, dogs, fowls, and other domestic animals. The leaves, being smooth and soft, are employed as dressings after blisters. The water from the soft trunk is astrinvent, and employed by some to check diarrhoea. Every other part of the tree is useful in different parts of rural economy. The leaves are used for napkins and tablecloths, and are food for hogs.

2. Musa sapientum, the banana tree. This species differs from the preceding in having its stalks marked with slanting stripes, and spots. The fruit is shorter, stronger, and rounder; the pulp is softer, and of a more delicious taste. It is never eaten green; but when ripe it is very agreeable, and is a food relied on by all ranks of people in the West Indies. Both these plants were carried to the West Indies from the Canary Islands, whither, it is believed, they had been brought from Gniunes, where they grow naturally. They are also cultivated in Egypt, and in most other hot countries, where they grow to perfection in about ten months from their first planting to the ripening of their fruit. When their stalks are cut down, several suckers come up from the roots, which in six or eight months produce fruit; so that by cutting down the stalks at different times, there is a constant succession of fruit. Europe some of these plants are raised by gentlemen who have hot-houses capacious enough for their reception, in many of which they have ripened their fruit very well; but as they grow more and more large, they require more room in the stoves than most people are willing to allow them. They are propagated by suckers, which come from the roots of those plants that have fruited; and many times the younger plants, when stunted in growth, also put out suckers. The fruit of this tree is four or five inches long, of the size and shape of a middling cucumber, and of a high, grateful flavour: the leaves are divided into two yards long, and four broad in the middle; they join to the top of the trunk of the tree, and often contain in their cavities a great quantity of water which runs out upon a small incision being made into the tree, at the bottom of which the plantains grow in great bunches, that weigh 12 lb. and upwards.

The body of the tree is so porous as not to merit the name of wood; the tree is only perennial by its roots, and dies down to the ground every year. When the nature of the West Indies (says Lacti) understand to take a voyage, they make provision of a paste of banana, which, in case of need, serves them for nourishment and drink: for
This purpose they take ripe bananas, and having squeezed them through a fine sieve, form the solid fruit into small leaves, which are dried in the sun or in hot ashes, after being previously wrapped up in the leaves of Indian flowering-reed.

Musca, fly, a genus of insects of the order Diptera. The generic character is: mouth formed into a fleshy proboscis, with two lateral lips; palp, none.

The vast extent of the genus musca makes it necessary to divide the whole into different subgroups, in order to the more readily investigation of the species. These divisions are instituted from the form of the antennae, which are either simple (without any lateral hair or plume), or serrated (that is, furnished with a lateral hair or plume). These divisions are further separated into others, according to the more or less downy or hairy appearance of the insects.

The first section of this genus comprehends such flies as have wings.

The larva, in the different tribes of flies, differ more in size, but in the complete insects, some being terrestrial, and others aquatic. Those of the more common kinds are commonly distinguished by the title of maggots, and spring from eggs deposited on various patriarchs and surfaces. Several of the aquatic kinds are of singularly curious formation, and exhibit wonderful examples of the provision ordained by nature for the preservation of even the smallest, and most seemingly contemptible of animals. Several are inhabitants of plants, feeding during this state on other living insects.

The general form of the chrysalis or pupa is that of an oval, differently modified, according to the species, and formed by the external skin of the larva, which hardens round the chrysalis. Some species, however, cast their skin before their change into the pupa state.

In this division one of the most remarkable species is the musca chamædon, which is a large black fly, with a broad flatish abdomen, having the sides of each segment yellow, forming so abrupt a transition across that part. It proceeds from an aquatic larva, of very considerable size, measuring two inches and a half in length, of a somewhat flattened shape, and of a brown colour, with a narrow or slender front, the body widening by degrees towards the middle, and from thence gradually tapering to the extremity or tail, which is terminated by a circle of radiating or diverging hairs. This larva is common in stagnant waters during the summer months, and passes into its chrysalis state without casting its skin, which dries over it, so as to preserve the former appearance of the animal in a more contracted state.

In this division also stands the musca vespæcola, a minute, fly-shaped fly, of a somewhat lengthened form, with a distinct resemblance to a tipupa. It is of a dull yellow colour, with transparent wings, the thorax marked above by a black ring, and below by ten black spots. The larva of this species measures above three quarters of an inch in length, and is of a pale yellowish-grey colour, slender and sharpened in front, and growing gradually broader towards the tail. It is found in the southern parts of Europe, and is not uncommon in some districts of France, and is remarkable for practising a method exactly similar to that of the hemerobius formicæcum in order to obtain its prey: excavating a circular cavity in the dry earth, and then, after a short distance from the verge of the cavity. This larva seems to have been first observed and described by Réamur, in the Memoirs of the French Academy for the year 1752. It assumes the state of a chrysalis by casting its skin, which rolls to the hinder part of the body: the chrysalis is of a dull reddish colour, and is rounded or clubbed at the upper part, suddenly tapering from thence to the extremity, and after lying nine or ten days, gives birth to the included insect.

Of the downy or slightly haired flies with bristled antennae, one of the most remarkable is the musca tropæa, which is about the size of a drone, and of a brown colour, with short wings, and a segment of the abdomen yellowish on each side. It proceeds from a larva of a very singular appearance, being a long-tailed brown maggot, of rather slow motion, measuring about three quarters of an inch in length, of the tail, which is extensive, and consists of a double tube, the exterior annulated into numerous segments, and the interior slender, and terminated by a circle of hairs, surrounding a spiracular orifice. This maggot is seen in muddy stagnant waters, drains, and other places of the dirtiest description; and notwithstanding its unpleasing appearance, exhibits, when accurately examined, many particulars very well worthy of admiration.

The feet in particular, which are seven in number on each side, are wonderfully calculated for enabling the animal to ascend walls or other perpendicular places, in apparently impossible situations in which it may undergo its change into chrysalis, being very broad, and beset on their under surface with numerous small hooked claws, giving it the power of clinging with security during its sluggish movements. Of this larva a particular notice is stated on the authority of Linneus, which, if true, may indeed well be numbered among the Miracula Insectorum (the title of the paper in the Annalenstes Academica, in which it is annexed), viz. being a frequent inhabitant of the turbid pulp used in the process of paper-making, it is often exposed to the action of the wooden mallets used in the process, as well as squeezed in the longest and sharpest press, and yet suffers unimpaired these seemingly destructive operations!!

The above larva commonly changes to a chrysalis about the end of August, the skin contracting and drying round the body, and the tail continuing in a shrivelled state. After thus remaining about the space of a fortnight, it gives birth to the complete insect, which has so much the general appearance of a drone, that it is very frequently mistaken for an insect. It is extremely common during the month of September.

Musca pendula, which belongs also to this division of the genus, is a moderately large and very beautiful insect. Its colour is black, with four bright yellow stripes down the thorax, and three broad interrupted bars across the abdomen; or, in other words, this fly might be described as of a bright yellow colour, with the thorax marked by four longitudinal black lines, and the abdomen by three transverse black stripes down the middle. Its larva, which is an inhabitant of stagnant waters, is of a still more remarkable appearance than that of the immediately preceding species, which it resembles in size, but is of a pale colour, and furnished with a tail of greater length, composed of a double tube, the interior of which is very slender, extended at the pleasure of the animal to a vast length, and terminated by a very small spiracle. The length of this tube is therefore varied according to the greater or smaller depth at which the insect chooses to continue, the tip reaching to the surface, in order to supply the requisite quantity of air. Sometimes great numbers of them are covered or twisted together by their tails in such a manner that it is by no means easy to separate any one from the rest. The chrysalis resembles that of the musca tropæa, the reason for the being visible in a dried and contracted state. The complete insect is frequently seen on flowers during the autumnal season.

Among the hairy or bristly flies with plumbed antennae stands the well-known species called musca carrionis, or the common large blow-fly. This, as every one knows, deposits its eggs on animal flesh, either fresh or putrid. The larva or maggots hatch about the space of a fortnight, and when full-grown, which happens in eight or ten days, are of a white or yellowish-white colour with a slight tinge of pale-red, and of a lengthened shape, with a sharpened front, in which the month is situated, and from whence the body gradually enlarges in size to the last or terminal segment, which is of a very broad and flattened form, surrounded by several slightly prominent lips, and furnished with a pair of dusky specks resembling eyes: so that an inaccurate spectator might easily mistake this part for the head, and the proper head for the tail. When the animal changes to a chrysalis, the skin dries round it, and the whole assumes a complete case and a reddish brown, soon changing into a reddish-brown. In ten days more the fly itself emerges, which is too well known to require particular description.

Muscavipula generally resembles the preceding, and is found in similar situations, but is vivacious, disclosing small ready-formed larvae instead of eggs, which in this species are hatched internally. This particularity is not confined to the present species, but has been observed in some others of this genus.

To this as well as to the preceding has been applied the observation, Tre musca consorunt ecundo et cepi quæcito ac loco; the number of flies proceeding from the flies, and the quick evolution of the successive broods, destroying the same quantity of flesh in a given time as the predacious quadruped, who devours a great quantity at certain intervals on those parts of the body, on which it continues with unremitting perseverance on the part of one or other of the respective races of flies. Of the hair-flies with bristled antennae, the musca grossa, the largest of European flies, affords a good example.
Musea flava, is one of the smallest but most elegant of the European flies; it is of a yellow colour, with bright gold-green eyes.

MUSCI, Mosser, one of the seven families or classes into which all vegetables are divided, is one of the Phylum Antho- komata, is the 2d order in the cryptogamic class, according to the sexual system.

The more perfect kinds of mosses are found in the shape of small but regular plants, divided into numerous filaments of the kind with leaves: these are of various forms and structures; some being broad and thin, others slender as hair; some belludic, others opaque; some smooth, others hairy. From the side of these leaves in some kinds, and from the summit of the stolts in others, there arise heads or capsules of various figure and structure, but all unicellular; some of these are naked, and others covered with a calyptra or hood; some stand on long pedicels, and others are placed close to the stalks. These heads are usually called capsule, which contain their seeds or spores; and their pedicels seta, in the musa, hypha, prophylls or pistillate of the plant, which rather in some are covered with a calyptra or hood; in others they are naked. Of the first kind are the sphagnum, polytrichum, ump, bryum, hypnum, kontium, and bethannia; and of the latter, the lycopodium, po-rella, spilagnum, and phascum.

Some of the mosses, it is evident, approach to the nature of the plants which have their male and female parts in the same flower, and others to those which have them in different ones. After all, this tribe of plants, as well as the mushrooms, ferns, and seaweeds, is still imperfectly known. The characteristics of these plants, however, according to the sexual system, are:

1. Tops without filaments or tendrils.
2. The male flower, constituted by the presence of the anther or tops, placed apart from the female, either on the same or distinct roots.
3. The female roots, flowers deprived of the pistil.
4. The seeds divided into both lobes (cotyledones) and proper coverings, so that they exhibit the naked embryo.

This order is subdivided into 13 genera, from the presence or absence of the calyx, which in this plant is a veil or cover like a monk's coat, that is placed over the male organs or tops of the stamens, and is dem- orticated calyptra, from the sexes of the plants, which bear male and female flowers, sometimes on the same, sometimes on distinct roots; and from the manner of growth of the female flowers, which are sometimes produced singly, sometimes in bunches or cones.

The manner of seeding of mosses in general, may be more clearly understood from the description of that genus of them which has been traced through all its stages, and which most of the others, though every genus has its distinct frictionat in some respects, yet bear a very general analogy.

The genus already observed, is that called by the botanists the hypnum. There is a species of this very numerous and common; but that particular one which was the subject of those observations, is the short-branched jelly kinds, common on old walls; and called by that author in his History, hypnum vul-
The insertion to be at E (Plate Miscel. fig. 188), near the wrist B, the muscle D, E being either loose and not bound down to it by some ligament or fascia R; in either of which cases the bone A cannot be turned up quite to the situation A, unless the muscle E is contracted, or shortened to D, M, which would not only be troublesome but even impossible. It would be troublesome, because the breadth and thickness of the arm would be vastly increased, so as to become as big as the belly of an animal. On the one hand, the structure of a muscle being such that it cannot be contracted but a little, seldom above two or three fingers' breadth; such an insertion as at E, which requires a contraction of about a foot and a half, would be altogether impossible. Therefore, in fact, we find the muscles inserted near the centre of motion, as at I, fig. 169.

In order to calculate the force of any muscle, we consider the bones or levers; and then the power or force of the muscle will be, always to the resistance or weight it is capable of raising, as the greater distance of the weight from the centre of motion is to the lesser distance.

Hence, it being found by experiments, that a robust young man is able to suspend a weight R, equal to twenty-eight pounds, when the arm is extended in a supine and horizontal situation, viz. the force of the muscle 1 D = to the weight R = 28 lb., as the distance D C is to the distance I C. But it is found, that D C, the length of the cubit and hand, is more than twenty times greater than I C, the distance of the muscle from the centre of motion. Therefore the force of the muscle 1 D, must be more than twenty times greater than the weight R, or more than 28 x 20 = 560 lb.

Again, to find the force which the biceps and brachialis muscles exert, when the humerus D A, (fig. 170.) is perpendicular to the horizon, we are first to consider what weight a man is accustomed to sustain in that posture, viz. R = 33 pounds, and next the quantity of the distances C B, C I, which in this case are as 10 to 1. Therefore the force of these muscles is to the weight R = 35 pounds, as the distance C B = to the distance I C = 1; or the force of the muscle is 500, as before.

But what appears most wonderful is, the force of the muscles that move the lower jaw; which, when taken altogether, do not in a man exceed the weight of 1 pound, and yet exert a force equal to 534 pounds, and in mastodons, wolves, bears, lions, &c. their force is vastly superior, so as to break large bones, as they practise daily in their feeding.

The motions of the far greater part of the muscles are voluntary, or dependant on our will; those of a few others, involuntary. The former are called animal, the other natural motions. Finally, the motions of some of the muscles are of a mixed kind, partly animal and partly natural.

Those muscles which perform the voluntary motions, receive nerves from the brain or spinal marrow: those which perform their motions involuntary, have their nerves from the cerebellum: and those whose motion is partly voluntary, and partly involuntary, have theirs in part from the brain, and in part from the cerebellum. And as a muscle can no longer act when the nerve in it is cut, asunder, or tied up, so the same absolute dependence it has on its artery: for from the experiments of Steno and others on living animals, it appears that in cutting or tying up the artery, the muscle in the same manner loses its whole power of action, as if the nerve had been cut or tied up.

**Muscovy Glass.** See Mica.

**Mushroom.** See Agaricus.

**Music.** A science which teaches the properties, dependances, and relations of melodious sounds; or the art of producing harmony and melody by the due combination and arrangement of those sounds. This science, when employed in searching the principles of this combination and succession, and the causes of the pleasure we receive from them, becomes very profound, and demands much patience, accuracy, and depth of thinking. It is generally supposed that the word music is derived from Muse, because it is commonly believed that an art of this kind is to be attributed to the muse; but Diocles derives it from an Egyptian name, intimating that music was first established as a science in Egypt after the Deluge, and that the earliest species of musical composition received from that produced by the seeds growing on the banks of the Nile, by the wind blowing into them. Others again imagine, that the first ideas of music were received from the working of birds. However this has not really been, it appears at least equally rational, to attribute its origin to mankind; since musical intonation, in the infancy of language, must often have been the natural result of passionate feeling, and since also we find that wherever there is speech there is song.

The antient writers on this science differ greatly as to its object and extent. In general, they give to it a much wider latitude than we do now. Under the name of music they comprehended not only the melodious union of voices and instruments, but also the dance, gesture, pantomime, and even all the other sciences. The ancient philosophers define music as the knowledge of order, which was also the doctrine of Plato, who taught that every thing in the universe was music.

Music, however, properly so called, only concerns the due order and proportion of sounds; and is divided into two parts, the theoretical and the actual. Theoretical music comprehends the knowledge of harmony and modulation; and the laws of that successive arrangement of sound by which air, or melody, is produced. Practical music is the art of bringing this knowledge and these laws into operation, by actually disposing of the sounds, both in combination and succession, so as to produce the desired effect; and this is the art of composition: but practical music may, in fact, be said to extend still further, and to include not only the production of melodious and harmonious composition, but also its performance; and to such a facility in execution, and neatness of expression has the denomination of practical music arrived at the present day, that its professors, generally speaking, hold a truly respectable rank in the various list of modern artists; and are highly, as well as most deservedly, esteemed by all lovers and patrons of the finearts.

**Musella.** An order of the plant kingdom, which consists of the genus Musella, or musk. It is generally supposed that the name Musella is taken from the Latin word Musella, which means musk, and it must be admitted that some of the species of this genus produce a musk-like odour. The European species, M. alba, M. neglecta, and M. obtusa, are the only ones which are of any importance. The musk of the Chinese species is more esteemed than that of the European. The musk is gathered in the autumn, and is dried, and kept in closed vessels. It is used in music to produce a delicious odour.
that this animal, the more effectually to conceal its retreat, contrives to make even this little air-hole in the midst of some thick bushes, and the principal entrance of the otter consists of fish, yet it is said that in hard weather, when this its natural prey fails, it will attack the smaller quadrupeds, as well as poultry, &c. The otter is naturally a very fierce animal; and when hunted with dogs, as is sometimes the practice, will inflict very severe wounds on its antagonists. The female produces four or five young at a birth; this commonly happens early in the spring. The young, if taken at a very early age, may be successfully tamed, and taught by degrees to hunt for fish, and bring them to their master.

When the otter, in its natural or uneducated state, has caught a fish, it immediately draws it ashore, and devours the head and upper parts, leaving the remainder; and when in a state of captivity, will eat no fish but what is perfectly fresh, but will prefer brook, milk, &c.

2. M. lutraola, the smaller otter, very much resembles the common otter, but is smaller; the body is of a dully colour, but with a considerable cast of tawny. In size it falls short of the other, measuring about a foot in length. In North America this species is known by the name of mink; and is said sometimes to leave the water, and prey on poultry, &c. in the manner of a polecat. It has two rows of sharp teeth and puncturing the blood. It is said also to have a fetid smell. In Europe the smaller otter is chiefly found in Poland and Lithuania, living on fish, frogs, &c. Its fur is very valuable, and next in beauty to that of the sable.

3. M. lutris, the sea otter, is the largest of the otters, measuring about 3 feet from the nose to the tail, and the tail thirteen inches. The colour of this species is a deep, glossy, brownish black, the fur being extremely soft and very fine; on the forehead is generally a cast of greyish or silver-colour. According to Mr. Pennant, it is one of the most local animals we are acquainted with, being entirely confined to between lat. 44. and 69. north; and between east long. from London, 125. to 150. inhabiting, in great abundance. Bering's islands, Kamtschatka, the Aleutian and Fox islands, between Asia and America. The habits of the Koreal islands, but are never seen in the channel between the north-east of Siberia and America. It is supposed that they bring but one at a time. They are most extremely harmless animals, and are singularly affectionate to their young. They bring forth on land, and often carry the young one between their teeth; fondle them; and frequently fling them up, and catch them again in their paws; and before they can swim, the parents take them in their bare feet, and swim about on their backs.

The young otter is wholly dependent on its parents till it takes a mate.

This animal is killed for its skin, which is one of the most valuable of furs, being sold at the rate of from 14 to 25 pounds sterling each. They are said to be chiefly sold to the Chinese.

The sea otter is sometimes taken with nets, but is more frequently destroyed with clubs and spears.

4. M. ferret, has eyes red and fiery. It inhabits Africa. In Europe it is tamed to catch rabbits, rats, &c. It procures twice a year, and brings forth from 6 to 8 at a time.

M. cujif, or the otter, is found in Europe, the cold parts of Africa, Asia, and China; lives in heaps of stones, banks of rivers, hollow trees, and forests, especially of heech; preys on squirrels, mice, and small birds. Body about ten inches long in front, when in northern climates becomes white, except the outer half of the tail, which remains black. The fur is very valuable. See Plate Nat. Hist. fig. 286. There are 28 species of the muskela.

MUTE. If any person being arraigned on any indictment or appeal for felony, or on any indictment for piracy, shall upon such arraignment stand mute, or will not answer directly to the felony or piracy, he shall be convicted of the offence, and the court shall thenupon award judgment and execution, in the same manner as if he had been convicted by verdict or confession; and by such judgment and execution the proceedings shall be dismissed as a conviction by verdict or confession.

12 G. III. c. 20.

And the law is the same with respect to an arraignment for petit treason or larceny, or for before this act, persons standing mute in either of the aforesaid cases, were to have the like judgment and execution as if they had confessed the indictment. 2 Inst. 177.

MUTILLA, a genus of insects, of the order hymenoptera; the generic character is, antennae illorum; &c. &c. The articulating obconic, erected on the tip of the lip; jaw membranaceous at the tip, lip projecting obconic; wings in most species obconic; body subpentac; thorax retuse behind; sting pungent, concealed. The M. holcena inhabits the Cape of Good Hope. See Plate Nat. Hist. fig. 287. There are 38 species.

MUST. See Fermentation.

MUSTISIA, a genus of the class and order syngeinae poli gania superfulia. The caly is cylindrical, rounded, car of the ray oval, oblong; of the disk, trid, down-feathered; recept. naked. There is one species, a climber of Peru.

MUTUAL PROMISE, is where one man promises to do anything to another, and in consideration thereof, promises to do a certain act, &c. &c. Such promises must be binding, as well on one side as the other; and both made at the same time. 1 Salk. 21.

MUTUS ET SURDUS, a person dumb and deaf, and being a tenant of a manor, the lord shall have the wardship and custody of him. But if a man be dumb and deaf, and have understanding, he may be grantor or grantee of lands, &c. 1 Co. Inst.

A prisoner who has been sentenced to the pillory, may be arraigned for a capital offence, if intelligence can be conveyed to him by signs or symbols. Leach's Gr. Law, 97. See Evidence.

MUTULIE. See Architecture.

MUTUUM, in the civil law, denotes a loan simply so called; or a contract introduced by the law of nations, whereby a thing consisting in weight, as bullion; in number, as money; or in measure, as corn, is given to a tenant, with the further stipulation, that he shall return another thing of the same quantity, nature, and value, on demand. This, therefore, is a contract with-out reward; so that where use or interest arises, there must be some particular article in the contract with which it is founded.

MUTINY, is a military sense, to rise against authority. Any officer or soldier who shall presume to use traitorous or disrespectful words against the sacred person of his majesty, or any of the royal family, is guilty of mutiny.

Any officer or soldier who shall behave himself with contempt or disrespect towards the general or other commander in chief of his forces, or shall speak words tending to such contempt or ill-nature, is guilty of mutiny.

Any officer or soldier who shall begin, excite, cause, or join in, any mutiny or sedi-}
MYC

Linnæus made a remarkable discovery relating to the generation of pearls in this fish. It is a fish that will bear removal remarkably well; and it is said, that in some places they form reservoirs for the purpose of keeping it, and taking out the pearls, which, in a few times, will again be renewed. From observations on the growth of their shells, and the number of their annular laminae or scales, it is supposed the fish will attain a very great age; for 63 years are imagined to be a moderate computation. The discovery turned on a method which Linnæus found, of putting these shell-fish into a state of producing pearls at his pleasure; though the final effect did not take place for several years; he says that in five or six years after the operation, the pearl would have acquired the size of a vetch. We are unacquainted with the means by which he accomplished this extraordinary operation.

MYAGRUM, Gold of Pleasure, a genus of the silicula order, in the tetranyx class of plants; and in the natural method ranking under the 20th order, siliqueae. The silicula is terminated by an orbicul shape; the cell garden having two or four species; but the most remarkable is the sativum, which grows naturally in cornfields in the south of France and Italy, and also in some parts of Britain. It is an annual plant; and is cultivated in Germany for the sake of the expressed oil of the seeds, which the inhabitants use for medicinal, culinary, and economical purposes. The seeds are a favourite food with geese. Horses, goats, sheep, and other beasts eat them.

MYCTERIA, the Jabiru, a genus of birds belonging to the order of grallae. The bill is long, bending upwards and acute; the nostrils are small and linear; there is no tongue; and the feet have four toes. There are two species: 1. The Americana, or American jabiru, is about the size of a turkey. See Plate Nat. Hist. fig. 238. The bill is long, stout, and of a black colour; the whole plumage is white, except the throat and breast, which are bare of feathers and of a blackish colour; the remainder is bare, and of a fine red; on the hind-head are a few greyish feathers; the legs are strong, of a great length in proportion to the body, clothed with black down and tail even at the end. This bird is found in all the savannas of Cayenne, Guiana, and other parts of South America. It is migratory and gregarious. It makes its nest in great trees, which grow on the borders; lays two eggs, and brings up the young in the nest till they can descend to the ground. The colour of the young birds is grey; the second year it changes to rose-colour, and the third to pure white. They are very wild and voracious, and their food is fish, which they devour in great quantities. The flesh of the young birds is said to be good eating, but that of the old is hard and oily. 2. The Atlántica, or Indus jabiru, is of a large size. The bill is dusky, almost straight above, and gibbous near the forehead; the under mandible swelled beneath; and from the base of the bill there passes through and beyond it a black streak, the whole colour of the plumage is white; the lower half of the back, the prime quills, and tail, are black; the legs a pale red. This species inhabits the Everglades, and feeds on nails.

MYGINDA, a genus of the tetranyx order, in the tetranyx class of plants; and in the natural method ranking with those of which the order is doubtful. The calyx is quadrangular; the petals four, the fruit a capsule. There are three species, shrubs of the West Indies.

MYOSOTIS, Scorpion-grass, a genus of the monogyna order, in the pentandria class of plants; and in the natural method ranking under the 20th order, ordine phanerogamia. The corolla is salver-shaped, quinquiseptal, and magnum; the throat siphon up by small arches. There are seven species, of which the most remarkable is the scorpions, or mouse-grass. This is a weed of Britain, growing naturally in dry fields, and margins of springs and rills. The blossoms vary from a full blue to a very pale one, and sometimes a yellow; and appear in a long spirally twisted spike. When it grows in the water, and its taste and smell are thereby rendered less observable, sheep will sometimes eat it; but it is generally fatal to them. Cows, horses, swine, and goats, refuse it.

MYOXUS, a genus of the polygyna order, in the pentandria class of plants; and in the natural method ranking under the 20th order, ordine phanerogamia. The calyx is pen-taphylous, the leaves cohering at the base; there are five subulate nectaria resembling petals; the seeds are numerous. There is one species, a weed.

MYXON, dormouse, a genus of quapu-rod's of the order glires: The generic character is, front-tooths two, the upper cuspated, the lower cusp four in each jaw; viscentia long; tail cylindric, villous, thicker towards the end; legs of equal length, fore-feet tetradactylous.

1. Myxurus gliis, fat dormouse: this species, the giss of Playf and the old naturalists, is a native of France and the South of Europe. It also occurs in Russia, Austria, &c. rising on trees, and leaping from branch to branch in the manner of a squirrel, though much less active in its movements. It feeds on nuts, acorns, fruit, &c. and during the greater part of the winter remains in a state of torpitude, awaking only at distant intervals. Its general length is about four inches and a half, and the tail rather less. It is of an elegant form, and from its peculiar posture it is called the little mouse beneath; the eyes are imbedded in a large black patch or spot, which extends to some distance beyond each ear; the tail is somewhat wider towards the end, and sharpens at the extremity and the paws are rather longer on the tip than on the other parts; the head, back, sides, belly, and tail, are of a tawny-red colour; the throat white; the fur is remarkably soft, and the whole animal has a considerable degree of elegance in its appearance. It sometimes happens that the colour is rather brown than reddish.

Dormice, says Mr. Pennant, inhabit woods or very thick hedges; forming their nests in the hollows of small trees, or near the bottom of a close shrub. As they want much of the sprightliness of the squirrel, they never rise to the tops of trees, or attempt to bound from spray to spray. Like the squirrel, they form little magazines of nuts, &c. for their winter provision, and take their food in the same upright posture. The consumption of their hoard during the rigour of winter is but small, for they sleep most part of the time, retiring into their nest of leaves, and rolling themselves up, lie torpid during the greatest part of the glummy season. Sometimes they experience a short revival in a warm sunny day, when they take a little food, and then refit back to their former state.
These animals seldom appear far from their retreats, or in any exposed situation; for which reason they seem less common in this country than they really are. They make their nest of grass, moss, and dead leaves. According to the count de Buffon, it consists of interwoven herbs, and is six inches in diameter, open only above, and is situated between the branches of hazel and bramble. The number of young is generally three or four.

**Myrica, Gale, or Sweet-willow**, a genus of the tetradnrdi order, in the direct class of plants, and in the natural method ranking under the 5th order, Anacardiatae. The scale of the male catkin is in the form of a crescent, without any corolla. The scale of the female catkin the same: there is no calyx; but two styles, and a monoporous berry.

1. The gale, Dutch myrtle, or sweet-willow, grows naturally upon bogs in many places both of Scotland and England. It rises about four feet high. The female flowers or catkins are produced from the tips of the branches, growing upon separate plants from the male, which are succeeded by clusters of small berries, each having a small seed. It flowers in July, and ripens in autumn. When transplanted into shrubberies, the moistest parts must be assigned to it.

The leaves, flowers, and seeds of this plant, have a strong fragrant smell, and a bitter taste. They are said to be used among the common people for destroying moths and cutaneous insects, being accounted an enemy to insects of every kind; internally, in infusions, as a stomachic and vermifuge; and as a substitute to hops for preserving malt liquors, which they render more aromatic, and of consequence less sublimable; it is said that this quality is destroyed by boiling.

2. The cereta, wax-bearing myrtle, or candleberry myrtle, is a native of North America, it is a small tree, about 10 or 12 feet high, with the female standing forth near the ground irregularly. The leaves grow irregularly on them all round; sometimes by pairs, sometimes alternately, but generally at unequal distances. The branches of the old plant are twigs of the same kind in the autumn; but the young plants raised from seeds retain them the greatest part of the winter, so as during that season, to have the appearance of an evergreen. But this beauty will not be lasting, for they shed their leaves proportionately earlier as the plants get older. There are both male and female trees of this sort: the flowers are small, of a whitish color, and make no figure; neither does the fruit. The fruits are the female (which is small, dry, blue berry), though produced in clusters, make any show; so that it is from the leaves this tree receives its beauty and value; for these being bruised, as well as the bark of the young shoots, emit the most refreshing and delightful fragrance, that is exceeded by no myrtle, or any other aromatic shrub. See Plate Nat. Hist. fig. 289.

There is a variety of this species of lower growth, with shorter but broader leaves, and of a fragrant odor. This grows commonly in Carolina; where the inhabitants pick from its berries a wax of which they make candles, and which occasion its being called the candleberry tree. It delights in a moist and soil. The wax is procured in the following manner: In November and December, when the berries are ripe, a man with his family will order some individuals to stand on sand-bank near the sea, where these trees most abound, taking with them kettles to boil the berries in. He builds a hut with palmetto-leaves for the shelter of himself and family during there, which is commonly four or five weeks. The man cuts down the trees, while the children strip off the berries into a porridge pot; and having put water to them, boil them till the oil flows, which is the sal volatile, into another vessel. This is repeated till no more oil appears. When cold, this hardness to the consistence of wax, and is of a dirty-green colour. They then boil it again, and clarify it in brass pan, which gives it a transparent greenness. These candles burn a long time, and yield a grateful smell. They usually add a fourth part of tallow, which makes them burn clearer. There are several other species.

**Myriophyllum**, a genus of the polyandria order, in the monogyna class of plants; and in the natural method ranking under the 15th order, Anacardiatae. The male calyx is tetraphyllous; there is no corolla; the stamina are eight in number. The female calyx is tetraphyllous; the pistil four; there is no stile; and four naked seeds. There are two species, aquatic of Europe.

**Myristica**, the nutmeg-tree; in botany, a genus of plants belonging to the class dicotyledons, and of the natural order Lamiaceae. The male calyx is monophyllous, strong, and parted into three lateral of an oval shape, and ending in a point: it has no corolla. In the middle of the receptacle rises a column of the height of the calyx; to the upper part of which the anthers are attached. They vary in number from three to twelve or thirteen. The female calyx and corolla, as in the male, on a distinct stem, the germen of an oval shape; the style short, the stigmatic stigma, the lacinate of which are oval and spreading. The fruit is of that sort called drupas. It is fleshy, roundish, sometimes unicolour, sometimes bicolour, and when ripe bursts at the side. The nutmeg is composed with a fleshy and fatty membranous substance, which divides into filaments; this, in one of the species is the mace of the shops. The seed or nutmeg is round or oval-shaped, unicolour, and contains a small kernel, variegated on the surface by the fibres running in the form of a screw.

There are five species of this genus according to some authors; but several of these being only varieties, may be reduced to three. viz. 1. *Myristica Fatua*, or wild nutmeg; the flowers in May, and rises to the height of an apple-tree; has oblong, lanceolate, downy leaves, and hairy fruit; the nutmeg of which is aromatic, but when given inwardly is narcotic, and occasions drunkenness, delirium for a time, and some occasional vomiting. The myristica sebiera, a tree frequent in Guiana, rising 40 or even to 60 feet high; on wounding the trunk of which, a thick, acid, red juice runs out. Anilbet says nothing of the nutmegs being aromatic; he only observes, that a yellow fat is obtained from them, which serves many medicinal and medical purposes, and that the natives make cakes of it. 3. The myristica aromatica, or nutmeg, attains the height of 30 feet by, producing numerous branches, which rise to the horizontal, and are covered with bark, which of the trunk is a reddish brown, but that of the young branches is of a bright green colour; the leaves are nearly elliptical, pointed, obtuse, obliquely nerved, on the upper side a bright green, on the under whist, and stand alternately upon footstalks; the flowers are small, and hang upon slender peduncles, proceeding from the axile of the leaves: they are both male and female upon separate trees.

The nutmeg has been supposed to be the concomium of Theophrastus, but there seems little foundation for this opinion; nor can it with more probability be thought to be the Dracaena of Galen. Our first knowledge of it was evidently derived from the Arabian; by Avicenna it was called Chivalon, or Jashbun, which signifies nut of Banda.

There are two kinds of nutmegs, the one male and the other female. The female is that in common use; the male is longer and more cylindrical, but it is of less aromatic flavour than the other. It is very subject to be worm-eaten, and by the Dutch it is strictly prohibited from being packed with the others, because it will give occasion to their being worm-eaten, too, by the insects getting from one species to the other. An almost exclusive and very lucrative trade in nutmegs from the island of Ceylon was carried on by the Dutch, but it is now transferred to the English, who have become masters of the colony.

The seeds or kernels called nutmegs are well known, as they have been long used both for culinary and medical purposes. Distilled with water, they yield a large quantity of essential oil, reconding in flavour the spice itself; after the essence is expressed a sebaceous matter is found swimming on the water; the decoction incipient, gives an extract of an unctuous, very light and bitterish, and with little or no aromaticity. Reepli- es such extract that of nutmegs by infusion, but elevates very little of it in distillation; hence the spirituous extract possesses the flavour of the spice in an eminently degree.

Nutmegs, when heated, yield the press a considerable quantity of liquid yellow oil, which on cooling concretes into a sebaceous consistence. In the shops we meet with three sorts of unctuous substances, called oil of mace, though really expressed from the nutmeg. The best is brought from the East Indies in stone jars; this is of a thick consistence, of the colour of mace, and has an agreeable fragrant smell; the second sort, which is pale-coloured, and much inferior in quality, comes from Holland in solid masses, generally flat, and of a square figure: the third, which is the worst of all, and is called common oil of mace, is an artificial composition of several palm oil, and the like, flavoured with a little genuine oil of nutmeg.

Method of gathering and preparing nutmegs.—When the fruit is ripe, the natives ascend the trees, and gather it by pulling
the branches to them with long hooks. Some are employed, in opening them immediately, and in taking off the green shell or first rid, which is laid together in a heap in the woods, where in time it putrifles. As soon as the putrification has taken place, the ant, or this kind of mushrooms, called boletiischwii, of a blackish colour, and much valued by the natives, who consider them as delicate eating. When the nats are stripped of their first rid, they are cut into pieces, and are carefully taken off with small knives. The mace, which is of a beautiful red, but afterwards assumes a darkish red colour, is laid to dry in the sun for the space of a day, and is then reduced to a place less exposed to his rays, where it remains for eight days that it may soften a little. They afterwards moisten it with seawater, to prevent it from drying too much, or from losing its oil. They are careful, however, not to employ too much water, lest it should become putrid, and be devoured by the worms. It is last of all put into small bags, and squeezed very close.

The nuts, which are still covered with their ligneous shell, are for three days exposed to the sun, and afterwards dried before a fre, till the smell, when shaken, they then beat them with small sticks in order to remove their shell, which flies off in pieces. These nuts are distributed into three parcels: the first of which contains the largest and most beautiful, which are destined to be brought to Europe; the second contains such as are reserved for the use of the inhabitants; and the third contains the smallest, which are irregular or untrue. These are burnt; and part of the rest is employed for procuring oil by pressure. A pound of them commonly gives three ounces of oil, which has the consistence of tallow, and has entirely the taste of nutmeg. Both the nut and mace, when divided, afford an essential, transparent, and volatile oil, of an excellent flavour.

The nutmegs which have been thus selected, would soon corrupt if they were not watered, or rather pickled, with lime-water mixed with salt. To this end, they are washed with salt water till it attains the consistence of fluid paste. Into this mixture they plunge the nutmegs, contained in small baskets, two or three times, till they are completely covered over with the liquor. They are afterwards laid in a heap, where they heat, and lose their superfluous moisture by evaporation. When they have sweated sufficiently, they are then properly prepared, and are kept for sale.

The aromatic qualities of nutmeg are supposed to be aromatic, anodyne, stimulac, and astrignent; and with a view to the last mentioned effects, it has been much used in diarrhoea and dysentery. To many people the aromatic flavour of nutmeg is very agreeable: but some, however, should be cautious not to use it in large quantities, as it is apt to affect the head, and even to manifest an hypnotic power: such a degree as to prove extremely dangerous. Botanists speak of this as a frequent occurrence in India; and Dr. Cullen relates a remarkable instance of this soporific effect of the nutmeg, which fell under his own observation, and hence concludes, that in apoplectic and paralytic cases this spice may be very improper. He observes that a person by mistake took two drams of a little more of powdered nutmeg; he felt it warm in his stomach, without any nausea; but in about an hour after he had taken it, he experienced a drowsiness, which gradually increased to a complete stupor and insensibility; and not long after he was found fallen from his chair, lying on the floor of his chamber in the state manifesting he had fell asleep; but waking a little from time to time, he was quite delirious; and he thus continued alternately sleeping and delirious for several hours. By degrees, however, both these symptoms diminished; so that in about six hours from the time of taking the nutmeg he was pretty well recovered from both. Although he still complained of head-ache, and some drowsiness, he slept naturally and quietly the following night, and next day was quite recovered.

The official preparations of nutmeg are, a spirit and essential oil; and the nutmeg in substance roasted, to render it more astrigent. Both the space itself and its essential oil contain several compositions, as the confectionary, aromatic, spicaria, and mace, &c.

Mace possesses qualities similar to those of the nutmeg, but is less astrigent, and its oil is supposed to be more volatile and acrid.

MYRMEICA, a genus of the class and order termitaria monogyna; the calyx is tubular, five-toothed; cor., one-petalled; gern five glands at the base; stigma bilatera. This is one species, a shrub of Guiana.

MYRMECOPHAGA, Ant-eater, a genus of quadrupeds of the order bruta. The generic character is, teeth none; tongue cylindrical, extend; mouth lengthened into a somewhat tubular form; body covered with hair. The animals of this genus live entirely on flesh, and are armed with the most kinds of ants; in order to obtain which, they extend their tongue, which is of a very great length, and of a roundish or wormlike form, into the nests of these insects; and when, by means of the saliva by means of which it is covered, a sufficient number are secured, they retract it suddenly into the mouth, and swallow them. A part of the generic character of the myrmecophaga is the total want of teeth, in which particular it resembles no other animals except those of the genus manis, in which the same circumstance takes place. There are, however, in the ant-eaters, according to the observations of Mons. Brongersum, certain bones or processes not unlike teeth, situated deep at the entrance of the gullet; or oesophagus; or rather, according to the celebrated Camper, at the lower end of the jaws. The species of ant-eaters are not numerous.

1. Myrmecophaga jabata, great ant-eater. This is by far the largest of the ant-eaters, being upwards of seven feet in length, from the tip of the nose to the end of the tail; but if measured to the origin of the tail, it is no more than six feet long. It is said to be a very slow animal of an uncouth appearance; the head is small; the snout very long; the eyes small; the ears short and round; the shoulders thick and muscular, from whence the body tapers towards the tail; but the thighs are thick and stout; the colour of the animal is a deep grey, with a very broad band of black running from the neck downwards on each side the body, growing gradually narrower as it passes down; this black band is accompanied by the yellow at the anterior part of the tail; the fore legs are of a lighter cast than the hinder; and have a patch of spot of black in front not much above the foot; the tail is black, extremely long and bushy; the hair on the whole body, but especially on the tail, is very harsh and coarse; there are four toes on the fore-feet, and five on the hind: the two middle claws of the fore feet are extremely large and strong; which render this creature, though destitute of teeth, a very formidable adversary; since it has been known to destroy animals of much greater apparent strength than itself; fixing its claws upon them, and exerting such powerful strength as to kill them by continued laceration and pressure.

2. Myrmecophaga douba, little ant-eater. This is an animal of great elegance. It is not superior in size to a squirrel; measuring little more than seven inches from the nose to the tail, which is longer than the body and head. The head is small; the snout sharpened, and slightly bent downwards; the legs are short; the fore feet have only two claws on each, the exterior one much larger and stronger than the interior; on each of the hind feet are four claws of moderate size; the ears are very small, and hid in the fur; the eyes are also small. The whole animal is covered with a beautiful soft, and somewhat crisped or curled fur, of a pale yellow colour, or rather yellow-brown; the tail, which is very thick at the base, gradually tapers to the tip; and the lower surface, for about the space of four inches from the tip, is bare; the tail in this species being prehensile, and the animal commonly residing on trees, and preying on ants, by means of its long tongue, in the manner of other species. It is a native of Guiana. See Plate Nat. Hist. fig. 290.

3. Myrmecophaga aculeata, aculeated ant-eater. The aculeated ant-eater is one of those curious animals which have been lately discovered in the vast island, or rather continent, of Australia or New Holland; and is a striking instance of that beautiful gradation, so frequently observed in the animal kingdom, by which creatures of one tribe or genus approach to those of a very different one. It forms a connecting link between the very distant Linncean genera of hysteris (porcupine) and Myrmecophaga (ant eater). The external coating and general appearance of the one, with the mouth and peculiar generic characters of the other. This animal, so far as may be judged from the specimens hitherto imported, is about a foot in length.
In its mode of life this animal resembles the rest of the ant-eaters, being generally found in the midst of some large ant-hill; it burrows with great strength and celerity under ground, when disturbed; its feet and legs being most excessively strong and short, and not adapted for this purpose. It will even burrow under a pretty strong pavement, removing the stones with its claws; or under the bottom of a wall. During these exertions, its body is strengthened or lengthened to an uncommon degree, and appears very different from the short or platy aspect which it bears in its undisturbed state.

It cannot escape the observation of every scientific naturalist, that, in consequence of the discovery of this curious animal, the Linnaean character of myrmecophaga is, in part, rendered inapplicable. Since, therefore, the genera of manis and myrmecophaga differ only in the external covering (the former being coated with scales, and the latter with hair), it would, perhaps, be proper to conjoin the two genera, to add this as a new species, and to give as part of the generic character, corpus pilosum, squamis vel acuminis tarsi. Or it might even constitute a new genus, which would differ essentially from manis and myrmecophaga, in having the body covered with spines.

*MYRMELEON*, a genus of insects of the order myrmeleont; the generic character is, mouth furnished with jaws, tender towards feeders four, elongated; stenoma none; antennae elevated, of the length of the thorax; wings detached; tail of the male furnished with a tuft consisting of two straight or filiform filaments. Of this genus into the specific history is best understood is the myrmecolean formicaleo of Linnæus, whose larva has long been celebrated by naturalists for its wonderful ingenuity, in preparing a kind of pitfall or deceptive cavity for the destruction of such insects as happen unawarly to enter it. The myrmecolean formicaleo, in its complete or fly state, bears no inconsiderable resemblance to a small spider, from which, however, it may readily be distinguished by its antennae. It is of a predacious nature, flying chiefly by night, and pursuing the smaller insects in the manner of a lubidula. It deposits its eggs in dry sandy situations; and the young larva, when hatched, continues to perform the same talent of preparing, by turning themselves rapidly round, a very small conical cavity in the sand. Under the centre of the cavity the little animal conceals itself, suddenly rushing forth at intervals in order to seize any small insect which, by approaching the edge of the cavity, has been so unfortunate as to fall in; and after sucking out its juices through its tubular forceps, throws it by a sudden exertion to some distance from the cavity. As the creature increases in size it enlarges the cavity, which at length becomes about two inches or more in diameter. The larva, when full-grown, is more than half an inch long, and is of a flattened figure, broad towards the upper part, and gradually tapering to an obtuse point at the extremity. It is of a brown colour, and beset with numerous tufts of dusky hair, which are particularly conspicuous on the crown of the head and abdomen; the legs are slender; the head and thorax rather small; the tubular jaws long, curved, serrated internally, and very sharp-pointed. The whole animal is of an unpleasing aspect, and on a cursory view bears a general resemblance to a flat-bodied spider. When magnified, its appearance is highly uncouth.

The ingenious Reaumur and Robel have given accurate descriptions of this larva and its external history. But this insect, whose term of life, like that of the lubiduleae and eumeneae, is protracted to a very considerable space, since it survives the winter in its larval state, taking no nourishment during that time, and in the spring resumes its usual manner of preying. In preparing its pit, it begins by tracing an exterior circle of the intended diameter of the cavity, continuing its motion, in a spiral line, till it gets to the centre, thus marking several volutes in the sand, resembling the impression of a large helix or snail-shell; and after having sufficiently deepened the cavity by a repetition of this motion, it smooths the sides into a regular shape by throwing out the superfluous material on the surface. While this its perforation is being made, it leaves the cavity, and in a few moments, when in near, a foot beyond the brink. The depth of the pit is generally equal to the diameter. When full-grown and ready to change into a chrysalis, the animal coves itself in a fibrous round ball, and is furnished with a tuft coiled round by very fine silk, which it draws from a tubular process at the extremity of the body; with this silk it also lines the internal surface of the ball, which, if opened, appears covered by a fine heart-coloured silken tissue, that continues in the state of chrysalis about four weeks, and then gives birth to the complete insect.

The myrmecolean barbarus has antennae as long as the body; thorax spotted with yellow. See Plate Nat. Hist. fig. 291.

*MYRROBALANS*, a kind of medicinal fruit brought from the Indies. See Materialia Medica.

*MYRODENDRUM*, a genus of the class and order poyandia monogyna. The cor. is five-petaled, stam. five; per. five-celled. There is one species, a tree of Guiana.

*MYRORIA*, a genus of the monandaphia poyandia class and order; the calyx is single, one-leaved; cor. five-petaled; pist. one. There are two species, shrubs of the West Indies.

*MYROSMA*, a genus of the monandaphia monogyna class and order; the calyx is double, outer three-leaved, inner three-petaled; cor. five-petaled; caps. three-cornered. There is one species, a shrub of Surinam.

*MYRXOXYLM*, a genus of the monogyna order, in the decandra class of plants. The calyx is campanulate; the superior petal larger than the rest; the gum is longer than the corolla; the legumin monoepernous. There is but one species, the penitiperum, a native of Peru and the warmer parts of Africa. It is this shrub that yields the essence of the balsam, being exsicated by the action of the sun, and exsicated from it by evaporation in water. This balsam, as brought to us, is nearly of the consistence of thin honey, of a reddish brown colour inclining to black, an agreeable arome, and a very hot bitters taste. Distilled with water, it yields a small quantity of a fragrant essence of a reddish colour; and in a strong fire, without addition, a yellowish red oil. Balsam of Peru is a very warm aromatic medicine, considerably stronger than eucalyptus. (See Balsam.) It possesses the principal effects of warm the habit, to strengthen the nervous system, and attenuate viscid humours. Hence its use in some cases of asthma, gonorrhœa, dysenteries, and other disorders proceeding from a debility of the skin, or sluggishness and inactivity of the juices. It is also employed externally, for cleansing and healing wounds and ulcers, and sometimes against piles and rheumatic pains. There is another sort of balsam of Peru of a white colour, and considered more fragrant than the former. This is very rarely brought to us. It is said to be the produce of the same plant which yields the common or black balsam; and to experience less incisiveness made in the trunk, while the former is obtained by boiling. There is also a third kind, commonly called the red or dry. This is supposed to obtain a different state from the white, merely in consequence of the juice. It is subjected after it is got from the tree. It is almost as fragrant as the balsam of Gilead, held in so high esteem among the Eastern nations. It is very rarely in use in Britain, and almost never to be met with in our shops.

*MYRRH*, a gummy resinous concrete juice. The plant from which this substance is obtained, is not certainly known. According to some it belongs to the genus myrrha, and grows in Abyssinia and Arabia. It is in the form of tears. Colour reddish-yellow, sometimes transparent, but more frequently opaque. Taste bitter and aromatic. Does not melt when heated, and burns with difficulty. With water it forms a yellow solution. The solution in alcohol becomes opaque when mixed with water. By distillation it yields oil. Its specific gravity is 1.36. It is said to be employed in medicine, and is soluble in alcohols.

The medical effects of this aromatic bitter are, to warm and strengthen the viscera; it frequently occasion a mild diarrhœa, and it is used in a general way. It seems that proves serviceable in languid cases, diseases arising from a simple inactivity, catarrhal disorders, and where the lungs and thorax are oppressed by viscid phlegm.

Rectified spirit extracts the fine aromatic flavour and bitterness of this drug, and does not elevate any thing of either in evaporation; the gummy substance left by this men- struum has a disagreeable taste, with scarcely any of the particular properties of myrrh; this part dissolves in water, except some impurities which remain. In distillation with water, a considerable quantity of a ponderous essential oil arises, resembling in flavour the original drug. Myrrh is the basis of an official tincture. It enters the pilule: a lae circum: myrrha, the pilule e gingumi, the pilule stoma- machica, and other formule.

*MYRSINE*, a genus of the monogyna class of plants, and in the natural method ranking under the 18th order, bicornes. The corolla is semilinquiniated and coonvolute; the germen filling the corolla; the berry quinquelocular and
See Myrtus.

MYRTUS, the myrtle, a genus of the monogynous order, in the icosaedra class of plants; and in the natural method ranking under the 19th order, hesperide. The calyx is quinquedent, superior; there are five petals; the berry is dispersive or dispersum. There are 36 species, of which the most remarkable are:

1. The communis, or common myrtle-tree, of which the most material varieties are:

- Broad-leaved, with ovate, or oval, pointed, green leaves, an inch and a half long, and one broad; and which is remarkably floriferous. Gold-striped broad-leaved Roman myrtle. Broad-leaved Dutch myrtle, with brightly colored, blue-blotched green leaves, an inch long, and about three quarters of one broad. Double-flowered Dutch myrtle. Broad-leaved Jew's myrtle, having the leaves placed by threes at each joint, the leaves are thick, those of the common myrtle. This latter variety of this species is in universal estimation among the Jews in their religious ceremonies, particularly in decorating their tabernacles; and for which purpose many gardeners set it out. The leaves and branches are of particular care to sell to the above people: for the true sort, having the leaves exactly by threes, is very scarce, and is a curiosity; but by care in its propagation, taking only the perfectly formed leaves and branches, it may be increased fast enough; and is worth the attention of the curious, and particularly those who raise myrtles for the London markets. Orange-leaved Spanish myrtle, myrtle, with oval, stippled leaves, an inch and a half long, or more, and one broad, in clusters round the branches, and resembling the shape and colour of orange-trees. Leaves. Gold-striped-leaved orange myrtle, a variety of the common upright myrtle, with its branches and leaves growing more erect, the leaves oval, lanceolate, acute-pointed, and near an inch long and half one broad. Silver-striped upright Italian myrtle, with oval, stippled leaves, the Portugal acute-leaved, myrtle, with spear-shaped, oval, acute-pointed leaves, about an inch long. Box-leaved myrtle, with weak branches, and small oval, obtuse, lobate, green leaves. Striped, silver leaved myrtle. Rosemary-leaved myrtle. Silver-striped rosemary-leaved myrtle. Thyme-leaved myrtle, with very small close-placed leaves. Nutmeg-myrtle, with erect branches and leaves; the leaves oval, acute-pointed, and thinly scented like a nutmeg. Broad-leaved nutmeg-myrtle. Silver-striped-ditto. Cristate or cockscomb myrtle, frequently called by this name, and it is a beautiful evergreen shrub, of exceeding fragrance, exotics originally of the southern parts of Europe, and of Asia and Africa, and consequently in this country require a shelter of a greenhouse in winter.

2. The pimenta, pimento, Jamaica pepper, or allspice tree, grows about 30 feet in height and two in circumference; the branches near the top are much divided and thickly beset with leaves, which by their continual verdure always give the tree a beautiful appearance; the bark is very smooth externally, and of a grey colour; the leaves vary in shape and size, but are commonly about four inches long, veined, pointed, elliptical, and of a deep shining green colour; the flowers are in branches or panicles, and stand upon subdividing or trichotomous stalks, which usually terminate the branches; the calyx is cut into four roundish segments; the petals are also four, white, ovate, red-stemmed, and opposite to each other between the segments of the calyx; the filaments are numerous, longer than the petals, spreading, of a greenish-white colour, and rise from the calyx and upper part of the gearment. There are roundish, and of a pale yellow colour; the style is smooth, simple, and erect; the stigma is obtuse; the germen becomes a round succulent berry, containing two kidney-shaped flatish seeds. This tree is a native of New Spain and the West India islands. In Jamaica it grows very plentifully; and in June, July, and August, puts forth its flowers, which, with every part of the tree, breathe an aromatic fragrance. The berries when ripe are of a dark purple colour, and full of a sweet pulp, which the birds devour greedily. The pimento is a most beautiful odoriferous evergreen, and exhibits a fine variety in the fruits at all seasons.

MYRTILUS, the mussel, a genus of animals belonging to the order of veneres testacei. The animal is an ascidia; the shell bivalve, often affixed to some substance by a broad; the hinge without a tooth, marked with a long, hollow line. Of these animals there are a great many species, some of which inhabit the seas, others the rivers and ponds. Several of them are remarkable for the beauty of their internal shell, and for the pearls which are sometimes found in them.

1. The edulis, or edible mussel, has a strong shell, slightly incurvated on one side, and angulated on the other. The end near the hinge is pointed, the other rounded. When the epidermis is taken off it is of a deep-blue colour. It is found in immense beds, both in deep water and above low-water mark. This species inhabits the European, and Indian tropics; it is the largest, and smaller within the polar circle. It is said to be hurtful if too often eaten, or in too great quantities.

2. The anatis, or duck mussel, has a shell more oblong and less convex than the last; it is very brittle and semitransparent; the space round the hinges like the last; the length about five inches, breadth two. It is found in Europe in fresh waters. Both it and the cygus are diversified by swans and ducks, whence their names; crosses also feed on these mussels, as well as on different other shell-fish; and it is diverting to observe, that when the shell is hard for their bills they fly it with a graceful flight, drop the shell on the water, and at last draw itself out of the shell by the fall.

3. The violaceus, or violet mussel, has the shell longitudinally furrowed, the run very obese, somewhat formed like the mytilus edulis, but considerably larger and more flattened, of a beautiful violet-colour. Inhabits the southern ocean.

4. The marapagia forms the true mother-of-pearl, and frequently the most valuable pearls; the most common are green, or emerald, or blue-colour with white rays; when the outer coat is removed it has the same lustre as the inside; the younger shells have ears as long as the shell, and resemble scallops.

There are between 50 and 60 other species. Mussels not only open and shut their shells at pleasure, but they have also a sliding motion; they canfasten themselves where they please; they respire water like the fishes; and some even flattter about on its surface so as to inhale air. If they lie in shallow waters they sink on the land; if in deep, then they fly them above the heel of the shell, and a few moments after they cast out the water by one single stroke at the other end of the shell. The mouth is situated near the sharp angle of the outer valve; they open with it to raise fringes in the shape of mustachios, which may perhaps answer the purpose of lips.

The bars which surround the edge of almost half the mussel, are a wonderful web of bollorium which they form in the organ of respiration, as vessels for the circulation of the fluids; and probably, as some philosophers suppose, as wedges for opening their shells; for we observe two large muscles or tendons for the purpose of shutting them; but we in vain look for their antagonists, or those which are destined to open them. When the mussel wishes to open itself, it relaxes the two muscles or tendons, and swells the fringes, which act as wedges, and separate the shells. The animal shuts up itself by the contraction of two thick fibrous muscles, which are fixed internally to each end of the shell; and these shells are covered with a membrane or epidermis, which unites them together when they are sealed in water, that not the smallest drop can escape from the mussel. When mussels choose to stick they oblong themselves on the sharp edge of their shells, and put forth a fleshy substance susceptible of extension, which serves them as a leg to drag themselves along, in a kind of groove or curved hollow, and these shellers are sometimes used with a membrane or epidermis, which unites them closely together when they are sealed in water, that not the smallest drop can escape from the mussel. When mussels choose to stick they oblong themselves on the sharp edge of their shells, and put forth a fleshy substance susceptible of extension, which serves them as a leg to drag themselves along, in a kind of groove or curved hollow, and these shellers are sometimes used with a membrane or epidermis, which unites them closely together when they are sealed in water, that not the smallest drop can escape from the mussel. When mussels choose to stick they oblong themselves on the sharp edge of their shells, and put forth a fleshy substance susceptible of extension, which serves them as a leg to drag themselves along, in a kind of groove or curved hollow, and these shellers are sometimes used with a membrane or epidermis, which unites them closely together when they are sealed in water, that not the smallest drop can escape from the mussel.
N, or n, the thirteenth letter of our alphabet; as a numeral stands for 900; and with a dash over it, thus N, for 9,000,000. N°. 114, nails for number, i.e. in number; and N. B. for nota bene, note well. Among the ancient Romans, N. denotes Nepos, Nonius, &c. N. C. Nero Caesar, or Nero Claudius; N. L. Non liquis; N. P. Notarius Publicus; and NBL stands for nobilis.

NADIR, in astronomy, that point of the heavens which is diametrically opposite to the zenith, or point directly over our heads. NADIRAS: a genus of the monandra order, in the discica class of plants; and in the natural method ranking with those of which the order is doubtful. The male calyx is cylindrical and broad; the corolla quadrifid; there is no filament, nor is there any female calyx or corolla; there is one pistil, and the capsule is ovate and unilocular. There is one species, an aquatic of the South of Europe.

NAIL, anguis. See Anatomy, and History.

NAILS, in building, &c. small spikes of iron, brass, &c, which being driven into wood, serve to bind several pieces together, or to fasten something upon them. The several sorts are very numerous; as, 1. back and bottom nails, which are made with flat shanks to hold fast, and not open the wood. 2. Clench-nails, for fastening the clamps in buildings, &c. 3. Clasp-nails, whose heads clapping and sticking into the wood, render the work smooth, so as to admit a plane over it. 4. Clench-nails, used by boat and barge-builders, and proper for any boarded buildings that are to be taken down; because they will drive without splitting the wood, and draw without breaking; of this there are many sorts. 5. Clout-nails, used for nailing on clouts to axles-trees. 6. Deck-nails, for fastening decks in ships, doubling of shipping, and floors of buildings. 7. Dog-nails, for fastening hinges on doors, &c. 8. Flat-points, much used in shipping, and proper where there is occasion to draw and hold fast, and no conven ience of clenching. 9. Jabot-nails, for nailing thin plates of iron to wood, as small hinges on cupboard-doors, &c. 10. Lead-nails, for nailing head, leather, and canvas, to hard wood. 11. Port-nails, for nailing linens to the ports of ships. 12. Pound-nails, which are four square, and are much used in Essex, Norfolk, and Suffolk, and scarcely any where else long, which sit tight in a spiral direction, and with which it sucks the substance of the mussel. Mussels are also subject to certain diseases, which have been supposed to be the cause of those bad effects which sometimes happen from the eating of them.

MYXINE, the hog; a genus of insects belonging to the order of vermox intestini. It has a slender body, carinated beneath; mouth at the extremity, ciliated; the two jaws pinnated; an adspose or rayless fin round the tail and under the belly. The only remarkable is the glutinos, about eight inches long. It inhabits the ocean; enters the mouth of fish when on the books of lines that remain a tide under water; and totally devours the whole, except the head. The Scarborough fishermen often take it in the robbed fish, when drawing up their lines. Limnaeus attributes to it the property of turning water into gube.

NAPEA, a genus of the polyandra order, in the polydeipha class of plants; and in the natural method ranking under the 37th order, columnifere. The calyx is single and cylindrical; the calyx-cells are monoecious and monosporous. There are two species; both of them with perennial roots. Both of them are natives of Virginia and other parts of North America; from the bark of some of the Indian kinds a sort of paper might be procured, capable of being woven into very strong cloth. They are easily propagated by seed, which will thrive in any situation.

NAPTHA a name given to the most liquid bitumens; it is light, transparent, and very inflammable. There are several varieties, found chiefly in Italy, and particularly near Modena. Kempfer, however, says, that great quantities are collected in several parts of Persia; naturalists attribute the formation of the liquid bitumens to the decomposition of those that are solid, by the action of the subterraneous fires. Naphtha is said to be the lightest, which the fire first discengages; it is very volatile, and so combustible, that it catches fire when being brought near it. In Persia, this and the other bitumens are employed for the purpose of giving light in lamps by means of wicks; they may be used also to give heat; for this purpose some naphtha are pared on a few handfuls of earth, and kindled with paper, when it burns briskly, but diffuses a thick smoke, which adheres to everything, and leaves a disagreeable smell. In India, the flame produced by it is wosintered, and the heat it emits is used for dressing victuals; and in some cases it has been successfully employed in paralytic diseases. See Bitumen.

NARCIISSUS, a genus of the monogyonia order, in the hexandra class of plants; and in the natural method ranking under the 9th order, spathaceae. There are six petals; the nectarium is funnel-shaped and monophyllous; the stamens are within the nectarium. There are 15 species; the most remarkable are:

1. The bastard narcissus, or common yellow English daffodil, grows wild in great plenty in many of our woods and meadows, and under hedges, in several parts of England. Its commonness renders it of but
little esteem with many; considered, however, as an early and elegant flower, of exceeding hardiness and easy culture, it merits a place in every garden, especially the double.

2. The biolar, or two-coloured inapplicable narcissus; the varieties are, commonly, single-double-flowered, with the interior petals some white, and some yellow, with sulphur-coloured flowers.

3. The poetis, poetis daubolii, or common white narcissus, is well known. Of this there are varieties with purple-capped petals, yellow petals, double-flowered; all of them with white petals. It is the antient celebrated narcissus of the Greek and Roman poets, which they so greatly extol for its extreme beauty and fragrance.

4. The bullcoccus. From the large spreading nectarium of this species, which is three or four times longer than the petals, narrow at bottom, and widening gradually to the brim, so as to resemble the shape of some old-fashioned hoop petticoats, it obtained the name hoop-petticoat narcissus.

5. The serotinis, or late-flowering small autumnal narcissus.

6. The tazetta, or multiflorous daubolii, commonly called polyanthus narcissus. The varieties of this are very numerous, consisting of about eight or nine principal sorts; each of which has many intermediate varieties, amounting in the whole to greatly above a hundred in the Dutch florists' catalogues, each variety distinguished by a name according to the fancy of the first raiser of it. They are all very pretty flowers, and make a charming appearance in the flower-borders, &c.; they are also finely adapted for blotting in glasses of water, or in pots, to ornament rooms in winter.

7. The jonquilla, or jonquill, sometimes called rush-leaved daubolii. The varieties are, jonquill minor with single flowers; jonquill major with single flowers, starry-flowered, yellow and white flowers, white-flowered, semi-double-flowered, double-flowered, and large double inodorous jonquill; all of them multiflorous, the single in particular; but some varieties, the doubles produce only two, or three flowers from a spath, and the singles commonly six or eight. All the sorts have so fine a shape, so soft a colour, and so sweet a scent, that they are among the most agreeable spring-flowers.

8. The calathus, or multiflorous yellow narcissus.

9. The odoros, oloriferous, or sweet-scented starry-yellow narcissus.

10. The triandrus, or triandrus rush-leaved white narcissus.

11. The trilobus, or trilobate yellow narcissus.

12. The minor, or yellow winter dasolfii.

NARCIOTICS, in medicine, soporiferous medicines, which excite a stupefaction. See the next article.

NARCOTIC PRINCIPLE. It has been long known, that the milky juices which exude from certain plants, as the poppy, lettuce, &c. and the infusions of others, as of the leaves of the digitalis purpurea, have the property of exciting sleep, or, if taken in doses producing a state of apoplexy, or blinding apoplexy, and terminating in death. How far these plants owe these properties to

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certain common principles which they possess, is not known, though it is exceedingly probable that they do. But as a peculiar substance has been detected in opium, the most noted of the narcotic preparations, which possesses peculiar properties in portions in potion, we are warranted, till further experiments elucidate the subject, to consider it as the narcotic principle, or at least as one species of the substances belonging to this genus.

Dil. This narcotic is obtained from the poppy album, or white poppy, a plant which is cultivated in great abundance in India and the East. The poppies are planted in a fertile soil, and well watered. After the flowering is over, and the sepal &c. are digested, and their full size, a longitudinal incision is made in them about sun-set for three or four evenings in succession. From these incisions there flows a milky juice, which soon concretes, and is brought into cakes. In this state it is brought to Europe.

Opium thus prepared is a tough brown substance, has a peculiar smell, and a nauseous bitter acid taste. It becomes softer when held in the hand, burns very readily and strongly. It is a very compound substance, containing sulphur of lime, sulphat of potass, an oil, a resinous body, an extractive matter, glutinous fibres, &c. besides the peculiar narcotic principle to which probably it owes its virtues as a narcotic.

When water is digested upon opium, a considerable portion of it is dissolved, the water taking up several of its constituents. When this solution is evaporated to the constience of a syrup, a gritty precipitate begins to appear, which is considerably increased by diluting the liquid with water. It consists of the several ingredients: namely, resin, oxygenized attractive, and the peculiar narcotic principle which is crystallized. When alcohol is digested on this precipitate, the resin and narcotic substances are taken up, while the oxygenized attractive remains behind. The narcotic principle falls down in crystals as the solution cools, still however coloured with resin. But it may be obtained tolerably pure by repeated solutions and crystallizations.

Water is incapable of dissolving the whole of opium. What remains behind still contains a considerable portion of narcotic principle. When alcohol is digested on this residue, it acquires a deep red colour; and deposits, on cooling, crystals of narcotic principle, coloured by resin, which may be purified by repeated crystallizations. The narcotic principle obtained by either of these methods possesses the following properties:

Its colour is white. It crystallizes in rectangular prisms with rhomboidal bases. It has neither taste nor smell.

It is insoluble in cold water, soluble in about 400 parts of boiling water, but precipitates again as the solution cools. The solution in boiling water does not affect vegetable blues.

It is soluble in 24 parts of boiling alcohol and 100 parts of cold alcohol. When water is mixed with the solution, the narcotic principle precipitates in the state of a white powder.

Hot ether dissolves it, but lets it fall on cooling.

When heated in a spoon it melts like wax. When distilled it froths, and emits white va-
pours, which condense into a yellow oil. Some water and carbonat of ammonia pass into the receiver; and at last carbonic acid gas, ammonia, and carburetted hydrogen gas, are disengaged. There remains a bulky coal, which yields traces of potass. The oil obtained by this process is viscous, and has a peculiar aromatic smell and an acid taste.

It is very soluble in all acids. Alkalies throw it down from these solutions in the state of a white powder. Alkalies render it rather more soluble in water. When they are saturated with acids, the narcotic principle falls down in the state of a white powder, which is redissolved by adding an excess of acid.

Volatile oils, while hot, dissolve it; but, on cooling, they let it fall in an oleaginous state at first, but it gradually crystallizes. If the oil had effects were counteracted by causing the animals to swallow vinegar. This substance is known to be of equal service in counteracting the effects of opium. Derosee used doses that the efficacy of the oil may either be owing to the readiness with which it dissolves the narcotic principle.

Many other substances besides opium possess narcotic virtues; but hitherto they have not been treated by chemists with much attention. The most remarkable are the following:

1. The lactuca virosa, and the sativa or garden-lettuce, and indeed all the lactuca, yield a sticky juice, which, when properly extracted, has very much the appearance of opium, and possesses the same properties. Indeed, Dr. Coxe of Philadelphia affirms, that as good opium may be obtained from the garden-lettuce as from the poppy. It is obtained by incisions at the time when the lettuce is running to seed. The resemblance between the insipid juice of the lactuca virosa and opium is striking.

2. The leaves of the Digitalis purpurea, or fox-glove, are still more powerful than opium. It has been observed that the digitalis, when digested, or distilled, yields the following substances:

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4. The leaves of the Digitalis purpurea, or fox-glove, are still more powerful than opium. It has been observed that the digitalis, when digested, or distilled, yields the following substances:

5. Contina maculatum, or hemlock.

6. Datura stramonium.

7. Ledin paliustris.

To these leaves the purgatives may be added the leaves of Digitalis purpurea, and the leaves of Nicotiana tabacum or tobacco. The list, indeed, might be easily increased; almost all the plants belonging to the natural order of Juris pos-
NATIONAL DEBT.

The principal advantages arising from national debts, and the system of credit on which they are founded, are: 1. The resource they afford in great emergencies, which gives a greater permanency to states, which in former times, for want of such occasional resources, were more liable to internal demage
ments and to foreign subjugation. 2. The equalization of taxes. If the supplies were raised within the year, and the expenses of war were considerable, every individual would be obliged, in consequence of the additional weight of his contributions, greatly to curtail his expenditure; the employment of the poor, and the consumption of the rich, would be considerably diminished; whereas, when taxes are nearly equal, in time of peace and war, the value of every species of property, of industry, and of the circulation of wealth, are maintained on as regular, steady, and uniform a footing, as the uncertainty and instability of human affairs will admit. 3. Their accumulating in the country, which would otherwise be sent out of it; and, by such means, the balance and debits have more influence in this respect than all the laws against the exportation of specie that ever were made. 4. They provide circular the property of the rich, and the amount they hold out to the aversive, prevent the accumulation of private hoards, and bring the whole money and personal property of a country. 5. They attach the people to the government; for every individual creditor is led by his own interest to support the authority on the property and existence of which the security of his property depends. The extent to which this influence is so well understood, that it is not probable the government of any country where a public debt has once existed, will ever permit it to be wholly paid off. 6. They encourage the practice of credit, and the encouragement of credit, by the facility with which individuals can lay out the surplus of their profits, without the risk of commercial bankruptcies, or the increase of expenses and small advantage which landed estates yield, and receive interest on their capital with certainty and regularity.

The disadvantages attending the system of incurring national debts, are: 1. The facility of carrying on war being much increased; while large sums can be easily borrowed, it may frequently cause wars to be protracted, which would have been much sooner brought to a conclusion, and the expense engendered in them experienced the difficulty of destroying the whole expense by taxation. 2. The value of the property of those who have lent their money to the state, depending on the interest to support indiscriminately the measure of government, whatever may be their tendency: they are interested both in practice, and virtue, under every invasion of the constitution of their country. 3. The increase of taxes to pay the interest of the debt, produces an increase in the price of all the necessaries of life, and renders it difficult for the manufacturer of a state in which this system has been carried to a great height, to maintain a successful competition with the subjects of other powers, who may be in a less embarrassed situation. 4. When a nation is engaged, both with debts, a precarious spirit of gambling is engendered, stock-jobbing, with all its train of evil consequences, necessarily arises; and a moneyed interest is erected, the sole employment of which is that of drawing every possible advantage from the wants of individuals, or the necessities of the public. 5. Public debts have a very material influence on the distribution of property. Every new loan must be procured from persons already possessing considerable wealth, and such persons will not lend their money without the expectation of making a profit by it; the increase of the debt is, therefore, to them a source of increasing additional taxes attendant upon it bears but a small portion; and if the government possesses no revenue but what is drawn from the people, whatever it pays to one description of men cannot be drawn principally from others; thus the additional income acquired by moneyed men, by taking advantage of the necessities of the state, is, in fact, a portion of the income of their less affluent fellow-citizens, raising money so fast as it circulates through the medium of the government, and which, in a much greater proportion than it increases their wealth, must render those poorer from whom it is drawn.

The national debt of Great Britain commenced in the reign of William III. The war which began in 1669 being very expensive, and the grants of parliament not supplying the necessary funds, the government,帐 first produce of particular taxes was assigned for repayment of the principal and interest of the money borrowed; large sums were also raised on life-assuratums, and annuities for terms of years; and the funds established for payment of these debts being generally inadequate to the charge upon them, occasioned great deficiency, and the war, amounted to 5,160,450l. 12s. 9d. in 1698, and was charged on the continuation of various duties which had been granted for short terms. The total amount of the funded and unfunded debts in the year 1697, was 192,094,947l. 10s. 8d. The frequent expectation of the different funds, and their general deficiency from the diminution of the revenue, in consequence of which the interest due upon the national debt to government was often long in arrear, reduced public credit at this period to a very low ebb, and rendered persons who had money very reluctant in advancing it to the government, though paid what would now be called an exorbitant interest; the accumulation of the public debts caused serious apprehensions among people of property of all descriptions.

The great expense of the war during the reign of queen Anne was chiefly defrayed by the sale of annuities for different terms, but mostly for 99 years; and money was not only borrowed to pay the interest of loans, but often to pay the deficiency of that interest; or, what is much the same thing, the arrears of interest were converted into principal, by
NATIONAL DEBT.

which means, and from great mismanagement of the public finances, the debt rapidly increased, so that at the end of the year 1727, the total of the funded debt amounted to £12,235,039, or 4.25d. of which it must be remembered that upwards of three million and a half was additional capital created by the South Sea company's subscription.

The whole sum paid off by the sinking fund from its establishment to the year 1739, was closer than £5,298,341. The total amount of the debt at this period, was £3,054,635. 3s. 4d.

The war with Spain and France, which began in the same year, increased the debt to £13,303,315. 1s. 0d., on which amount the interest of money, which had been during the war to upwards of 4 per cent. fell, together with the creation of hostilities terminated the loans of government, and the administration seized the moment of increased prosperity to propose another important reduction of interest. Towards the end of 1739, 3 per cent. stock had been for some months above par, and Parliament passed by which the interest was reduced on all the public debts redeemable by law, which then carried 4 per cent. interest, forming to a capital of £3,475,6s. 4d. The proprietors, on signifying their intention to the reduction, were to have 4 per cent. interest to the 25th December following, thence 34 per cent. till 25 December, 1757, and after- wards 3 per cent. per annum. Upwards of three millions remained unsubsisted, which was therefore paid off, by money borrowed at 3 per cent., and thus a saving of £1,735,6s. 4d. per annum was effected, which ought to have been transferred materially to the reduction of the debt. Little progress, however, was made in diminishing the capital of the debt; and at the commencement of the war in 1755 it amounted to £7,440,886l. 8s. 2d.

The great expenses of the war rendered the loans of greater magnitude than had ever before been raised, and the debts incurred were somewhat increased by the practice of entitling the persons lending the money to the same per cent. in all cases, usually advanced; so that at the end of the war, including the loan of 1763, they amounted to £14,691,631l. 13s. 4d., and the annual interest was £4,708,734l. 12d.

During the course of 12 years of peace, little was done in reality towards diminishing the amount of the debt; for although in each year from 1755 to 1775, some small portion of the funded debt was paid off, the whole amounted to only £1,983,534, being a less amount than had sometimes been borrowed in one year of war; and the debt was far from being diminished even that amount, as during the same period a new debt of £6,032,500l. was contracted, by borrowing money on 3 per cent. stock, in order to redeem 4 per cent.

The American war was entered into with a funded debt of £9,333,031l., including an estimated value of the long annuities and exchequer annuities, and an unfunded debt of about £6,300,000, making together £15,634,031l., the interest on which amounted to £642,021l. per annum. The expenses of this war greatly exceeded those which had preceded it; and the increase of the debt was much greater than had ever been incurred by any country in the same space of time. The following statements will shew the extent of the sums borrowed, and the additions thus made to the annual burthen of the country:

<table>
<thead>
<tr>
<th>Year</th>
<th>Money bor.</th>
<th>Debt created.</th>
<th>Interest</th>
</tr>
</thead>
<tbody>
<tr>
<td>1770</td>
<td>£2,060,000</td>
<td>£2,150,000</td>
<td>£64,500</td>
</tr>
<tr>
<td>1777</td>
<td>£5,000,000</td>
<td>£5,000,000</td>
<td>£225,000</td>
</tr>
<tr>
<td>1778</td>
<td>£6,000,000</td>
<td>£6,000,000</td>
<td>£240,000</td>
</tr>
<tr>
<td>1779</td>
<td>£7,000,000</td>
<td>£7,000,000</td>
<td>£242,500</td>
</tr>
<tr>
<td>1780</td>
<td>£12,000,000</td>
<td>£12,000,000</td>
<td>£675,000</td>
</tr>
<tr>
<td>1781</td>
<td>£13,000,000</td>
<td>£13,000,000</td>
<td>£690,000</td>
</tr>
<tr>
<td>1782</td>
<td>£15,000,000</td>
<td>£15,000,000</td>
<td>£712,500</td>
</tr>
<tr>
<td>1783</td>
<td>£12,000,000</td>
<td>£15,000,000</td>
<td>£569,000</td>
</tr>
<tr>
<td>1784</td>
<td>£6,000,000</td>
<td>£2,000,000</td>
<td>£91,250</td>
</tr>
</tbody>
</table>

| Total | £75,508,000 | £75,508,000 | £4,119,125 |

From which it appears that a nominal capital of £21,900,000l. was added to the sum of 75,500,000l., actually borrowed, and that the interest on the whole amounted to 5l. 9s. 1d. per cent., on which the perpetual interest was equal to 4l. 6s. per cent., on the whole sum. In addition to the above sums, a very considerable amount of navy debt was funded after the conclusion of the war, which being properly part of the expenses of it, the total debt incurred by the American war may be stated as follows:

<table>
<thead>
<tr>
<th>Year</th>
<th>Debt created.</th>
<th>Interest</th>
</tr>
</thead>
<tbody>
<tr>
<td>1786</td>
<td>£64,048,000</td>
<td>£1,839,450</td>
</tr>
<tr>
<td>1797</td>
<td>£28,750,000</td>
<td>£828,500</td>
</tr>
<tr>
<td>1798</td>
<td>£17,809,922</td>
<td>£598,500</td>
</tr>
<tr>
<td>Total</td>
<td>£151,267,922</td>
<td>£5,461,502</td>
</tr>
</tbody>
</table>

The whole amount of the funded and unfunded debts, including a valuation of the terminable annuities, was on the 5th Jan. 1786, £268,100,379l. 18s. 6d., and the amount of the annual interest £1,312,239l. 7s. 9d.

The magnitude of the public debt, and the consequent low price of the funds, appear at this period to have engaged the serious attention of the government; in consequence of which some new taxes were imposed, in order to raise a surplus of revenue, as the formation of a navy, and for establishing a new sinking fund. In order to ascertain what per cent. of the revenue might be appropriated to this purpose, a select committee of the house of commons was appointed to examine and state the amounts presented to the house relating to the public income and expenditure, and report what might be expected to be the annual amount of the income and expenditure in future. On the 21st March, 1786, the committee made their report; and conceiving that the circumstances of the times rendered any average drawn from the amount of the revenue in former periods in a great degree inapplicable to the situation of the country, they formed an account from the receipt and expenditure to Michaelmas 1775, and from January 1786, from which it appeared, that at the former period there was a surplus of 911,000l., and at the latter a surplus of 519,000l. less than one million per annum would be very inadequate to the purpose for which it was designed, new taxes were imposed for raising the surplus revenue to this sum; and in order the more effectually to prevent the ministers from diverting it to any other purpose, the mode was adopted which had been frequently suggested, of vesting the annual sums in the hands of commissioners; some other
### NATIONAL DEBT

#### PROGRESS OF THE NATIONAL DEBT FROM ITS COMMENCEMENT TO MIDsummer 1802

<table>
<thead>
<tr>
<th>Description</th>
<th>Amount in £</th>
<th>Interest and Management in £</th>
</tr>
</thead>
<tbody>
<tr>
<td>National Debt at the Revolution, 1688</td>
<td>14,304,920</td>
<td>29,883</td>
</tr>
<tr>
<td>Increase during the reign of William III</td>
<td>1,570,439</td>
<td>1,071,907</td>
</tr>
<tr>
<td>Amount at the Revolution of Queen Anne</td>
<td>16,875,359</td>
<td>3,910,842</td>
</tr>
<tr>
<td>Increase during the reign of Queen Anne</td>
<td>3,156,299</td>
<td>1,841,582</td>
</tr>
<tr>
<td>Amount at establishment of sinking fund, 1716</td>
<td>49,564,501</td>
<td>3,152,524</td>
</tr>
<tr>
<td>Increase during the reign of Geo. I</td>
<td>4,054,554</td>
<td>241,958</td>
</tr>
<tr>
<td>Amount at the accession of Geo. II</td>
<td>53,109,159</td>
<td>2,910,566</td>
</tr>
<tr>
<td>Decrease of annuity charge</td>
<td>6,064,502</td>
<td>2,946,541</td>
</tr>
<tr>
<td>Amount at commencement of the War, 1739</td>
<td>46,854,623</td>
<td>1,884,305</td>
</tr>
<tr>
<td>Increase during the War</td>
<td>1,189,140</td>
<td>1,084,679</td>
</tr>
<tr>
<td>Amount at the end of the War in 1748</td>
<td>78,985,512</td>
<td>2,031,564</td>
</tr>
<tr>
<td>Decrease during the Peace</td>
<td>5,414,126</td>
<td>2,093,264</td>
</tr>
<tr>
<td>Amount at the commencement of the War, 1755</td>
<td>74,580,880</td>
<td>2,671,840</td>
</tr>
<tr>
<td>Increase during the War</td>
<td>2,183,981</td>
<td>2,829,114</td>
</tr>
<tr>
<td>Amount at the end of the War, 1762</td>
<td>141,691,313</td>
<td>4,706,734</td>
</tr>
<tr>
<td>Decrease during the Peace</td>
<td>57,426,545</td>
<td>2,299,234</td>
</tr>
<tr>
<td>Amount at commencement of the American War</td>
<td>133,492,501</td>
<td>4,476,821</td>
</tr>
<tr>
<td>Increase during the War</td>
<td>132,157,328</td>
<td>4,554,114</td>
</tr>
<tr>
<td>Amount at the conclusion of the American War</td>
<td>286,179,379</td>
<td>5,119,222</td>
</tr>
<tr>
<td>Increase in the year 1789</td>
<td>1,181,140</td>
<td>56,683</td>
</tr>
<tr>
<td>Amount in 1789</td>
<td>320,983,519</td>
<td>5,069,093</td>
</tr>
<tr>
<td>Redeemed during the Peace</td>
<td>9,411,530</td>
<td>283,832</td>
</tr>
<tr>
<td>Amount at the commencement of the War, 1798</td>
<td>259,947,669</td>
<td>9,258,840</td>
</tr>
<tr>
<td>Increase during the War</td>
<td>330,015,240</td>
<td>8,198,620</td>
</tr>
<tr>
<td>Redeemed during the War</td>
<td>69,694,361</td>
<td>2,177,473</td>
</tr>
<tr>
<td>Amount at conclusion of the War in 1802</td>
<td>590,615,841</td>
<td>19,185,283</td>
</tr>
</tbody>
</table>

Since the period at which the above statement terminates, another war has been entered into, which has already added many millions to the public debt; but as the sum to which it may be increased is beyond the reach even of probable estimate, we can only give the following statement of the total amount of the Debt on the 1st January, 1803, which will also show the different descriptions of Stock and Annuities of which it consists:

### NATIONAL DEBT OF GREAT BRITAIN

<table>
<thead>
<tr>
<th>Description</th>
<th>Amount in £</th>
<th>Interest and Management in £</th>
</tr>
</thead>
<tbody>
<tr>
<td>5 per Cent. Consolidated Annuities</td>
<td>41,389,193</td>
<td>8,4</td>
</tr>
<tr>
<td>4 per Cent. Annuities, 1757 and 1802</td>
<td>9,038,016</td>
<td>16,5</td>
</tr>
<tr>
<td>4 per Cent. Consolidated Annuities</td>
<td>39,723,084</td>
<td>17,2</td>
</tr>
<tr>
<td>3 per Cent. Consolidated Annuities</td>
<td>157,246,269</td>
<td>8,7</td>
</tr>
<tr>
<td>3 per Cent. Reduced Annuities</td>
<td>976,707,092</td>
<td>9,4</td>
</tr>
<tr>
<td>2 per Cent. Consolidated Annuities</td>
<td>1,740,702</td>
<td>9,1</td>
</tr>
<tr>
<td>3 per Cent. Deferred Annuities</td>
<td>1,740,702</td>
<td>9,1</td>
</tr>
<tr>
<td>2 per Cent. Annuities, 1728</td>
<td>1,000,000</td>
<td>0</td>
</tr>
<tr>
<td>Bank Stock</td>
<td>11,695,100</td>
<td>0</td>
</tr>
<tr>
<td>South Sea Stock</td>
<td>13,500,000</td>
<td>0</td>
</tr>
<tr>
<td>Old South Sea Annuities</td>
<td>12,300,470</td>
<td>2,7</td>
</tr>
<tr>
<td>New South Sea Annuities</td>
<td>8,349,830</td>
<td>2,10</td>
</tr>
<tr>
<td>South Sea Annuities, 1751</td>
<td>1,019,600</td>
<td>0</td>
</tr>
<tr>
<td>Imperial 3 per Cent. Annuities</td>
<td>7,626,638</td>
<td>6,8</td>
</tr>
<tr>
<td>Value of the Long Annuities</td>
<td>19,026,791</td>
<td>12,6</td>
</tr>
<tr>
<td>Value of the Short Annuities</td>
<td>7,166,590</td>
<td>10</td>
</tr>
<tr>
<td>Do. of the Short Annuities</td>
<td>7,166,590</td>
<td>10</td>
</tr>
<tr>
<td>Do. of the Life Annuities</td>
<td>403,779</td>
<td>6</td>
</tr>
<tr>
<td>Annuities on Lives, with Survivorship, 1765</td>
<td>18,000</td>
<td>0</td>
</tr>
<tr>
<td>Tontine Annuities, 1759</td>
<td>38,043,18</td>
<td>5</td>
</tr>
<tr>
<td>Value of Escheuer Annuities</td>
<td>28,246,144</td>
<td>8,2</td>
</tr>
<tr>
<td>Redeemed by Sinking Fund</td>
<td>30,917,013</td>
<td>0</td>
</tr>
<tr>
<td>Transferred for Land Tax redeemed</td>
<td>14,000,000</td>
<td>0</td>
</tr>
<tr>
<td>Total Funded Debt</td>
<td>33,907,113</td>
<td>0</td>
</tr>
<tr>
<td>Navy, Victualling, and Transport Debt</td>
<td>5,000,000</td>
<td>0</td>
</tr>
<tr>
<td>Army, Barracks, Ordnance, &amp;c.</td>
<td>5,000,000</td>
<td>0</td>
</tr>
<tr>
<td>Treasury Bills, &amp;c.</td>
<td>19,000,000</td>
<td>0</td>
</tr>
<tr>
<td>Total of the Nat. Debt and ann. interest thereon</td>
<td>818,727,113</td>
<td>0</td>
</tr>
</tbody>
</table>

For the comparative value of the different funds, and the mode of transacting business therein, see Public Funds.
NATRUM. See Soda.

NATIVITY, in old law-books, signified villainage or servitude.

NATURAL HISTORY. The object of this branch of science may be divided into two heads; the first teaches us the characteristics, or distinctive marks, of each individual object, whether animal, vegetable, or mineral; the second makes us acquainted with all its peculiarities, as to its habits, its qualities, and its uses. To assist in attaining the first, it is necessary to adopt some system of classification, in which individuals that agree in particular points may be arranged together. In this work we have adopted the Linnaean system, as the most simple and perfect that has been presented to the public.

A knowledge of the second head is only gained by a patient investigation of each particular object; for this we refer the reader to the several genera described in these volumes, under which we have endeavoured to give a brief account of all the interesting and material facts.

The study of natural history consists in the collection, arrangement, and exhibition of the various productions of the earth. These are divided into the three grand kingdoms of nature, the boundaries of which meet together in the zoophytes. See Zoophytes.

Minerals inhabit the interior parts of the earth, in rude and shapeless masses. They are bodies concrete without life and sensation. See Mineralogy.

Vegetables inhabit the surface with verdure, imbibe nourishment through bivalved roots, breathe by leaves, and continue their kind by the dispersion of seed within prescribed limits. They are organized bodies, and have life and sensation. See Botany.

Animals adorn the exterior parts of the earth, respire and generate eggs; are impelled to action by hunger, affections, and pain; and by preying on other animals and vegetables, restrain within proper bounds and proportions the numbers of both. They have organized bodies, and have life, sensation, and the power of locomotion.

Man, the governor and subjugator of all other beings, is, by his wisdom alone, able to form just conclusions from such things as present themselves to his senses, which consist of natural bodies. Hence the first step of wisdom is to know these bodies; and to be able, by marks imprinted on them by the God of nature, to distinguish them from each other, and to affix to every object its proper name. These are the elements of this science; this is the great alphabet of sciences, for if the name is lost, the knowledge of the object is lost also.

The method adopted in natural history, indicates that every body may, by inspection, be known by its peculiar name, and this points out whatever the industry of man has been able to discover concerning it; so that, whilst the greatest apparent confusion, the greatest order is science.

The Linnaean system is divided into five branches, each subordinate to the other: these are, class, order, genus, species, and variety, with their names and characters. In this arrangement, the classes and orders are arbitrary, the genera and species are natural. Of the three grand divisions above referred to, the animal kingdom ranks highest in com-
NAVIGATION, the art of conducting a ship from one point to another. The main end of all practical navigation is, to conduct the ship in safety to her destined port; and for this purpose it is necessary to know in what particular part of the surface of the globe she is at any particular time. This can only be done by having an accurate map of the sea-coasts of all the countries of the world, and, by tracing out the ship's progress along the map, to know at what time she approaches the desired haven, or by obtaining her course in order to reach it. It is therefore a matter of great importance for navigators to be furnished with maps, or charts, as they are called, not only very accurate in themselves, but such as are capable of having the ship's course easily traced upon them, without the trouble of laborious calculations, which are apt to create mistakes. The navigator should have a perfect knowledge of the figure and motion of the earth; the various real and imaginary lines upon it, so as to be able to ascertain the distance and situation of places with respect to one another. He should also be acquainted with the several instruments employed in measuring the ship's way; such as the log, half-mile glass; quadrant to take the altitude of the sun and stars; compass to represent the sensible horizon, and azimuth compass to take the azimuth and amplitude of the sun, in order to know the variation of the magnetic needle. He should have an accurate knowledge of maps and charts of the lands and seas, together with the depth of water, the times and setting in of the tides upon the coasts that he may have occasion to visit, also the currents, of the mould and trim of the ship, and the sail she bears, so as to give allowance may be made for lee-way. By the help of these, he may at all times know the place the ship is in, which way he must steer, and how far he has to run to gain his intended port.

The names of the two great divisions of navigation are taken merely from the kind of charts used. Plane sailing is that in which the plane chart is made use of; and Mercator's sailing, or globular sailing, is that in which Mercator's chart is used. In both these methods, it is easy to find the ship's place with as great exactness as the chart will allow, either by the solution of a case in plane trigonometry, or by geometrical construction.

1. Plane sailing. As a necessary preliminary to our understanding this method of navigation, we shall here give the construction of the plane chart.

1. This chart supposes the earth to be a plane, and the meridians parallel to one another; and likewise the parallels of latitude at equal distances from one another, as they really are upon the globe. Though this method is in itself evidently false; yet, in a short run, and especially near the equator, an account of the ship's way may be kept by it tolerably well.

Having determined the limits of the chart, that is, how many degrees of latitude and longitude, or meridional distance (they being in this chart the same), it is to contain: suppose from the lat. of 60° N. to the lat. of 71° N., and from the longitude of London in 0 deg. to the long. of 50° W.; then choose a scale of equal parts, by which the chart may be contained within, and write a sheet of paper on which it is intended to be drawn.

Make a parallelogram ABCD (Plane Navigation, fig. 1), the length of which A5 from north to south 90°; and suppose the difference of latitude between the limits of 50° and 71°; and the breadth AD from east to west shall contain the proposed 90° degrees of longitude, the degrees being taken from the said scale, and this parallelogram will be the boundaries of the chart.

About the boundaries of the chart make scales containing the degrees, halves, and quarters of degrees (if the scale is large enough); or drawing lines across the chart through every 5 or 10 degrees; let the degrees of latitude and longitude have their respective numbers entered, and the sheet is then fitted to receive the places intended to be delineated thereon.

On a straight slab of a cork board, or stiff paper, let the scale of the degrees and parts of degrees of longitude, in the line AD, be laid close to the edge; and the divisions numbered from the right hand towards the left, being all west longitudes.

Seek in a geographical table for the latitudes and longitudes of the places contained within the proposed limits; and let them be written out in the order in which they increase in latitude.

Then, to lay down any place, lay the edge of the paperboard scale to the divisions on each side the chart, showing the latitude of the place; so that the beginning of its divisions falls on the right-hand border AB; and against the division of the longitude of the given place make a point, and this gives the position of the place proposed; and in like manner are all the other places to be laid down.

Draw lines from one point to the other, where the coast is contiguous, and thus the representation of the lands within the proposed limits will be delineated.

Write the names to the respective parts, and in some convenient place insert a compass, and the chart will be completed.

2. The method by the meridian and rhumb that a ship sails upon, is called, as we have said, the ship's course. Thus, if a ship sails on the N.N.E. rhumb, then her course will be 22° 20'; and so of others, as is manifest from the following table of the angles which every point of the compass makes with the meridian.

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>N. by E.</td>
<td>S. by E.</td>
<td>1</td>
<td>2.99</td>
<td>N. by W.</td>
<td>S. by W.</td>
</tr>
<tr>
<td>N. N. E.</td>
<td>S. S. E.</td>
<td>2</td>
<td>22.30</td>
<td>N. N. W.</td>
<td>S. S. W.</td>
</tr>
<tr>
<td>N. E. by N. S. E. by S.</td>
<td>3</td>
<td>35.48</td>
<td>N. W. by N. S. W. by S.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>N. E. E. E.</td>
<td>4</td>
<td>47.49</td>
<td>N. W.</td>
<td>S. W.</td>
<td></td>
</tr>
<tr>
<td>N. E. by E. S. by E.</td>
<td>5</td>
<td>56.15</td>
<td>W. N. W. by W. S. by W.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>E. N. E. E. S. E.</td>
<td>6</td>
<td>64.42</td>
<td>70.19</td>
<td>70.19</td>
<td></td>
</tr>
<tr>
<td>E. by N. S. by E.</td>
<td>7</td>
<td>75.56</td>
<td>75.56</td>
<td></td>
<td></td>
</tr>
<tr>
<td>East.</td>
<td>8</td>
<td>88.54</td>
<td>88.54</td>
<td></td>
<td></td>
</tr>
<tr>
<td>West.</td>
<td>90.0</td>
<td>90.0</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

3. The distance between two places lying on the same parallel counted in miles of the compass, or the distance of one place from the meridian of another counted as above on the parallel passing over that place, is called meridional distance; which, in plane sailing, goes under the name of departure.

4. Let A (fig. 5), denote a certain point on the earth's surface, AC its meridian, and AD the parallel of latitude passing through it; and suppose a ship to sail from A on the N.N.E. rhumb till she arrives at B; and through B draw the meridian BD, which, according to the principles of plane sailing, must be parallel to CA, and the parallel of latitude BC; then the length of AB, viz. how far the ship has sailed upon the N.N.E. rhumb, is called her distance; AC or BD will be her distance of latitude, or marching CB will be her departure, or easing; and the angle CAB will be the course. Hence it is plain, that the distance sailed will always be greater than either the difference of latitude or departure; it being the hypothesis of a right-angled triangle, whereas of the other two are the legs; except the ship sails either on a meridian or parallel of latitude: for if the ship sails on a meridian, then it is plain, that her distance will be just equal to her difference of latitude, and she will have no departure; but if she sails on a parallel, then her distance will be the same with her departure, and she will have no difference of latitude. It is evident also from the figure, that if the course is less than 4 points, 45 degrees, its complement, viz. the other oblique angle, will be greater than 45 degrees, and so the difference of latitude will be greater than her departure; but if the course is greater than 4 points, then the difference of latitude.
will be less than the departure; and lastly, if the course is just 90°, the difference of latitude will be equal to the departure.

5. Since the distance, difference of latitude, and departure, form a right-angled triangle, in which the side between south and west, or the departure is the course, and the other its complement; therefore, having any two of these given, we can (by plane trigonometry) find the rest, and hence arrive the cases of plane-sailing, which are as follow:

Case I. Course and distance given, to find the difference of latitude and departure.

Example. Suppose a ship sails from the latitude of 30° 25' N., to the latitude of 30° 23' N., and the course is 30°, required the difference of latitude and departure, and the latitude come to. Then by right-angled trigonometry we have the following analogy for finding the departure, viz.

\[
\text{As the distance sailed to the Departure BC} = 13.25 \times 10.00000 \\
\text{so is the sine of the course A 25° 30'} = 9.38584 \\
\text{to the departure BC 20.57} \\
\text{so the ship has made her latitude, or made of north, 28.57 minutes.}
\]

And since her former latitude was north, and her difference of latitude also north; therefore, To the latitude sailed from - 30° 23' N 20.57
add the difference of latitude 30° 25' N and the sum is the latitude come to 30°, 54.57'.

By this case are calculated the tables of difference of latitude, and departure, to every degree, point, and quarter point, of the compass.

Case II. Course and difference of latitude given, to find distance and departure.

Example. Suppose a ship in the latitude of 45° 30' N., sails NE 80° Easterly (Plate Navigation, fig. 4), till she comes to the latitude of 46° 55' N.: required the distance and departure made good upon that course.

Since all latitudes are north, and the course also northerly; therefore, From the latitude come to - 46° 55' \\
subtract the latitude sailed from - 45° 30' \\
and there remains - 1° 55' \\
the difference of latitude, equal to 10 miles.

And (by rectangular trigonometry) we have the following analogy for finding the departure BD, viz.

\[
\text{As the course AB} = 10.00000 \\
\text{is to the distance of latitude BD} = 0.23042 \\
\text{so is the tangent of course A} 80° 80' = 9.01904 \\
\text{to the departure BD 73.84} \\
\text{so the ship has got 73.84 miles to the eastward of her former meridian.}
\]

Again, for the distance AD, we have (by rectangular trigonometry) the following proportion, viz.

\[
\text{As the course AB} = 10.00000 \\
\text{is to the secant of the course A 80° 80'} = 10.11175 \\
\text{so is the dif of latitude AB} 90° 54' = 0.95829 \\
\text{to the departure AD} = 72.84 \\
\text{so the ship has sailed 72.84 miles to the north.}
\]

Case III. Difference of latitude and distance given, to find course and departure.

Example. Suppose a ship sails from the latitude of 30° 30' N., on a rhumb between north and west, 124 miles, and is found to have made of westing 86 miles; required the course steered, and the difference of latitude or northing.

In this case (by rectangular trigonometry) we have the following proportion for finding the course AB, (fig. 7), viz.

\[
\text{As the distance AD} = 124 \\
\text{so is the distance AB} = 86 \\
\text{to the size of the course A 45° 34'} = 8.9108 \\
\text{so is the distance to the ship's course north 32° 34'} = 89.35 \\
\text{or west, and WNW 4° 10' west nearly.}
\]

Then for the difference of latitude, we have (by rectangular trigonometry) the following analogy, viz.

\[
\text{As the course AB} = 10.00000 \\
\text{is to the distance AD} = 124 \\
\text{so is the diff of latitude AB} = 90° 02' \\
\text{to the course of the ship A 45° 35'} = 8.9108 \\
\text{so is the size north or west 32° 34'} = 89.35 \\
\text{which is equal to 1 degree and 39 min. nearly.}
\]

Case IV. Difference of latitude and departure given, to find course and distance.

Example. Suppose a ship in the latitude of 34° 20' N., sails ESE, till she has made of easting 90 miles; required the distance and difference of latitude made good.

In this case (by rectangular trigonometry) and by case 2, we have the following proportion for finding the distance (fig. 8), viz.

\[
\text{As the size of the course G 135° 45'} = 9.74474 \\
\text{so is to the departure HM 90} = 1.98527 \\
\text{so is radius} = 10.00000 \\
\text{to the distance GM} = 17.25 \\
\text{2.07338}
\]

Then, for the difference of latitude, we have (by rectangular trigonometry) the following analogy, viz.

\[
\text{As the tangent of course} 23° 45' = 9.92399 \\
\text{so is to the departure HM 90} = 1.98527 \\
\text{so is radius} = 10.00000 \\
\text{to the difference of lat. GH 145.7} = 2.15738 \\
\text{2.54' nearly.}
\]

Again, the latitude the ship sailed from was south, and she sailing still towards the south,

To the latitude sailed from - 23° 45' \\
add the difference of latitude 1° 20' \\
and the sum is 24° 55' N.

And the ship is the latitude she is come to south.

6. When a ship sails on several courses in 24 hours, the reducing all these into one, and thereby finding the course and distance made good upon the whole, is commonly called the reckoning of a traverse.

7. At sea they commonly begin each day's reckoning from the noon of that day, and from that time they set down all the different courses and distances sailed by the ship till noon next day upon the log-board; then from those several courses and distances, they compute the difference of latitude and departure for each course (by Case I. of Plane Sailing); and these, together with the courses and distances, are set down in a table, called the Traverse Table, which consists of five columns: in the first which are placed the courses and distances; in the two next, the differences of latitude belonging to these courses, according as they are north or south; and in the two last, the departures belonging to these courses, according as they are east or west. Then they sum up all the northings and all the southings; and taking the differences of these, they know the difference of latitude made good by the ship in the last 24 hours, which will be north or south, according as the sum of the northings or southings is greatest; the same way, by taking the sum of all the eastings, and likewise of all the westings, and subtracting the lesser of these from the greater the difference will be the departure made good by the ship last 24 hours, which will be east or west according as the sum of the eastings is greater or less than the sum of the westings; then from the difference of latitude and departure made good by the ship last 24 hours, found as above, they find the true course and distance made good upon the whole (by Case 4. of Plane Sailing) as also the course and distance to the intended port.

Example. Suppose a ship at sea, in the latitude of 45° 20' N., on any day it is found to be in a port in the latitude of 43° 50' N., whose departure from the Ll. is 114 miles east; consequently the direct course and distance of the ship is 53° 24' east, which is made good on by reason of the shifting of the winds she is obliged to steer.
the following courses; till noon next day, viz. SE 36 miles, SSE 61 miles, NWW 45 miles, NW 4 west 54 miles, and SE 4 4 east 74 miles: required the course and distance made good the last 24 hours, and the bearing and distance of the ship from the intended port.

The solution of this traverse depends entirely on the 1st and 2nd Cases of Plane Sailing; and first we must (by Case 1) find the difference of latitude and departure for each course. Thus,

1. Course SSE distance 55 miles.
   
   For departure.
   
   As radius
   
   is to the distance
   
   so is the sine of the course
   
   to the departure
   
   10.00000

   For difference of latitude.
   
   As radius
   
   is to the distance
   
   so is the sine of the course
   
   to the dif of latitude
   
   5.72413

2. Course SSE and distance 61 miles.

   For departure.
   
   As radius
   
   is to the distance
   
   so is the sine of the course
   
   to the departure
   
   10.00000

   For difference of latitude.
   
   As radius
   
   is to the distance
   
   so is the sine of the course
   
   to the dif of latitude
   
   7.13840

3. Course NW 4 west and distance 48 miles.

   For departure.
   
   As radius
   
   is to the distance
   
   so is the sine of the course
   
   to the departure
   
   10.00000

   For difference of latitude.
   
   As radius
   
   is to the distance
   
   so is the sine of the course
   
   to the dif of latitude
   
   3.82739

4. Course SE 4 4 east and distance 74 miles.

   For departure.
   
   As radius
   
   is to the distance
   
   so is the sine of the course
   
   to the departure
   
   10.00000

   For difference of latitude.
   
   As radius
   
   is to the distance
   
   so is the sine of the course
   
   to the dif of latitude
   
   8.16702

Now these several courses and distances, together with the differences of latitude and departures deduced from them, being set down in the proper columns in the traverse table, will stand as follow:

**The Traverse Table.**

<table>
<thead>
<tr>
<th>COURSE</th>
<th>DISTANCE</th>
<th>DIFF. OF LAT.</th>
<th>DEPARTURE.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>N.  S.  E.  W.</td>
<td></td>
</tr>
<tr>
<td>SE 8</td>
<td>56</td>
<td>45.57 31.11</td>
<td></td>
</tr>
<tr>
<td>SE</td>
<td>84</td>
<td>39.13 24.5</td>
<td></td>
</tr>
<tr>
<td>NW 4</td>
<td>43</td>
<td>36.67 29.9</td>
<td></td>
</tr>
<tr>
<td>NW 4</td>
<td>43</td>
<td>51.67 15.67</td>
<td></td>
</tr>
<tr>
<td>SE 4</td>
<td>94</td>
<td>67.21 46.94</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>26.57 211.2 108.53 55.58</td>
<td>29.57 55.58</td>
</tr>
</tbody>
</table>

Diff. of Lat. 187.91 46.97 Eps.

**NAVIGATION.**

From the above table it is plain, since the sum of the northings is 256.7, and of the southings 914.58, that the difference between those, viz. 187.91, will be the shilling made good by the ship the last 24 hours; also the sum of the castings being 155.54, and of the bearings 53.56, the difference 46.97 will be the course or departure the ship has made good by the ship's last 24 hours; consequently, to find the true course and distance, round the ship's last true post in time, it will be (by Case 4, of Plane Sailing),

As the difference of latitude 187.91 2.73936 is to the radius 10.00000
so is the departure 46.97 1.77815
to the tangent of the course 14.56° 09.39789 which is SSE 4 3 east nearly. Then for the distance, it is to be,

As radius

is to the difference of latitude 187.91 2.73936
so is the secant of the course 14.56° 10.01319
As the difference of latitude 2.73936 1.28712 consequently the ship has made good last 24 hours, on a SSE 4 east course, 193.7 miles: and since the ship is sailing towards the equator, therefore,

From the latitude sailed from - 44° 24' N take the diff of latitude made good 3° 08' 8

there remains - 41° 16' N the latitude the ship is in north. And because the port the ship is bound for lies in the latitude of 40° 00' N, and consequently south of the ship; therefore,

From the latitude the ship is in - 44° 24' N take the latitude she is bound for - 40° 20' N

is to the cosine of the lat. 10.00000
so is the departure 97 1.98677
to the tangent of the course 45.56° 19.00000

As radius

is to the difference of latitude 97.19637
so is the secant of the course 45.56° 10.13590
As the difference of latitude 1.96337 2.19690 consequently the true bearing and distance of the intended port, is SE 193.7 miles.

**Example 2.** A degree on the equator being 60 miles or nautical miles, required the length of a degree on the parallel of 57° 30'.

By Cor. 8 of the last article, it will be

10.00000 is to the cosine of the lat. 57° 30' 9.76579 so are the minutes of diff. lon. 765 2.18566 to the distance on the parallel 464.1 2.69438

Note: When the length of any parallel of latitude is required, it is the length of any parallel of latitude for the miles answering to a degree on the parallel of 57° 30'.

By this problem a table is constructed, showing the geographical answering to a degree on any parallel of latitude, from which you may observe, that the column marked at the top with D. L. contains the degrees of latitude between the equator and the parallel, and that the adjacent columns marked at the top Miles, contain the geographical miles answering to a degree upon these parallels. See the table in the article Max. Though the table does only shew the miles answering to a degree of any parallel, whose latitude consists of a whole number of degrees; yet it may be made to serve for any parallel whose latitude is some number of degrees and minutes, by making the following proportion.

As 1 degree, or 60 minutes, is to the degrees answering to a degree in the next greater and next less parallel than that proposed; so is the excess of the proposed parallel above the next parallel latitude, to a proportional part; which, subtracted from the miles answering to a degree of longitude in the next less parallel latitude, will give the miles answering to a degree in the proposed latitude.

**Example.** Required to find the miles answering to a degree on the parallel of 56° 44'.

In the next parallel of latitude in the table that than proposed, viz. that of 56°, a degree of which (by the table) is equal to 55.55 miles; and the next greater parallel of latitude in the table, than that proposed, viz. that of 57° 30', a degree of which (by the table) is equal to 39.58 miles; the difference of these is 17, and the distance between these parallels is 1 degree, or 60
NAVIGATION.

When the earth is imagined as a sphere, the distance between any two points on its surface is the shortest of all great circles. The latitude and longitude of any place are the coordinates of that place, and the difference of latitude and longitude between two places is defined by the angle between the plane of the great circle passing through the two places and the plane of the meridian at any one of the places.

Case I. The latitudes of two places, and their difference of longitude given, to find the direct course and distance.

Example. Required the direct course and distance between the Lizard in the latitude of 50° 00' N, and longitude of 4° 14', west, and St. Vincent in the latitude of 17° 10' N, and longitude of 29° 20' W. First, To the latitude of the Lizard 50° 00' N add the latitude of St. Vincent = 17° 10' = 23° 10'. The cosine of the middle parallel 33 33 N = 0.99909. To the same, the cosine of the same parallel 9.86924. To the difference of the same parallel 2.98557. And for that course it will be (by Case 4. of Plane Sailing) = 289° 37' 5.6838 W. miles.

Case II. Sailing. Given the course and distance, to find the latitude and longitude of the place of arrival.

Example. A ship sails on a certain parallel of latitude 50° 00' N. What will be its latitude and longitude when it is 10° 00' W. distant from that place? As already explained, the cosine of the middle parallel between the two places is given by the cosine of the middle parallel of St. Vincent, and the cosine of the middle parallel of the place of arrival, divided by their difference, will give the cosine of the middle parallel of the course sailed. When this is multiplied by 180°, it will give the difference of latitude and longitude of the place of arrival. Then, suppose a ship sails on a certain parallel of latitude 50° 00' N, and is 10° 00' W. distant from that place. The latitude and longitude of the place of arrival will be 40° 00' N, and 60° 00' E. respectively.

Case III. Course and difference of latitude and longitude given; to find the distance sailed and difference of longitude.

Example. Suppose a ship in the latitude of 50° 00' N, sails 50° 00' W. till she has arrived at the latitude of 50° 00' N, and 3° 00' W., and has sailed a distance of 10° 00'. Then, to find the distance sailed and difference of longitude, subtract the distance sailed from the distance between the two places by sight, and divide by the cosine of the middle parallel, which will give the cosine of the difference of longitude of the place of arrival. Then, multiply that cosine by 180°, and divide by the number of minutes in the degree, and you will have the difference of longitude of the place of arrival. When this is subtracted from the difference of longitude of the course, the result will give the difference of longitude of the place of arrival. Then, by the difference of longitude of the place of arrival, and the difference of latitude of the same place, multiply the cosine of the difference of longitude of the place of arrival by the cosine of the middle parallel of the place of arrival, and divide by the cosine of the difference of longitude of the course sailed. When this is multiplied by 180°, it will give the difference of latitude of the place of arrival. Then, by the difference of latitude of the place of arrival, and the difference of longitude of the same place, subtract the difference of latitude of the place of arrival from the difference of longitude of the course sailed, and divide by the cosine of the middle parallel of the place of arrival. When this is multiplied by 180°, it will give the difference of longitude of the place of arrival.

Case IV. Difference of latitude and longitude, given; to find the course and distance of the voyage.

Example. Suppose a ship in the latitude of 50° 00' N, sails 50° 00' W. till she has arrived at the latitude of 50° 00' N, and 3° 00' W., and has sailed a distance of 10° 00'. Then, by the difference of longitude of the place of arrival, and the difference of latitude of the same place, multiply the cosine of the difference of longitude of the place of arrival by the cosine of the middle parallel of the place of arrival, and divide by the cosine of the difference of longitude of the course sailed. When this is multiplied by 180°, it will give the difference of latitude of the place of arrival. Then, by the difference of latitude of the place of arrival, and the difference of longitude of the same place, subtract the difference of latitude of the place of arrival from the difference of longitude of the course sailed, and divide by the cosine of the middle parallel of the place of arrival. When this is multiplied by 180°, it will give the difference of longitude of the place of arrival.

Case V. Given the course and distance, to find the latitude and longitude of the place of arrival.

Example. A ship sails on a certain parallel of latitude 50° 00' N, west 200° 00' W. till she has arrived at the latitude of 50° 00' N, and 3° 00' W., and has sailed a distance of 10° 00'. Then, by the difference of longitude of the place of arrival, and the difference of latitude of the same place, multiply the cosine of the difference of longitude of the place of arrival by the cosine of the middle parallel of the place of arrival, and divide by the cosine of the difference of longitude of the course sailed. When this is multiplied by 180°, it will give the difference of latitude of the place of arrival. Then, by the difference of latitude of the place of arrival, and the difference of longitude of the same place, subtract the difference of latitude of the place of arrival from the difference of longitude of the course sailed, and divide by the cosine of the middle parallel of the place of arrival. When this is multiplied by 180°, it will give the difference of longitude of the place of arrival.

Therefore, the latitude and longitude of the place of arrival will be 40° 00' N, and 60° 00' E. respectively.
NAVIGATION.

equal to 4° 39', the difference of longitude 

Case V. Course and departure given; to find 
the difference of latitude, difference of longitude, and 
distance sailed.

Example. Suppose a ship in the latitude 

of 48° 23' north, sails 235 miles, till she has made 

of westing 193 miles: required the latitude come 
to, the difference of longitude, and the distance 
sailed.

First, For the distance, it will be, (by Case 6. 
of Plane Sailing).
As the sine of the course 32°, 43' 6.74174
is to the departure 123 2.08991
so is radius 10.00000

to the distance 231.1 2.34517
And for the difference of latitude, it will be, 
by the same Case,
As the tang. of course 28°, 43' 9.82489
is to the departure 123 2.08991
so is radius 10.00000

to the diff. of latitude 184 2.28592

equal to 3° 04', and since the ship is sailing to 

wards the equator, the latitude come to will be 

3° 19' north; and consequently the middle 

Paral will be 48° 23'.

Then, to find the difference of longitude, it will be, (Case 2. of Parallel Sailing).
As the course of the mid. par. 48° 23'
is to the departure 123 2.08991
so is radius 10.00000

to min. of diff. of longitude 180 2.28592
which is equal to 3° 04', the difference of longi 
dute westerly.

Case VI. Difference of latitude and departure 
given; to find course, distance, and difference of 
longitude.

Example. Suppose a ship in a latitude of 

48° 27' north, sails between south and east, till 
she has made of easting 146 miles, and is 
then found to be in the latitude of 48° 24' north: required the course, distance, and 
difference of longitude.

First, By Case 4. of Plane Sailing, it will be 

do the course, 193 2.28536
As the diff. of latitude 184 2.28592

so is the departure 123 2.08991

so is radius 10.00000

to the tang. of the course 38° 55' 5.87581

which, because the ship is sailing between 
south and east, will be south 30° 55' east, or SSE ½ 

east nearly.

For the distance, it will be, by the same Case,
As radius 10.00000

is to the diff. of latitude 193 2.28536
so is the secant of the course 36° 55' 10.09718

to the tangent 294 4.26897

Then, for the difference of longitude, it will be, 
by Case 2. of Parallel Sailing,
As the course of the mid. par. 43° 09' 9.84949
is to the departure 146 2.16137
so is radius 10.00000

so is the tangent of the course 30° 29' 9.7601

which, because it is between south and east, 

will be south 30° 29' west, or SSW ¼ west nearly.

And for the distance, it will be, by the same 

Case,
As radius 10.00000

is to the difference of lat. 214 2.28501
so is the secant of the course 30° 29' 10.04461

so is the tangent of the course 30° 29' 9.7601

which, because it is between south and east, 

will be south 30° 29' west, or SSW ¼ west nearly.

Example. Suppose a ship in the latitude of 

48° 27' north, sails upon the following course, 

viz. SW 63 miles, SSW 4 west 43 miles, SSE 54 
miles, and SW 74 miles: required the latitude 

the ship has come to, and how far she has 


First, By Case 2. of this sect, find the 
difference of latitude and difference of longitude 
belonging to each course and distance, and they 
will stand in the following table:

<table>
<thead>
<tr>
<th>Course</th>
<th>Distance</th>
<th>Diff. of Lat.</th>
<th>Diff. of Long.</th>
</tr>
</thead>
<tbody>
<tr>
<td>SW 63</td>
<td>524</td>
<td>47.85</td>
<td></td>
</tr>
<tr>
<td>SSW 45</td>
<td>397</td>
<td>28.62</td>
<td></td>
</tr>
<tr>
<td>SSE</td>
<td>530</td>
<td>14.75</td>
<td></td>
</tr>
<tr>
<td>SW 74</td>
<td>414</td>
<td>81.08</td>
<td></td>
</tr>
<tr>
<td>Diff. of Lat.</td>
<td>1865</td>
<td>137.55</td>
<td></td>
</tr>
</tbody>
</table>

Diff. of Long. 143.80

Hence it is plain the ship has differed her latitude 185.2 minutes, or 3° 6', and has 

come to the latitude of 48° 19' north and has 
differed in difference of longitude 143.8 minutes, 
or 2° 24' 5", which is very strictly true; and it serves, 

without any considerable error, in running of 

450 miles between the equator and parallel of 

300 miles, of 300 miles between that and the parallel of 600 degrees, and of 150 miles 

as far as there is any occasion, and conse 

sequently must be sufficiently exact for 24 

hours run.

Of Mercator's sailing. Though the 

meridians do all meet at the pole, and the 

parallels to the equator do continually 

change, and that in proportion to the co-sines of 

their latitudes; yet in old sea-charts the meridians 

were drawn parallel to one another, and conse 

sequently the parallels of latitude made equal 

distances from one another, and so a degree of longitude 

on any parallel as large as any degree on the 

equator; also in these charts the degrees of latitude 

were still represented (as they are in 

themselves) equal to each other, and to 

those meridians which they intersected. By these means the degrees 

of longitude being increased beyond their 

true, and the more so the nearer they approach the pole, the degrees of latitude 

at the same time remaining the same, it 

is evident that on these charts with respect 

to their latitude and longitude, and conse 

quently their bearing from one another very 

false.

To remedy this inconvenience, so as still to 

keep the meridians parallel, it is plain we 

must protract, or lengthen, the degrees of latitude 

in the same proportion as those of longitude 

are, so that the proportion in east 

ing and westing may be the same with 

that in running and standing. For 

example, if the bearing on the chart 

be N 40° 20' E, which is the 

same as 40° 20' of the equator, 

and the meridian, from which draw BP 

perpendicular to AC, and BG perpendicular to CD: then 

BG will be the sine, and BF or CG the 

co-sine of BD the latitude of the point B; DB 

the tangent and CE the secant of the art 

CD. It has been demonstrated, that any 

arch of a parallel is to the like arch of the 

equator, as the co-sine of the latitude of that 

parallel to radius. Thus any arch, as a 

minute on the parallel described from the point 

B, will be to a minute on the equator, as BF 

or CG is to CD: but since the triangles CGB, 

CD, are similar, therefore CG will be 

to CD as CE to CB, i.e. the co-sine of any 

parallel is to radius as radius is to the 

secant of the latitude of that parallel. But it 

has been just now shown, that the co-sine of any 

parallel is to radius, as the length of any arch 

(as a minute) on that parallel is to the length 

of the like arch on the equator, and therefore the length of any arch (as a minute) on any 

parallel, is to the length of the like arch on 

the equator, as radius is to the secant of 

the latitude of that parallel; and so the length 

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of any arc (as a minute) on the equator, is
longer than the like arc of any parallel, in the same proportion as the secant of the latitude of that parallel is to radius. But since in this projection the meridians are parallel, and cannot be united in one line, except parallel to the equator, no such problem can be propounded. Thus, to find the length of any arc (as a minute) on any parallel, is increased beyond its just proportion, at such rate as the secant of the latitude of that parallel is greater than radius, and therefore, to keep up the proportion of making and working to that of eating and working, upon this chart, as it is upon the globe itself, the length of a minute upon the meridian at any parallel must also be increased beyond its just proportion at the same rate, i.e., as the secant of the latitude of that parallel is greater than radius. Thus to find the length on a minute upon the meridian at the latitude of 75 degrees, since a minute of a meridian is every where equal on the globe, and also equal to a minute upon the equator, let it be represented by unity; then making it as radius to the secant of 75 degrees, so is unity to a fourth number nearly; and therefore, by whatever line you represent one minute on the equator of this chart, the length of one minute on the enlarged meridian at the latitude of 75 degrees, or the distance between the parallel of 75° 01' and that of 60° 01', will be equal to 3 of these lines, and \( \frac{3}{4} \) of one of them. By making the same proportion, it will be found that the length of a minute on the meridian of this chart at the parallel of 0° 00', will be equal to the distance of the parallel of 0° 00' and that of 75° 01', equal to two of these lines. After the same manner, the length of a minute on the enlarged meridian may be found at any latitude; and consequently be printed at the equator, and computing the length of every intermediate minute between that and any parallel, the sum of all these shall be the length of a meridian intercepted between the equator and that parallel; and the length of any parallel of latitude from the equator upon the meridian of this chart, computed in minutes of the equator, forms what is commonly called a table of meridional parts.

1. If the part of the meridian (20 00') represents the latitude of any point B, then (CD) being radius) CE will be the secant of that latitude; but it has been shown above, that radius is to secant of any latitude, as the length of a minute upon the equator is to the length of a minute upon the meridian of this chart at that latitude; therefore CD is CE, as the length of a minute on the equator is to the length of a minute upon the meridian of that chart at that latitude; therefore CD is CE, as the length of a minute on the equator is to the length of a minute upon the meridian of that chart at that latitude; therefore CD is CE, as the length of a minute on the equator is to the length of a minute upon the meridian of that chart at that latitude; therefore CD is CE, as the length of a minute on the equator is to the length of a minute upon the meridian of that chart at that latitude;...
NAVIGATION.

1. As radius
   - is the distance
   - to the course of the course $35^\circ 4^\prime$ 9.83978
to the distance of lat. $25^\circ 22'$ 2.39099
equal to $2^\circ 07'$ since the ship is sailing from a north latitude towards the south, therefore, the latitude taken will be $47^\circ 55'$ north. Hence the meridional difference of latitude will be 195.4.

2. Produce BK to D, till BD is equal to the course of the line $25^\circ 40'$ 2.21484
   so is the course of the line $25^\circ 40'$ 9.9628
   which, because the ship is sailing between north and east, will be north $35^\circ 22'$ east, or NEN $2^\circ 07'$ easterly.

Then, for the difference of longitude, it will be, (by rectangular trigonometry)

R : AC :: T : A : GB

i.e. As the proper diff. of lat. 170 2.20683
   to the course of the course $25^\circ 22'$ 9.84289
   2.27048 10.00000
   equal to $2^\circ 18'$ 48" the difference of longitude
   the ship has made westerly.

Case IV. Given course and both latitudes, viz. the latitude sailed from, and the latitude come to; to find the distance sailed, and the difference of longitude.

Example. Suppose a ship in the latitude of $56^\circ 54'$ north, sails south $3^\circ 45'$ east, until by observation she is found to be in the latitude of $51^\circ 45'$ north; required the distance sailed, and the difference of longitude.

Through A draw AB (fig. 14), to represent the meridian of the ship in the first latitude; and set off from A to B 1.53 the minutes of the proper difference of latitudes, also AG equal to 0.3, the minutes of the enlarged difference of latitude. Through B and G, draw the lines BC and GK perpendicular to AG; and also AK, making with AG an angle of $3^\circ 45'$, which will pass the two former lines in the points C and K; so the course is constructed, and AC and GK may be found from the line of equal parts.

By Calculation:

First, for the difference of longitude, it will be, (by rectangular trigonometry)

R : AC :: T : A : GB

i.e. As radius
   - is the enlarged diff. of lat. 237.2 2.1141
   to the course of the course $35^\circ 4^\prime$ 9.84289
   so is the course of the course $35^\circ 4^\prime$ 9.3407
   2.27048 10.00000
   equal to $2^\circ 18'$ 48" the difference of longitude
   the ship has made easterly.

There might also have been found, by first finding the departure BC (by Case 2, of Plane Sailing), and then it would be AB : BC : : AC : GK, the difference of longitude the ship has made easterly.

Example. Suppose a ship from the latitude of $36^\circ 35'$ N. sails between south and west, till she has made of departure 196.4 miles, and then by observation she is found to be in the latitude of $33^\circ 55'$ north; required the course and distance sailed, and difference of longitude.

Geometrically. 1. Draw AE (fig 16), to represent the meridian of the ship in the first latitude, and make the angle EAC equal to $35^\circ 4^\prime$, the angle of the course; then draw FC parallel to AE, at the distance of 196.4 the minutes of difference of longitude, which will meet AC in the point C. From C let fall upon AE the perpendicular AG, which will be the enlarged difference of latitude. To find which, by calculation, it will be, (by rectangular trigonometry)

R : AC :: T : A : GC

i.e. As the course of the course $35^\circ 4^\prime$ 9.84289
   so is the course of the course $35^\circ 4^\prime$ 9.3407
   2.27048 10.00000
   equal to $2^\circ 18'$ 48" the difference of longitude
   the ship took the merit, difference of latitude 237.2

and there remains - - - - 32.92 - the meridional parts of the latitude come to, viz. $46^\circ 09'$.

Hence, for the proper difference of latitude, from the latitude sailed from - - - - 2.35200 N. take the latitude come to - - - - 16 46 00 N.

and there remains - - - - 2.41 equal to 161, the minutes of difference of latitude.

2. Set off upon AE the length AD equal to 161 the proper difference of latitude, and through D draw DB parallel to CE; then AB will be the direct distance. To find which, by calculation, it will be, (by rectangular trigonometry)

R : AD :: T : A : DB

i.e. As radius
   - is the proper diff. of lat. 155 2.10003
   to the course of the course $35^\circ 4^\prime$ 10.00000
   so is the course of the course $35^\circ 4^\prime$ 10.00000
   2.27048 10.00000
   consequently the ship has sailed south $35^\circ 4^\prime$ east 10.00000 miles, and has diminished her longitude $2^\circ 52'$ 18" easterly.

Case V. Both latitudes and distances sailed, given; to find the direct course, and difference of longitude.

Example. Suppose a ship from the latitude of $35^\circ 25'$ sails between north and east 10.3 miles, and then by observation she is found to be in the latitude of $48^\circ 6'$ north; required the direct course, and difference of longitude.

Geometrically. 1. Draw AE (fig. 16), equal to 100, the proper difference of latitude, and from the point B raise the perpendicular BD; then take 100 in your compasses, and setting down the parts of AB, draw the line BE in B. Produce AB till AC is equal to 235.6 the enlarged difference of latitude.
NAVIGATION.

which, because the ship sails between south and west, will be south 37° 27' west, or SW 06° 39' westerly.

Lastly, for the distance AB, it will be, by (rectangular trigonometry).

\[ S = a \times \sin B \quad \text{and} \quad R = \frac{a}{\tan B} \]

\[ A \times \sin B = 37.5995 \quad \text{to the departure} = 135.4 \quad 2.0175 \quad \text{it is radius} \]

\[ = 100.0000 \quad \text{to the direct distance} = 207.9 \quad 2.3170 \]

CASE IX. One latitude, distance sailed, and departure, given; to find the other latitude, difference of longitude, and course.

Example. Suppose a ship in the latitude of 48° 28' north, sails between south and east 38 miles, and has then made of departure 112° 8' required the latitude come to, the direct course, and difference of longitude.

Geometrically. I. Draw BD (fig. 19) for the meridian of the ship at B; and parallel to it draw FE, at the distance of 112° 8' the departure. Take DB, the distance in your compasses, and fixing one point of them in B, with the other cross the line FE in the point E; then join B and E, and from E draw BE perpendicular to BD the proper difference of latitude, and the angle B will be the course; to find which by calculation.

First, For the course it will be, by (rectangular trigonometry).

\[ BE \times \sin E = \text{the course} \]

\[ BE \times \cos E = \text{the angle} \]

= 2.13988

\[ = 100,0000 \]

so is the distance = 138.2 13998

so is the course of the course = 54° 41' 9.62000

so to the difference of latitude = 79.3 1.00180

= equal to 17° 19'. Consequently the ship has come to the latitude of 47° 19'. Hence the meridional difference will be 1177.

2dly. Produce B to A, till BA is equal to 117.7; and through A draw AC parallel to DE, meeting BE produced in C; then AC will be the difference of longitude; to find which by calculation, it will be found.

\[ BD \times DE = BA \times AC \]

\[ = 1000000 \]

\[ = 138.2 13998 \]

\[ = 54° 41' 9.62000 \]

\[ = 79.3 1.00180 \]

\[ = 17° 19' \]

Hence G being the middle parallel of the chart, and the point in the west, the course BA will be 11° 19', which is the difference of longitude to the parallel of the chart.

Having shown under the article Maps how to construct a Mercator's chart, we shall now proceed to point out its several uses.

Prob. I. Let it be required to lay down a place upon the chart, its latitude, and the difference of longitude between it and some known place upon the chart being given.

Example. Let the known place be the Lizard, lying on the parallel of 30° 00' north, the place to be laid down St. Katherine's on the east coast of America, differing in longitude from the Lizard 42° 39', lying so much to the westward of it.

Let L represent the Lizard on the chart, (fig. 20) lying on the parallel of 50° 00' north, its meridian. Set off AB from E upon the equator EQ 42° 39', towards Q, which will reach from E to T; and this will be the meridian of St. Katherine's then set off from Q to H upon the graduated meridian OB, 38 degrees, and through H draw the parallel of latitude HI, which will meet the former meridian in K, the place upon the chart required.

Prob. II. Given two places upon the chart; to find their difference of latitude and difference of longitude.

Through the two places draw parallels of latitude; then the distance between these parallels, numbered in degrees and minutes upon the graduated meridian, will be the difference of latitude required; and through the two places drawing meridians, the distance between these, counted in degrees and minutes on the equator, or any parallel graduated, will be the difference of longitude required.

Prob. III. To find the bearing of one place from another, upon the chart.

Example. Required the bearing of St. Katherine's at K, from the Lizard at L.

To find the meridian of the Lizard AE, and join K and L with the right line KL; then, by the line of chords, measuring the angle KLE, and with that entering the tables, we shall have the thing required.

This may also be done, by having compasses drawn on the chart (suppose at two of its corners); then lay the edge of a ruler over the two points, and let fall a parallel that take the nearest distance from the centre of the compass next the first place, to the ruler's edge; then, with this distance in your compasses, slide them to the other place, draw them as near to the one close to the ruler, and the other as near as you can judge perpendicular to it, which will describe the rhumb required.

Prob. IV. To find the distance between two given places upon the chart.

This problem admits of four cases, according to the situation of the two places with respect to one another.

Case I. When the given places lie both upon the equator.

In this case their distance is found by converting the degrees of difference of longitude intercepted between them into minutes.

Case II. When the two places lie both on the same meridian.

Draw the parallels of those places; and the degrees upon the graduated meridian, intercepted between those parallels, reduced to minutes, give the distance required.

Case III. When the two places lie upon the same parallel.

Example. Required to find the distance between the points K and N, both lying on the parallel of 50° 00' north. Take from your scale 119° 5' to e: through the parallel of the point K plotted on the chart, and with that extent on KN as a base make the isosceles triangle KPN: then take from the line of sines the co-sine of the latitude, or sine of 72° and set that off from P to S and T. Join S and T with the right line ST, and that applied to the graduated equator will give the degrees and minutes upon it equal to the distance; which, converted into minutes, will be the distance required.

The reason of this is evident from the method of Parallel Sailing; for it has been there demonstrated, that radius is to the co-sine of any parallel, as the length of any arc on the circumference, to the length of the same arc on that parallel. Now, in the isosceles triangle KPN is the distance of the meridians of the two places K and N upon the equator; and since, in the triangle LPT is parallel to KN, therefore PT = PT = PT = PT = PT = TS. Consequently TS will be the distance of the two places K and N upon the parallel of 50° 00'.

If the parallels the two places lie on is not far from the equator, and they not far asunder, then their distance may be found thus: Take the distance between them in your compasses and apply that to the graduated meridian, so that one foot may be as many miles above as the other is below the given parallel; and the degrees and minutes intercepted, reduced to minutes, will give the distance.

Or it may also be found thus: Take the length of a degree on the meridian at the given parallel, and turn that over on the parallel from the one place to the other, as off as you can; then take that distance as far as you can go on the chart before you run over the other places, so many times 60 miles will be contained in the distance between them.

Case IV. When the places differ both in longitude and latitude.

Example. Suppose it was required to find the distance between the two places a and b upon the chart. By Prob. II, find the difference of latitude between them; and take that in your compasses from the graduated equator, which set off on the meridian of 60° a, from a to k; then through draw ke parallel to de; and taking ac in your compasses, apply it to the graduated equator, and it will shew the degrees and minutes contained in the distance required, which multiplied by 60 will give you the miles of distance.

The reason of this is evident; for it is plain that the difference of longitude makes the apparent difference of latitude in the space that you have passed over the chart being known, and the space that you have run over the chart having the course and difference of latitude that a ship has made, to lay down the running of the ship, and find her place upon the chart.

Example. A ship from the Lizard in the latitude of 50° 00' north, sails SSW till she has differed her latitude 50° 40'; required her place upon the chart.

Count from the Lizard at L, on the graduated meridian downwards (because the course is southerly) 50° 40' to g; through which draw a parallel of latitude, which will be the parallel the ship is in; then from L draw a SSW line k, cutting the former parallel in f, and this will be the ship's place upon the chart.

Prob. VI. One latitude, course, and distance sailed, given; to lay down the running of the ship, and find her place upon the chart.

Example. Suppose a ship a in the latitude of 30° 00' north, sails north 37° 20', east 191 miles; required the ship's place upon the chart.

Having drawn the meridian and parallel of the place a, set off the rhumb line ae, making with as an angle of 37° 20'; and upon it set off 191 miles; through that point parallel to ae, and taking sb in your compasses, apply it to the graduated equator, and observe the number of degrees it contains; then count the same number of degrees on the graduated meridian from C to c, and through draw the parallel of course, which will cut sb produced in the point c, the ship's place required.

Prob. VII. Both latitudes and distance sailed, given; to find the ship's place upon the chart.

Example. Suppose a ship sails from a, in the latitude of 20° 00' north, between north and east 191 miles, and is then in the latitude of 45° 00' north. Required the ship's place upon the chart.

Draw sb the parallel of 45°, and set off upon the meridian of a upwards, sb equal to the proper difference of latitude between the equator or graduated parallel. Through sb parallel to de; then, with 191 in your compasses, fixing one foot of them in a, with the other 191 feet in c; joining a c, which produced would meet de in d, the ship's place required.

Prob. VIII. One latitude, course, and difference of longitude, given; to find the ship's place upon the chart.
Example. Suppose a ship from the Lizard in the latitude of 30° 00' north, sails SW 20°, till her difference of longitude is 42° 20'; she required the ship's place upon the chart.

Having drawn the meridian of the Lizard at A, count from E to F upon the equator 42° 30'; and through F draw the meridian EF; then from L draw the SW 20° line LF, and where this meets EF, as at L, will be the ship's place required.

Problem I. One latitude, course, and departure; given; to find the ship's place upon the chart.

Example. Suppose a ship at a in the latitude of 30° 00' north, sails north 20° east, till she has made of departure 116 miles; required the ship's place upon the chart.

Having drawn the meridian and parallel of the place a, set off upon the parallel as equal to 116, and through a draw the meridian B. Take the given distance 116 in your compasses, and set off from a to the parallel B, then you will find the ship's place to be b.

Problem X. One latitude, distance, and departure; given; to find the ship's place upon the chart.

Example. Suppose a ship at a in the latitude of 20° 00' north, sails 191 miles between north and east, till she is then found to have made of departure 116 miles; required the ship's place upon the chart.

Having drawn the meridian and parallel of the place a, set off upon the parallel as equal to 116, and through a draw the meridian B. Take the given distance 116 in your compasses, and set off from a to the parallel B, and you will find the ship's place to be b.

Problem XI. The latitude sailed from, difference of latitude, and departure; given; to find the ship's place upon the chart.

Example. Suppose a ship from a in the latitude of 20° 00' north, sails between north and east, till she is found to have made of departure 116 miles; required the ship's place upon the chart.

Having drawn the meridian of a, set off upon the parallel as equal to 116, and through a draw the meridian B. Take the given distance 116 in your compasses, and set off from a to the parallel B, and you will find the ship's place to be b.

Example. Suppose a ship from the Lizard in the latitude of 30° 00' north, sails SW 20°, till her difference of longitude is 42° 20'; she required the ship's place upon the chart.

Having drawn the meridian of the Lizard at A, count from E to F upon the equator 42° 30'; and through F draw the meridian EF; then from L draw the SW 20° line LF, and where this meets EF, as at L, will be the ship's place required.

Example. Suppose a ship at a in the latitude of 30° 00' north, sails north 20° east, till she has made of departure 116 miles; required the ship's place upon the chart.

Having drawn the meridian and parallel of the place a, set off upon the parallel as equal to 116, and through a draw the meridian B. Take the given distance 116 in your compasses, and set off from a to the parallel B, then you will find the ship's place to be b.
NAVIGATION.

Making it, as 50 feet are to 41 feet, so are 6.5 knots to 5.72 knots, I find that the true rate of sailing is 5.72 miles an hour.

Again, measuring the distance between knot and knot on the log-line to be exactly 50 feet, but that the glass is not 30 seconds; then, if the glass requires longer time than 30 seconds, the distance given will be too great, if estimated by lowering one mile for every knot run in the time the glass runs; and, on the contrary, if the glass requires less time to run than 30 seconds, it will give the distance sailed too small. Consequently, to find the true distance in either case, we must measure the time the glass requires to run out (by the method in the following article); then we have the following proportion, viz.

As the number of seconds the glass runs, is to half a minute, or 30 seconds; so is the distance given by the log, to the true distance.

Example I. Suppose a ship runs at the rate of 74 knots in the time the glass runs; but measuring the glass, I find it runs 34 seconds; required the true distance sailed.

Example II. Suppose a ship runs at the rate of 63 knots; but measuring the glass, I find it runs only 25 seconds; required the true rate of sailing.

Make it, as 25 seconds are to 30 seconds, so are 6.5 knots to 7.8 knots; I find that the true rate of sailing is 7.8 miles an hour.

In order to know how many seconds the glass runs, you may try it by a watch or clock that vibrates second; but if neither of these is at hand, then take a line, and to the end fasten a plummet, hang the other upon a nail or peg so that the distance from the peg to the centre of the plummet is 30 inches: then put this into motion will vibrate seconds; r. e. every time it passes the perpendicular, you are to count one second; consequently, by observing the number of vibrations that it makes during the time the glass is running, we know how many seconds the glass runs.

If there is an error both in the log-line and half-minute glass, viz. the distance between knot and knot and the log-line is either greater or less than 50 feet, and the glass runs either more or less than 30 seconds; then finding out the ship's true distance will be somewhat more complcated, and admit of various cases, viz.

Case I. If the glass runs more than 30 seconds, and the distance between knot and knot is less than 50 feet, then the distance given by the log-line, viz. by allowing 1 mile for each knot the ship sails while the glass is running, will always be greater than the true distance, since either of these errors gives the distance too great. Consequently, to find the true rate of sailing in this case, we must first find the distance or the opposition on which the log-line only is wrong; and then with this we shall find the true distance.

Example I. Suppose a ship is found to run at the rate of 6 knots; but examining the glass, I find it runs 35 seconds; and measuring the log-line, I find the distance between knot and knot to be but 46 feet: required the true distance run.

First, we have the following proportion, viz. As 50 feet : 46 ; 6 knots : 5.52 knots.

Then, As 35 seconds: 30 seconds :: 5.52 knots: 4.73 knots. Consequently the true rate of sailing is 4.73 miles an hour.

Case II. If the glass is less than 30 seconds, and the space between knot and knot is more than 50 feet, then the distance given by the log-line will always be less than the true distance, since either of these errors lessens that true distance.

Example. Suppose a ship is found to run at the rate of 7 knots; but examining the glass, I find it runs only 25 seconds; and measuring the space between knot and knot on the log-line, I find it is 54 feet: required the true rate of sailing.

First, As 25 seconds: 30 seconds :: 7 knots : 8 knots. Then, As 50 feet : 54 feet :: 8 knots : 9.072 knots. Consequently the true rate of sailing is 9.072 miles an hour.

Case III. If the glass runs more than 30 seconds, and the space between knot and knot is greater than 50 feet; or if the glass runs less than 30 seconds, and the space between knot and knot is less than 50 feet: then, since in either of these two cases the effects of the errors are contrary, it is plain the distance will sometimes be too great, and sometimes too little, according as the greater quantity of the error line on the log-line will be evident from the following examples:

Example I. Suppose a ship is found to run at the rate of 94 knots per glass; but examining the glass, it is found to run 30 seconds; and by measuring the space between knot and knot, it is found to be 38 feet; required the true rate of sailing.

First, As 50 feet : 58 feet :: 9.5 knots : 11.20 knots. Then, As 38 seconds : 30 seconds :: 11.02 knots : 8.7 knots. Consequently the ship's true rate of sailing is 8.7 miles an hour.

Example II. Suppose a ship runs at the rate of 60 knots per glass; but examining the glass, it is found to run only 20 seconds; and by measuring the space between knot and knot, it is found to be 38 feet: required the true rate of sailing.

First, As 50 feet : 38 feet :: 4.56 knots : 9.5 knots. Then, As 20 seconds : 30 seconds :: 4.56 knots : 6.84 knots. Consequently the true rate of sailing is 6.84 miles an hour.

But if in this case it happens, that the time the glass takes to run, is to the distance between knot and knot, as 30, the seconds in half a minute, is to 50, the true distance between knot and knot; then it is plain, that whatever number of seconds the glass consists of, and whatever number of feet is contained between knot and knot, yet the distance given by the log-line will be the true distance in miles.

The meridian and the horizontal, or any plane through the horizon in four points, at 90 degrees distance from one another, viz. North South, East, and West; that part of the meridian which extends itself from the place of the north point of the horizon is called the north line; that which tends to the south point of the horizon is called the south line; and that part of the prime vertical which extends toward the right hand of the observer, when his head is turned toward the west line, is called the east line, and lastly, that part of the prime vertical which tends toward the left hand is called the west line; the four points in which these lines meet the horizon are called the cardinal points.

In order to determine the course of the wind and to discover the various alterations or shifting, each quadrant of the horizon, intercepted between the meridian and prime vertical, is usually divided into eight equal parts, and consequently the whole horizon into thirty-two; and the lines drawn from the place on which the observer stands, to the points of division in his horizon, are called rhumb-lines; the four principal of which are those described in the preceding paragraph, each of them having its name from the cardinal point in the horizon towards which it tends: the rest of the rhumb-lines have their names compounded of the principal lines on each side of them, as in the figure; and over withiows of these lines the course of the wind is directed, that wind takes its name accordingly. See Magnetism.

Hence it follows, that all rhumbs, except the four cardinlls, must be curves or hemispherical lines, always tending towards the pole, and approaching it by infinite gyration, or turnings, but never falling into it. Thus let P, F, E, and G be the arch of the equator, PF, PA, &c. meridians, and EFGIKL any rhumb; then because the angles PEF, PFG, &c. are by the nature of the rhumb-line equal, it is evident that it will form a curve-line only if we always approach the pole P, but never falling into it; for if we were possible for it to fall into the pole, then it would follow, that the same line could in an infinite number of other lines at equal angles, in the same point, which is absurd.

Because there are 32 rhumbs or points in the compass equally distant from one another, therefore the angle contained between any two of them adjacent will be 11° 15', viz. 70 of 360°; and so the angle contained between the meridian and the NNE will be 11° 15', and between the meridian and the WNW will be 23° 30'; and so of the rest. See Table of the angles &c. at the beginning of the article.

Concerning currents, and how to make proper allowances. I. Currents at certain settings of the stream, by which all bodics (as ships, &c.) moving therein, are compelled to alter their course or velocity, or both; and submit to the motion impressed upon them by the current.

Case I. If the current sets just the course of the ship, i.e. moves on the same rhumb with it; then the motion of the ship is increased, by as much as is the drift or velocity of the current.

Example. Suppose a ship sails SE&S at the rate of 6 miles an hour, in a current that sets SE&S 2 miles an hour; required her true true rate of sailing.

Here it is evident that the ship's true rate of sailing will be 8 miles an hour.

Case II. If the current sets directly against the ship's course, then the motion of the ship is lessened by as much as is the velocity of the current.

Example. Suppose a ship sails SSW at the rate of 10 miles an hour, in a current that sets NNE 6 miles an hour, required the ship's true rate of sailing.

Here it is evident, that the ship's true rate of sailing will be 4 miles an hour. Hence it is plain,
1. If the velocity of the current is less than the velocity of the ship, then the ship will get so much ahead as is the difference of velocity.

2. If the velocity of the current is greater than that of the ship, then the ship will fall so much astern as is the difference of velocities.

3. Lastly, if the velocity of the current is equal to that of the ship, then the ship will stand still, the one velocity destroying the other.

Case III. If the current thwarts the course of the ship, then it not only lessens or augments her velocity, but gives her a new direction, compounded of the course she steers and the setting of the current.

The method of keeping a journal at sea, and how to correct it: by making proper allowance for the leeway, variation, &c. 1. Leeway is the angle that the rhumb-line, upon which the ship endeavours to sail, makes with the rhumb she really sails upon. This is occasioned by the force of the wind or surge of the sea, when she lies to the windward, or is close hauled, which causes her to fall off and glide sideways from the point of the compass she capes at. Thus let N E S W (fig. 22.) represent the compass; and suppose a ship at C capes at, or endeavours to sail upon, the north point of the compass, and the surge of the sea, she is obliged to fall off, and make her way upon the rhumb CB; then the angle angle CB is the leeway; and if that angle is equal to one point, the ship is said to make one point leeway; and if equal to two points, the ship is said to make two points leeway, &c.

2. The quantity of this angle is very uncertain, because some ships, with the same quantity of sail, and with the same gale, will make more leeway than others; it depending much upon the mould and trim of the ship, and the quantity of water that she draws. The common allowances that are generally made for the leeway, are as follow:

(1.) If a ship is close hauled, has all her sails set, and a moderate gale of wind, she is then supposed to make little or no leeway. (2.) If it blows so fresh as to cause the small sails to be had, it is usual to allow one point. (3.) If it blows so hard that the topsails must be backed, then the common allowance is two points for leeway. (4.) If one top-sail must be handled, then the ship is supposed to make between two and three points leeway. (5.) When both topsails must be handled, then the allowance is about four points for leeway. (6.) If it blows so hard as to occasion the forecourse to be handled, the allowance is between 5 and 6 points. (7.) When both main and fore-courses must be handled, then 6 or 6 points are commonly allowed for leeway. (8.) When the mizen is hauled, and the ship is trying all, she is then commonly allowed about 7 points for leeway.

3. Hence, by knowing the leeway, variation, and course steered, we may from thence find the ship's true course; but if there is a current under foot, then that must be tried, and proper allowances made for it, as has been shown in the section concerning currents, from thence to find the true course.

4. After making all the proper allowances for finding the ship's true course, and making as just an estimate of the distance as we can; yet by reason of the many accidents that attend a ship in a day's running, such as different rates of sailing between the times of hours, the heads of the log, the want of due care at the helm by not keeping her steady but suffering her to yaw and fall off, sudden storms when no account can be kept, &c., the latitude by account frequently differs from the latitude by observation; and when that happens, it is evident there must be some error in the reckoning; to discover which, and where it lies, and also how much of the reckoning, you may observe the following rules:

1st. If the ship sails near the meridian, or within 2 or 2 points thereof, then if the latitude by account disagrees with the latitude by observation, it is most likely that the error lies in the distance run; for it is plain, that in this case it will require a very sensible error in the distance to cause any considerable error in the difference of latitude, which cannot well happen if due care is taken at the helm, and proper allowances are made for the leeway, variation, and currents. Consequently, if the course is pretty near the truth, and the error in the distance runs regularly through the whole, we may, from the latitude obtained by observation, correct the distance and departure by account, by the following analogies, viz.

As the difference of latitude by account is to the true difference of latitude, so is the departure by account to the true departure, and so is the difference by account to the true direct distance.

The reason of this is plain: for let AB, fig. 24, denote the meridian of the ship at A; and suppose the ship sails upon the rhumb AE near the meridian, till by account she is found to be at B; and suppose the true difference of latitude by account is AB; but by observation she is found in the parallel EJ, and so her true difference of latitude is AD, her true direct distance AE, and her true departure DE; then, since the triangles ABC, ADE, are similar, it will be AB : AD :: BC : DE, and AB : AD :: AC : AE.

Example. Suppose a ship from the latitude of 45° 30' north, after having sailed upon several courses near the meridian for 24 hours, her difference of latitude is computed to be upon the whole 95 miles southerly, and her departure 34 miles easterly; but by observation she is found to be in the latitude of 43° 10', and consequently her true difference of latitude is 130 miles southerly; then for the true departure, it will be, As the difference of latitude by account, to the true difference of latitude, is 95 to 130, so is the departure by account to the true departure 46.32, and so is the distance by account 100.9, to the true distance 138.

2dly. If the courses are for the most part near the parallel of east and west, and the ship is sailing in the meridian, or near points of the meridian; then if the latitude by account differs from the observed latitude, it is most probable that the error lies in the course or distance, or perhaps both; for in this case it is evident, that by account will be very nearly true; and thence by the help of this, and the true difference of latitude, may the true course and direct distance be readily found by case 4, of plane sailing.

The form of the log-book and journal, together with an example of a day's work, are here subjoined.

To express the days of the week, we commonly use the characters by which the sun and planets are expressed, viz. O denotes Sunday, X Monday, Z Tuesday, W Wednesday, Y Thursday, & Friday, & Saturday.
NAU

The Form of the Log-Book, with the Manner of working Days Work at Sea.

The Log-Book.

14 x 15. Course. Winds. Observations and Accidents. — Day of —

Fair weather: at four this afternoon I took my departure from the 15°. In the latitude of 5° 00' north, it being N.N.E., distance 5 leagues.

16 1 S W E S. The gale increasing and being under all our sails.

After this morning, frequent showers with thick weather till near noon.

The variation reckoned to be one point westerly.

The Log-Book.


N. S. E. W.

S W 50 46.2 29.4
S 6 W 19 15.6 2.3
S W 49 29.7 48.5
S W 65 24.5 59.2 20.0 20.0
S W 25.2 19.5 19.5

Hence the ship, by account, has come to the latitude of 34° 40' north, and has differed her longitude 5° 05' westerly; so this day I have made my way good S. 31° 31' W. distance 157.4 miles.

At noon the Lizard bore from me N. 31° 31' E. distance 157.4 miles; and having observed the latitude, I found it agreed with the latitude by account.

We have under the article Longitude shown the method of finding the longitude at sea by means of timekeepers. For the method of doing the same by lunar observations, we refer to the Nautical Almanac, and the tables that accompany it.

NAUTIUS, in zoology, a genus belonging to the order of vermices testaceae. The shell consists of one spiral valve, divided into several apartments by partitions. There are 17 species, chiefly distinguished by particularities in their shells.

The most remarkable division of the nautilus is into the thin and thick-shelled kinds. The first is called nautilus pappaceus; and its shell is indeed no thinner than a piece of paper when open to the water. This species is not at all fastened to its shell; but there is an opinion, as old as the days of Pliny, that they are inclosed on the small; and goes on shore to feed. When this species is to sail, it expands two of its arms on high, and between these supports a membrane which it throws out on this occasion; this serves for sail; and the two other arms it hangs out of its shell, to serve occasionally as oars or as a steerage; but this last office is generally served by the tail. When the sea is calm, it is common to see numbers of these worms diverging in this manner; but as soon as a storm rises, or any thing gives them disturbance, they draw in their legs, and take in as much water as makes them specifically heavier than that in which they float; and they sink to the bottom. When they rise again, they void this water by a number of holes, of which their legs are full. The other nautilus, whose shell is thick, never quirs that habituation. This shell is divided into 40 or more partitions, which grow smaller and smaller as they approach the extremity or centre of the shell; between every one of these cells and the adjoining ones, there is a communication by means of a hole in the centre of every one of the partitions. Through this hole there runs a pipe of the whole length of the shell. It is supposed by many, that by means of this pipe the fish occasioned pases from one cell to another; but it seems by no means probable, as the fish must undoubtedly be crushed to death by passing through it. It is much more likely that the fish always occupies the largest chamber in its shell; that is, that it lives in the cavity between the mouth and the first partition, and that it never removes out of this; but that all the apparatus of cells and a pipe of communication, which we so much admire, serves only to admit occasionally air or water into the shell, in such proportion as may serve the creature in its intentions of swimming.

Some authors call this shell the concha margaritifera; but this can be only on account of the thin-coloured inside, which is more beautiful than any other mother-of-pearl; for it has not been observed that this species of fish ever produced pearls. It must be observed, that the polypus is by no means confounded with the powerful-nautilus; but all, notwithstanding the great resemblance in the arms and body of the inclosed fish; nor is the conch ammiculus, so frequently found foul, to be confounded with the thick-shelled nautilus, though the concomitances and general structure of the shell are alike in both; for there are great and essential differences between all these genera.

NAZARITES, among the Jews, persons who either of themselves, or by their parents, were dedicated to the observation of Nazarite-ship. They were of two sorts, namely, such as were bound to this observance for only a short time, as a week or month; and those who were bound to it all their lives. All that we find peculiar in the latter way of life is, that they were to abstain from wine and all intoxicating liquors, and never to shave, or cut off the hairs of their heads. The first Nazarite was to avoid all defilement; and if they chanced to contract any pollution before the term was expired, they were obliged to begin afresh. Wo-

NELL

men as well as men might bind themselves to this vow.

NE. ADMITTAS, in law, a writ directed to the bailiff at the suit of one that is possessor of a church, where, on a quarre impedit, &c. depriving, he is doubtful that the bishop will collate his clerk, or admit the other's clerk, during the suit between them.

NEAT, or NET-WEIGHT, the weight of a commodity alone, clear of the cask, bag, case, or even full.

NEBULOUS, cloudy, in astronomy, a term applied to certain of the fixed stars, which shew a dim hazy light, being less than those of the sixth magnitude, and therefore scarce visible to the naked eye.

NECESSITY. The law charges no man with default where the act is compulsory, and not voluntary, and where there are not a consent and election; and therefore if either there is an impossibility for a man to do otherwise, or so great a perturbation of the judgment and reason as in presumption of law man's nature cannot overcome, such necessity carries a privilege in itself.

Necessity is of three sorts: necessity of conservation of life, necessity of obedience, and necessity of the act of God, or of a stranger.

And first, of conservation of life; if a man steals viands to satisfy his present hunger, this is no felony nor larceny.

The second necessity is of obedience; and therefore where Baron and feme commit a felony, the feme cannot be principal nor accessory, because the Baron intends her to have no will in regard of the subject and obedience she owes her husband.

The third necessity is of the act of God, or of a stranger; as if a man is particular tenant for years of a house, and it should be overthrown by thunder, lightning, and tempest, in this case, he is excused of waste. Bec. Elem. 22, 26, 27.

NECK. See Anatomy.

NECKERIA, a genus of the class and order cryptogamia musc, but little known.

NECTARIUM. See Botany. vol. i. p. 254.

NECTRIS, of the hexandrix digitata class and order: the calyx is one-leafed, six-parted; corolla none; styles pendulous; caps. two; superior ovate, one-seeded; many-seeded; there is one species, native of Guiana.

NECYDALEUS, a genus of insects belonging to the order of coleoptera. The fedeis are staccato; the elys are shorter and narrower than the wings; the tail is simple. There are 11 species, chiefly distinguished by the size and figure of the eyle.
the attendance and service of all his liege-men; but he cannot somewhat man out of the realm, or even the public service, except sea-
men and soldiers, the nature of whose em-
ployment necessarily implies an exception. 1 Black. 138.

This writ is now mostly used where a suit is commenced in the county court, and the party is a man, and he intending to defeat the other of his just demand, or to avoid the justice and equity of the court, is about to go be-

fore sea, or however, that the duty will be

dangerous if he goes.

If the writ is granted on behalf of a subject, and the party is taken, he either gives security by bond in such sum as is demanded, or he satisfies the court by answering (where the answer is not already in) or by affidavit, that he intends not to go out of the realm, and gives such reasonable security as the court directs, and then he is discharged. P. R. C. 292.

NEGLIGENCE, is, where a person neg-
lcts or omits to do a thing which he is

duty to do, a thing which might eventu-
ally be contrary to his interests, and,

beyond all possibility of being

aggravated, and which prevents the

good of another to keep till such a time, and he has a certain recompence or reward for the

keeping, he shall stand charged for in-

jury by negligence, &c.

NEEA, a genus of insects of the order he-

moerpters; the female of this genus is, stout in-

fected; wings long, cross-complicate, cori-

ceous on the upper part; fore-feet cheliform, the

rest formed for walking. This genus is

aquatic, inhabiting stagnant waters, and prey-

ing on the smaller water-insects, &c. The

largest species yet known, and which very far

surpasses in size all the European animals of

the genus, is the nepa grandis, which is a na-

tive of Surinam and other parts of South

America, often measuring more than three

inches in length. Its colour is a dull yellow-

brown, with a few darker shades or varie-

gations; the under wings are of a semi-trans-

parent white colour, and the abdomen is

terminated by a short tubular process, &c.

Nepa cinerea, or the common water-scorp-

ion, is a very frequent inhabitant of stagnant

waters in our own country, measuring about

an inch in length, and appearing, when the

wings are closed, entirely of a dull brown co-

lour; but on the singular shape, resembling

the body appears of a bright red colour

above, with a black longitudinal band down the

middle; and the lower wings, which are of a

fine transparent white, are decorated with red

veins; from the tail proceeds a tubular hind

process or style, nearly of the length of the

body, and which appears single on a general

view, the two valves of which it consists

being generally applied close to each other

throughout nearly their whole length. The animal

is of slow motion, and is often found creeping

about the shallow parts of ponds, &c. In

the month of May it deposits its eggs on the

soft surface of the mud at the bottom of the wa-

ter; they are of a singular shape, resembling

some of the crowned seeds, having an oval

body, and an upper part surrounded by seven

radiating processes or curved spines; the

young, when first hatched, are not more than

the eighth part of an inch in length. The

scorpion flies only at night, when it wanders

about the fields in the neighbourhood of its

native waters. The larve and pupa differ in

appearance from the complete insect, in hav-

ing only the rudiments of wings, and being of

a paler or yellowish colour. See Plate Nat.

Hist. fig. 292.

Nepa cinocols of Linneys differs ma-

terially from the preceding species, and has

at first view more the aspect of a notiona-

t scorpion, but the body is formed for swim-

ning briskly, and furnished with an edging

of hairs on the inner side. This insect is

less common than the preceding, but is found

in similar situations.

Nepa linearis is an insect of a highly sin-

gular aspect, bearing a distant resemblance to

some of the smaller insects of the genera

mantis and phasma. It measures about an

inch and a half from the tip of the snout to the

beginning of the abdominal style or process,

which is itself of equal length to the former

part, and the whole animal is extremely

slender in proportion to its length; the legs,

are also long and slender, and the chelae or

fore-legs much longer in proportion than the

heads of the second species or nepa cinerea; the
colour of the animal is dull yellowish-brown;

the back, when the wings are expanded,

appearing of a brownish-red, and the under

parts pale yellow.

It inhabits the larger kind of stagnant waters, for

entering the shallower parts during the middle

of the day, when it may be observed to pre-

y on the smaller water-insect, &c. Its motions are

singular, often striking out with its legs in a

kind of starting manner at intervals, and con-

tinuing this exercise for a considerable time.

The eggs are smaller than those of the nepa

cinerea, of an oval shape, and furnished with

a ring of hairs diverging from the top of each.

See Plate Nat. Hist. fig. 293.

There are 14 species.

NEPENTHES, a genus of the tetradi-

order annu, in the gynadria class of plants,

and in the natural method ranking among those of which the order is doubtfiul. The calyx is

quadripartite; there is no corolla; the cap-

sule is quadrilocular. There is one species,

a plant of Ceylon.

NEPER'S RODS, or BONES, an instru-

ment mentioned by J. Nepen, Baron of Mer-

chiston, in Scotland, whereby the multiplic-

ation and division of large numbers are much

facilitated.

NEPER'S ROD, the construction of. Sup-

pose the common table of multiplication to be

made upon a plate of metal, ivory, or paste-

board, and then conceive the several columns

(standing downwards from the digits on the head) to be cut asunder; and these

are what we call Nepen's rods for multiplica-

tion. But then there must be a good number

of each; for as many times as any figure is in the multiplcand, so many rods of that species

(i.e. with that figure on the top of it) must

we have; though this rods of each species will

be sufficient for any example in common aff-

airs; there must be also as many rods of 0's.

But before we explain the way of using these rods, there is another thing to be known, viz. that the figures on every rod are written

in an order different from that in the table.

Thus, the little square space or division in

which the several products of every column

are written, is divided into two parts by a

dotted line; and if the figure is written

the lower to the lower; and if the product is

a digit, it is set in the lower division; if it has

two places, the first is set in the lower, and

the second in the upper division; but the
spaces on the top are not divided. Also there is a rod of digits, not divided, which is called the index-rod; and of this we need but one single rod. See the figure of all the single rods, and also between one another, in plate Mised. fig. 174.

Nepeta’s rod, multiplication by. First lay down the index-rod; then on the right of it set the rod whose top is the figure in the highest position of the multiplier; next to this again set the rod whose top is next the figure of the multiplicand; and so on in order to the first figure. Then is your multiplicand tabulated for all the nine digits; for in the line of squares against every figure of the index-rod, you have the product of that figure, and therefore you have no more to do than to transfer the products and sum them. But in taking out these products stand at your table, and the order in which the figures stand obliges you to a very easy and small addition; thus, begin to take out the figures in the lower part, or unit’s place, of the square of the first rod on the right; add the figure in the upper part of the same rod in the lower part of the next, and so on, which may be done as fast as you can look on them. To make this practice as clear as possible, take the following example.

Example to multiply 4768 by 385. Having set the rods together for the number 4768, against 5 in the index I find this number, by adding according to the rule : 23940.
Against 8 this number : 14992.
Against 3 this number : 13394.
Total product : 186098.

To make the use of the rods yet more regular and easy, they are kept in a flat square box, whose breadth is that of ten rods, and the length of that one rod, as thick as it is tall, or (as many as you please) the capacity of the box being divided into ten cells, for the different species of rods. When the rods are put up in the box (each species in its own cell distinguished by the first figure of the rod set before it on the face of the box near the top), as much of every rod stands without the box as shows the first figure of that rod; also upon one of the flat sides without and near the edge, upon the upper hand the index-rod is placed; and also there is a small square, so that when the rods are applied are laid upon this side, and supported by the edge, which makes the practice very easy; but in case the multiplicant should have more than 9 places, the upper face of the box may be made broader. Some make the rods with four different faces and figures on each for different purposes.

Nepeter’s rods, division by. First tabulate your divisor and index, and you have it multiplied by all the digits, out of which you may choose such convenient divisors as will be next less to the figures in the divisor, and write the index answering in the quotient, and multiply down the work as done. Thus 2710758 divided by 6123, gives in the quotient 356.

Having tabulated the divisor, 6123, you see that 6123 cannot be had in 2719; therefore take five places, and on the rods find a number that is equal, or next less to 2719, which is 27107, which is 3 times the divisor, whereof set 3 in the quotient, and subtract 18390 from the figures above, and there will remain 3428; to which add 8, the next figure of the dividend, and seek again on the rod for it, or the next less, which you will find to be five times; therefore set 5 in the quotient, and subtract 35615 from 34285, and there will remain 3573; to which add 5, the last figure in the divisor, and finding it to be just 5 times the divisor, set 5 in the quotient.

Nepeta, Catmint, or Nepeta, a genus of the gymnospermia order, in the dilydynamia class of plants; and in the natural method ranking under the 42d order, verticillata. The under lip of the corolla has a small middle segment created; the margin of the throat is reflexed; the Stamina approach one another. There are 20 species; the most remarkable is the common nepeta, or catmint. This is a native of many parts of Britain, growing about hedges and in waste places. The plant has a bitter taste, and strong smell, not unlike pennyroyal. An infusion of this plant is reckoned a good cephalic and emmenagogue; being found very efficacious in chronic cases. Two ounces of the expressed juice may be given for a dose. It is called catmint, because cats are very fond of it, especially when it is dewed; for then they will roll themselves on it, and tear it to pieces, chewing in them their mouths with great pleasure.

Nephalium, a genus of the pentandria order, in the monocotyledonous class of plants. The male calyx is quinquenervitate; there is no corolla: the female calyx is quadrifoliate; there is no corolla. There are two germens and two styles on each; the fruit are dry, plumose, and monocious; there is one flower, a herb of the East Indies.

Nephritic Wood, lignum nephritim, a wood of a very dense and compact texture, and of a fine grain, brought from us by New Spain, in small blocks, in its natural state, and covered with its bark. It is to be chosen of a pale colour, sound and firm, and such as has not lost its acrid taste; but the surest test of it is the infusing it in water; for if a piece of it infused only half an hour in cold water, gives it a changeable colour, which is blue or yellow, as variously held to the light. If the phial it is in is held between the eye and the light, the tincture appears yellow; but if the eye is placed between the light and the phial, it appears blue.

This wood is a very good diuretic, and is said to be of great use with the Indians in all diseases of the kidneys and bladder, and in suppression of urin, without cause. It is also recommended in fevers and obstructions of the viscera. The way of taking it, among the Indians, is only an infusion in cold water.

Nephritis. See Medicine.

Nereis, in zoology, a genus of animals belonging to the order of vermes mollusca. The body is oblong, linear, and fitted for creeping; it is furnished with lateral pellucid tentacles. There are 11 species, of which the most remarkable are the five following:

1. The nocillio, or nocillitene nereis, which inhabits almost every sea, and is one of the causes of the luminosity of the water.

These creatures shine like glow-worms, but with a brighter splendour, so as at night to make the element appear as if on fire all around. Their bodies are so minute as to evade examination by the naked eye.

It is sometimes called the sea lantern, or the sea firebug; and is thus described by Grusine: the head is roundish and flat, and the mouth acuminated. The two horns or feelers are short and subulated. The eyes are prominent, and placed on each side of the head. The body is composed of about twenty-three segments or joints, which are much less near the tail than at the head. These segments on both sides the animal end in a short conical apex, out of which proceed a number of hairs; from under these-handles the feet grow in the form of small fleshy subulated segments destitute of any thing like claws. It is scarcely two lines long, and is quite pubescent, and its color is that of water, green. They are found upon all kinds of marine plants, but they often leave them, and are found upon the surface of the water; they are frequent at all seasons, but especially in summer before stormy weather, when they are more agitated and more luminous. Their numbers, and wonderful agility, added to their pellucid and shining quality, do not a little contribute to their illuminating the sea, or myriad of those animals may be contained in the portion of a small cup of sea water. Innumerable quantities of them lodge in the cavities of the scales of fishes, and to them probably do the fishes owe their noctilucent quality.

2. Nereis lacustris, or bog nereis (fig. 2.) The body of the size of a hog’s short bristle, transparent, articulated, and on either side at every articulation provided with a short setaceous foot; internally it is furnished with a variety of oval-shaped articulations, and a back formed by two lines bent backwards. It inhabits marshes abounding in clay, where it remains under ground, pushing out its other extremity by motion. When taken out it twists itself up, and is frequent in Sweden.

3. Nereis cirrosa, or waving nereis. The body is red, hemispheric, with sixty-five notches, furnished on both sides with two rows of bristles. At each side of the head ten filaments, at the sides of the mouth many, twice as long as the former. It dwells in Norway, on racks at the bottom of the sea. It vomits a red liquid with which it tingles the water. See much Nat. Hist. fig. 294.

4. Nereis curcula, or blue nereis. It inhabits the ocean, where it destroys the serpula and ceresalis. fig. 393.

5. Nereis elicula, or giant nereis, is a kind of those large worms that make their way into decayed piles driven down into the sea, which they bore through and feed upon, whence they are called sew-worms, or nereis. From head to tail they are beset on either side with small tufts terminating in three points, which are like the fine hair-pencils used by painters, and composed of shining bristles of various colours. The upper part of the body in this worm is all covered with small hairs. The rings of which it is formed are closely pressed together, and yield to the touch. The three rows of small tufts we have been describing, serve this nereis instead of feet, which it uses to go forwards as fishes do their fins. Fig. 296.

Neria, a genus of vermes testacea; the generic character is; animal a limax; shell univalve, spiral, gibbous, flatish at bottom; aperture semi-circular or sub-oval, periphery truncate, flatish. There are about 80 species of this genus.

Nerium, a genus of the monogynia order, in the pentadentia class of plants, and in the natural method ranking under the 30th
order, contorta. There are two erect foli- 
cles; the seeds plump; the tube of the cor-
olla terminated by a lacerated crown. There are 
are usually them natives of the winter climates; the most remarkable of 
which are, 1. The oleander, South Sea rose; 
this is a beautiful shrub, cultivated in gardens 
and an account of its flowers, which are of a fine red, 
and in clusters, but of an indifferent smell; the whole plant is poisonous, and 
especially the bark of the roots. The double 
variety is beautiful, but it should be kept in a 
shrub. 2. The antisyntemer, a native of 
Ceylon, is the bark of this tree is an article of 
the materia medica, under the name of cossist. 
3. The tinctorium, a new species, with beau-
tiful blue flowers, discovered by Dr. Rox-
burgh at Madras. A detection of the leaves, 
with an addition of linseed-water, makes an in-
digo of fine quality. This is the plant of the 
了一句 is a poisonous plant, in that 
respect resembling aconyrum.

NEUTERIA, a genus of the class and or-
der tamieria de dignia; the corolla funnel-
shaped, four cleft; superior berry tax-celled; 
seeds solitary. There is one species, an 
annual of New Zealand.

NEWES, See Anatomy.

NEWTEN, 1st sect. the fol-
lowers of Nestorius, bishop and patriarch 
of Constantinople; who, about the year 439, 
taught that there were two persons in Jesus 
Christ, the divine and the human, which are 
united not hypothetically or substantially, 
but in a mystical manner: whereas he con-
cluded, that Mary was the mother of Christ, 
and not the mother of God. For this opin-
ion, Nestorius was condemned and deposed 
by the council of Ephesus; and the decree 
of this council was confirmed by the emperor 
Theodorus, who banished the bishop to a 
monastery.

NEWETS, in a ship, a sort of 
grates made of small ropes, seized together with rope, 
or a description of the diagonal of a parallelogram, in 
the same time that it would describe the 
sides by those forces.

2. Hence is explained the composition of 
any one direct force out of two oblique 
one, viz. by making the two oblique forces 
the sides of a parallelogram, and the diagonal 
the direct one.

3. The quantity of motion, which is 
collected by adding the sum of the motions 
directed towards the same parts, and the dif- 
erence of forces that are directed to contrary 
parts, suffers no change from the action of bod-
ies among themselves; because the motion 
which one body loses is communicated to 
another.

4. The common centre of gravity of two 
or more bodies does not alter its state of mo-
 tion or rest by the converse of the bodies 
among themselves; and therefore the com-
 mon centre of gravity of all bodies is acting 
on each other, (excluding external actions 
and impediments) is either at rest, or moves 
uniformly in a right line.

5. The modes of bodies included in a 
given space are the same among themselves, 
whether that space is at rest, or moves uni-
formly in a straight line.

6. If bodies, any how moved among 

NEWTONIAN PHILOSOPHY, the doc-
trine of the universe, or the properties, laws, 
affects, actions, forces, motions, &c. of 

bodies, both celestial and terrestrial, as de- 

divered by Newton.

The chief parts of the Newtonian phi-
losophy, as delivered by the author, except his 
the Optical and Astronomical Principles; &c., are contained in his 
Principia, or Mathematical Principles of Na-
tural Philosophy. He founds his system on the 
following definitions.

1. Quantity of matter is the measure 
of the space, arising from its density and bulk 
conjunctly. The ratio of a double density, in 
the same space, is double in quantity; in a 
double space, is quadruple in quantity; in a 
triple space, is sextuple in quantity, &c.

2. Quantity of motion is the measure 
of the same, arising from the velocity and 

Newton defines the following corollaries: 

1. A body by two forces conjoint will 
describe the diagonal of a parallelogram, in 
the same time that it would describe the 
sides by those forces.

2. Hence is explained the composition of 
any one direct force out of two oblique 
one, viz. by making the two oblique forces 
the sides of a parallelogram, and the diagonal 
the direct one.

3. The quantity of motion, which is 
collected by taking the sum of the motions 
directed towards the same parts, and the dif-
erence of forces that are directed to contrary 
parts, suffers no change from the action of bod-
ies among themselves; because the motion 
which one body loses is communicated to 

"Newtonian Philosophy depends chiefly on the following lemmas, especially the first, containing the doctrine of prime and ultimate ratios."
NEWTONIAN PHILOSOPHY.

Leg. 1. Quantities, and the ratios of quantities, which in any finite time converge continuously to equal velocities, and at that time approach nearer the one to the other than by any given difference, become ultimately equal.

Leg. 2. Shews, that in a space bounded by two right lines and a curve, if an infinite number of parallelograms are inscribed, all of equal breadth; then the ultimate ratio of the curve space, and the sum of the parallelograms, will be a ratio of equality.

Leg. 3. Shews, that the same thing is true when the breadths of the parallelograms are unequal.

In the succeeding lemmas it is shewn, in like manner, that the ultimate ratios of the sine, chord, and tangent, of angles infinitely diminished, are ratios of equality; and therefore that in all our reasonings about these, we may safely use the one for the other; that the ultimate form of evanescent triangles, made by the arc, chord, or tangent, is that of similitude, and their ultimate ratio is that of equality; and hence, in reasonings about ultimate ratios, these triangles may safely be used one for another, whether they are made with the sine, chord, or tangent. He then demonstrates some properties of the ordinates of curvilinear figures; and shews that the spaces which a body describes by any finite force urging it, whether that force is determined, and imparts motion to it continually varied, are to each other, in the very beginning of the motion, in the duplicate ratio of the forces; and lastly, having added some demonstrations concerning the evanescence of angles of contact, he proceeds to lay down the mathematical part of his system, which depends on the following theorems.

Theor. 1. The areas which revolving bodies describe by radii drawn to an immovable centre of force, lie in the same incommensurable planes, and are proportional to the times in which they are described. To this proposition are annexed several corollaries, respecting the velocities of bodies revolving by centripetal forces; and the several proportions of those forces, &c., such as, if all the rays from the centre of such a revolving body are reciprocally as the perpendicular let fall from the centre of force upon the line touching the orbit in the place of the body, the body that moves in any curve line described in a plane, and by a radius drawn to a point either immovable or moving forward with an uniform rectilinear motion, describes about that point areas proportional to the times, it is urged by a centripetal force directed to that point. With corollaries relating to such motions in resisting mediums, and to the direction of the forces when the areas are not proportional to the times.

Theor. 2. Every body that moves in any curve line described in a plane, and by a radius drawn to a point either immovable or moving forward with an uniform rectilinear motion, describes about that point areas proportional to the times, it is urged by a centripetal force directed to that point. With corollaries relating to such motions in resisting mediums, and to the direction of the forces when the areas are not proportional to the times.

Theor. 3. Every body that, by a radius drawn to the centre of another body, any how moved, describes areas about that centre proportional to the times, is urged by a force compounded of the centripetal forces tending to that other body, and of the whole accelerative force by which that other body is impelled. With several corollaries.

Theor. 4. If the centripetal forces of bodies which by equal radii move in different circles, tend to the centres of the same circles; and are to one the other as the squares of the arcs described in equal times, applied to the radii of the circles. With many corollaries relating to the velocities, times, periods, and forces, &c. And, in a scholiast, the author further acquaints us with the means of deducing the foregoing proposition and its corollaries, we may discover the proportion of a centripetal force to any other known force, such as that of gravity. For if it be, by means of its gravity, resolved in a circle concentric to the earth, this gravity is the centripetal force of that body. But from the descent of heavy bodies, the time of one entire revolution, as well as the arc described in any given time, is found by a certain method.

On these and such-like principles depends the Newtonian mathematical philosophy. The author farther shews how to find the centre to which the forces compelling any body are directed, having the velocity of the body given; and finds that the centripetal force is always as the versed sine of the nascent arc directly, and as the square of the time inversely, or directly as the square of the velocity quadratically. And therefore the nascent arc. From these premises, he deduces the method of finding the centripetal force directed to any given point when the body revolves in a circle; and this, whether the centre is near the place of descent; so that all the lines drawn from it may be taken for parallels. And he shews the same thing with regard to bodies revolving in spirals, ellipses, hyperbolae, or parabolae. He concludes, having the facility of the orbes given, to find the velocities and moving powers; and indeed resolves the most difficult problems relating to the celestial bodies with a surprising degree of mathematical skill. These problems and demonstrations are all contained in the first book of the Principia; but an account of them here would neither be generally understood, nor can be comprised in the limits of this work.

In the second book, Newton treats of the properties and motion of fluids, and their powers of resistance, with the motion of bodies through such resisting mediums, those resistances being in the ratio of any powers of the velocity, the resistance being either made in right lines or curves, or vibrating like pendulums.

On entering upon the third book of the Principia, Newton briefly recapitulates the contents of the two former books in these words: "In the preceding books I have laid down the principles of philosophy, principles not philosophical, but mathematical; such, to wit, as we may build our reasonings upon in philosophical enquiries. These principles are, the laws and conditions of certain motions, and powers or forces, which chiefly have respect to philosophy. But lest they should have appeared of themselves dry and barren, I have illustrated them here and there with some philosophical scholiasts, giving an account of such things as are of more general nature, and which philosophy seems equally to be founded on; such as the density and the resistance of bodies, spaces void of all matter, and the motion of light and sounds. It remains, he adds, that from the same principles I now demonstrate the frame of the system of the world. Upon this subject I shall have composed the third book in a popular method, that it might be read by many. But afterwards considering that such as had not sufficiently entered into the principles could not easily discern the strength of the consequences, nor lay aside the prejudices to which they had been many years accustomed, to shew there from the foregoing propositions and its corollaries, which might be raised upon such accounts, I chose to reduce the substance of that book into the form of propositions, in the mathematical way, which should be read by those only who had first made themselves masters of the principles established in the preceding books."

As a necessary preliminary to this third part, Newton lays down rules for reasoning in natural philosophy.

The phenomena first considered are, 1. That the satellites of Jupiter, by radii drawn to his centre, describe areas proportional to the times of description; and that their periodic times, the fixed stars being at rest, are in the same proportion to their distances from that centre. 2. The same thing is likewise observed of the phenomena of Saturn. 3. The five primary planets, Mercury, Venus, Mars, Jupiter, Saturn, with their several orbits, describe certain areas in the same times, the fixed stars being supposed at rest; the periodic times of the said five primary planets, and of the earth, about the sun, are in the same proportion to their mean distances from the sun. 4. The planetary orbits, by radii drawn to the earth, describe areas in no way proportional to the times; but the areas which they describe by radii drawn to the sun are proportional to the times of description. 6. The moon, by a radius drawn to the earth, describes an area proportional to the time of description. All which phenomena are clearly evinced by astronomical observations. The mathematical demonstrations are next applied by Newton in the following propositions.

Prop. 1. The forces by which the satellites of Jupiter are continually drawn off from rectilinear motions, and retained in their proper orbits, tend to the centre of that planet, and are reciprocally as the squares of the distances of those satellites from that centre.

Prop. 2. The same thing is true of the primary planets, with respect to the sun's centre.

Prop. 3. The same thing is also true of the moon, in respect of the earth's centre.

Prop. 4. The moon, moving towards the earth; and by the force of gravity is continually drawn off from a rectilinear motion, and retained in her orbit.

Prop. 5. The same thing is true of all the other planets, both primary and secondary, each with respect to the centre of its motion.

Prop. 6. All bodies gravitate towards every planet; and the weights of bodies towards any one and the same planet, at equal distances from its centre, are reciprocally as the squares of the distances of matter they contain.

Prop. 7. There is a power of gravity tending to all bodies, proportional to the several quantities of matter which they contain.

Prop. 8. In two spheres mutually gravitating each towards the other, if the matter in places on all sides, round about, and equidistant from the centres, is similar, the weight of either sphere towards the other, will be reciprocally as the square of the distance between their centres. And if we should sum together the weights of bodies towards different planets; hence also are discovered the quantities of matter in the several planets; and hence
When heated in an open vessel, it combines with oxygen, and assumes a green colour; and if the heat is continued, acquires a hue of sulphur and phosphoric acid. Crook cott found that sulphuret of nickel may be easily formed by fusion. The sulphuret which he obtained was yellow and hard, with small sparkling facets; but the nickel which he employed was impure.

Phosphuret of nickel may be formed either by fusing nickel along with phosphoric glass, or by dropping phosphorus into it while red hot. It is of a white colour, and when burned, it exhibits the appearance of very slender prisms collected together. When heated, the phosphorus burns, and the metal is oxidized. It is composed of 83 parts of nickel and 17 of phosphorus. The nickel however on which this experiment was made, was not pure.

Nickel is not acted upon by azote, nor does it combine with muriatic acid.

The alloys of this metal are but very imperfectly known. With gold it forms a white, hard, brittle alloy, easily oxidized when exposed to the air; with iron it combines very readily, and forms an alloy whose properties have not been sufficiently examined; with tin it forms a white, hard, brittle mass, which swells up when heated; with lead it does not combine without difficulty; with silver and mercury it refuses to unite; with combination with platinum has not been tried.

The affinities of nickel, and its oxides, are, according to Bergman, as follows:

**Nickel**

- Iron
- Cobalt
- Arsenic
- Copper
- Gold
- Tin
- Antimony
- Platinum
- Bismuth
- Lead
- Silver
- Zinc
- Sulphur
- Phosphorus
- Boracic
- Prussic
- Carbonic

**Oxide of Nickel**

- Oxalic acid
- Muratic acid
- Sulphuric acid
- Tartaric acid
- Nitric acid
- Phosphoric acid
- Fluoric acid
- Soatic acid
- Benzoic acid
- Citric acid
- Lactic acid
- Acetic acid
- Arsenie
- Phosphoric acid
- Boracic
- Prussic
- Carbonic

Nickel, like gold, is to a great extent valueless to the poor. The cost of mining nickel is not great, but the cost of the metal is very high. It is not known to exist in any quantity in the United States, but it is found in small quantities in the western provinces of Canada. It was first discovered in America by the Spaniards about the year 1566, and by them imported into Europe. It had been used by the inhabitants of America long before; and was called by those of the islands yoll, and pruta by the inhabitants of the continent. It was sent into Spain from Tabaco, a province of Yucatan, where it was first discovered, and whence it takes its common name.

There are two varieties of that species of nicotiana which is cultivated for common use; and which are distinguished by the names of Oranokeo, and sweet-scented Tabacco. They differ from each other in the figure of their leaves; those of the former being longer and narrower than the latter. They are tall herbaceous plants, growing to an height of 2 feet, and rising with a strong stem from a white, or yellow, tuber. The stalk, near the root, is upward of an inch diameter, and surrounded with a kind of hairy or yellowish substance, of a yellowish tinge. The leaves are rather of a deeper green, and four or five inches long, and almost at the distance of two or three inches from each other. They are oblong, of a spear-shaped oval, and simple; the largest about eighteen inches long, and exceedingly small in the upper leaves, and than five inches long. The leaves are of a greenish yellow, and acquire a yellowish cast. The stem and branches are terminated by large bunches of flowers, collected in clusters of a delicate red; the edges, when full-blown, inclining to a pale yellow. They continue in succession till the end of the summer; their leaves are of brown colour, and sometimes spotted with a small black spot, containing about 1000; and the whole produce of a single plant is reckoned at about 350,000. The seeds ripen in the month of September.

Mr. Caver informed us, that the Oranokeo, or, as it is called, the long Virginia tobacco, is the kind best suited for bearing the rigour of a northern climate; the strength, as well as the scent, of the leaves, being greater than that of the other; and that the sweet-scented sort, which is said to have a more pungent and strong odour, is not so much esteemed by the tobacco-growing public. The climate of Virginia, too, is generally considered as more favourable to the growth of tobacco than that of any other country in the world. Tobacco thrives best in a warm, kindly, rich soil, that is not subject to be overrun by weeds. In Virginia the soil in which it thrives best is warm, light, and in which the tobacco is well managed, is the seed: nor is it possible that the plant is to be cultivated in Britain, it ought to be planted in a soil as nearly of the same kind as possible. Other kinds of soil might probably be brought into cultivation, but we must rest under the conviction, that whatever mixture of manure we may use, that whatever mixture of manure we may use, and that whatever mixture of manure we may use, and that whatever mixture of manure we may use.
be thoroughly incorporated with the soil. The best site for a tobacco-plantation is the southern declivity of a hill rather gradual than abrupt, or a spot that is sheltered from the north winds; but at the same time it is necessary that the plants enjoy a free air; for without that they will not grow. 

Having sown the seed, on the least appearance of frost after the plants appear, it will be necessary to spread mats over the beds, a little elevated from the ground by poles laid across, that they may not be crushed. When the tobacco has risen to the height of four, it commonly begins to put forth the branches on which the flowers and seeds are produced; but as this expansion, if suffered to take place, would drain the nutrition from the leaves, which are the most valuable part, and thereby lessen their size and efficacy, it becomes needful at this stage to nip off the extremity of the stalk to prevent its growing higher, in some climates the top is commonly cut off when the plants are but two or three inches high. Tobacco is intended to be a little stronger than usual, this is done when it has only 13.

The apparent signs of maturity are these: the leaves, as they approach a state of ripeness, become more corrugated or rough; and when fully developed, with yellow spots on the raised parts; whilst the cavities retain their usual green colour.

Tobacco is subject to be destroyed by a worm; and without proper care to exterminate this enemy, a whole field of plants may soon be lost. This animal is of the homed species, and appears to be peculiar to the tobacco-plant; so that in many parts of America it is distinguished by the name of the tobacco-worm. In what manner it is first produced, or how propagated, is unknown; but it is not discernible till the plants have attained about half their height; and then appears to be nearly as large as a grain. Soon after this it lengthens into a worm; and by degrees increases in magnitude to the size of a man's thumb. It is regular in its form, with its head to its tail, without any diminution at either extremity. The colour of its skin is, in general, green, interspersed with several spots of a yellowish white; and the whole covered with a glittering dust, which is removed by brushing. These worms are found the most predominant during the end of July and the beginning of August; at which time the plants must be particularly attended to, and every leaf carefully searched. As soon as a wound is discovered (and it will not be long before it is perceptible), care must be taken to destroy the cause of it, which will be found near it, and from its unctuous texture may easily be removed. 

When the tobacco is fit for being gathered, on the first morning that promises a fair day, before the sun is risen, take an axe or a long knife, and holding the stalk near the top with one hand, sever it from its root with the other, as low as possible. Lay it gently on the ground, taking care not to break off the leaves, and there let it remain exposed to the rays of the sun throughout the day, or until the leaves, according to the American custom, are thoroughly cured; that is, till they become limber, and will bend away without breaking. But if the weather should prove rainy without any intervals of sunshine, and the plants appear to be fully ripe, they must be housed immediately. This must be done, however, with great care that the leaves, which are in this state very brittle, may not be broken. They are next to be placed under proper shelter, either in a barn or covered lay, so that they cannot be affected by rain or too much air, thinly scattered on the floor; and if the sun does not appear for several days, they must be left to wilt in that manner; but in this case the quality of the tobacco will not be quite so good.

When the leaves have acquired the above-mentioned flexibility, the plants must be laid in heaps, or rather in one heap if the quantity is not too great, and in about 24 hours they will be found to sweat. But during this time, when they have lain for a little while, and begin to ferment, it will be necessary to turn them; bringing those which are in the middle to the surface, and placing those which are at the surface in the middle. The longer they lie in this situation, the darker-coloured the tobacco. After they have lain for three or four days, for a longer continuance might make the plants turn mouldy, they may be fastened together in pairs with cords or wooden pegs, near the bottom of the stalk, and hung across a pole, with the leaves suspended in the same covered place, a proper interval being left between each pair. In about a month the leaves will be thoroughly dried, and of a proper temperature to be taken down. This state may be ascertained by their appearing of the same colour with those imported from America. But this can be done only of tobacco, which is excessively apt to attract the humidity of the atmosphere, which gives it a pliability that is absolutely necessary for its preservation; for if the plants are removed in a very dry season, the external parts of the leaves will crumble into dust, and a considerable waste will ensue.

Care.—As soon as the plants are taken down, they must again be laid in a heap, and covered with wet straw; but capers are always put in about the 3rd week; but this climate may possibly require a longer time. While they remain in this state it will be necessary to introduce your hand frequently into the heap, to discover whether the leaves can be pressed; for in larger quantities this will sometimes be the case, and considerable damage will be occasioned by it. When they are found to heat too much, that is, when the heat exceeds a moderate degree of warmth, the top of the weight by which they are pressed must be taken away; and the cause being removed, the effect will cease. This is called the second, or last sweating, and, when completed, which it generally will be about the time just mentioned, the leaves may be stripped from the stalks for use. Many, however, omit this last sweating.

When the leaves are stripped from the stalks, they are to be tied up in bunches or laps, and kept in a cellar or other damp place; though if not handled in dry weather, but only during a rainy season, it is of little consequence in what part of the house or barn they are laid up. At this period the tobacco is thoroughly cured, and is proper for manufacturing as that imported from the colonies. Tobacco is made up into rolls by the in-
crystallizes

NIMBUS, in antiquity, a circle observed on certain medals, or round the head of some emperors, answering to the circles of light drawn around the images of saints. The name is given to the constellations of Mauritius, Ptolemy, and others, even of the upper empire. See also Meteorology.

NIPA, a genus of the natural order of palms. The male has a spath; the corolla is six-petalled. The female has a spath; corolla none; lip circular.

There is one species, native of the E. Indies. The leaves are used in making mats.

NIPPERS, in a ship, are small ropes about a fathom or two long, with a little truck at one end, and sometimes only a wale-knot. Their use is to help holding off the cable from the main or jigger-capstan, where the cable is so shaggy, so wet, and so great, that they cannot strain it, to hold it off with their bare hands.

NISI PRIUS, in law, a commission directed to the judges of assize, empowering them to try all questions of fact issuing out of the courts at Westminster, which are then ready for trial by jury. The original of which name is this: all causes connected in the courts of Westminster-hall are, by course of the courts, appointed to be tried on a day fixed in some Easter or Michaelmas term, by a jury returned from the county wherein the causes are assizes; but with this proviso, nisi prius justice was and assigned vestiary: that is, unless before the day prefixed the judges of assize come into the county in question, which they always do in the vacation preceding each Easter and Michaelmas term, and there try the cause. And then, upon the return of the verdict given by the jury to the court above, the judges there give judgment for the party to whom the verdict is a Black. 29. See Assizes.

NISOLS, in crystallography, the decamaria star, in the diapedia class of plants, and in the natural method ranking under the 52d order, papilionaceae. The calyx is quinque- dentate; the capsule monospermous, and terminated by a single wing. There are two species, tree of Carthageni.

NITIDULA, a genus of insects of the coleoptera order. The generic character is, antennae clavate, the club solid; shells margined; head prominent; thorax a little flattened, margined. There are upwards of 30 species of this genus.

NITRARIA, a genus of the monogynium order, in the dodecanmia class of plants, and in the natural method ranking with those of which the order is doubtful. The corolla is pentapetalous, with the petals arched at the top; the calyx eximant; the stamens 12; the fruit a monospermous plum. There is one species, a shrub of Siberia.

NITRATS, salts formed by the nitric acid. The most important of the nitrates have been long known; and in consequence of the quantities which they possess, no class of bodies has excited greater attention, or been examined with more unwearied industry. See Nitre. They may be distinguished by the following properties:

1. Soluble in water, and capable of crystallizing by cooling of 2. When heated to redness, along with combustible bodies, a violent combustion and detonation are produced. 3. Sulphuric acid denatures from them fumes, which have the odour of nitric acid. 4. When heated, this acid and the oxymuriatic acid is exhaled. 5. Decomposed by heat, and yield at first oxygen gas. The nitrates at present known are 12 in number. Few of them combine with an excess of acid, and the nitrates are almost any supernitrates, or subnitrates.

NITRE, or nitrat of potash. As this salt, known also by the name of saltpetre, is produced naturally in considerable quantities, particularly in Egypt, it is highly probable that the patients were acquainted with it; but scarcely anything certain can be collected from their writings. If Pliny mentions it at all, he confounds it with soda, which was known by the names of nitrum and nitrata. It is certain, however, that it has been known from time immemorial. Roger Bacon mentions this salt in the 13th century under the name of nitrite.

No phenomenon has excited the attention of chemists philosophers more than the continuous reproduction of nitre in certain places, and that it is not produced from them. Inordinate quantities of this salt are necessary for the purposes of war; and as nature has not laid up great magazines of it, as she has of other salts, this annual reproduction is the only source from which it can be procured. It became therefore of the utmost consequence, if possible, to discover the means which nature employed in forming it, and in order to enable us to imitate her processes by art, or at least to accelerate and facilitate them at pleasure. Numerous attempts accordingly have been made to explain and to imitate these processes.

Lemery the younger advanced, that all the nitre obtained exists previously in animals and vegetables; and that it is formed in these substances by the processes of vegetation and mineralization. But it was soon discovered that nitre exists, and is actually formed, in many places where no animal nor vegetable substance is decomposed; and decomposed, and consequently this theory was as untenable as the former. So far indeed is it from being true that nitre is formed by these processes alone, that the quantity of nitre in plants has been found to depend entirely on the soil in which they grow.

At last, by the numerous experiments of several French philosophers, particularly those of Thouvenel, it was discovered that nothing else is necessary for the production of nitre than a basis of lime, heat, and an open but not too free communication with dry atmospheric air. When these circumstances combine the acid is first formed, and afterwards the alkali makes its appearance. How the furnaces furnishes materials for this production is easily explained, now that the component parts of the nitric acid are known to be oxygen and azote; but how lime contributes to their union it is not so easy to see. The occurrence of the potass is equally extraordinary. If any thing can give countenance to the hypothesis that potass is composed of lime and azote, it is this singular fact.

Nitre is found abundantly on the surface of the earth in India, South America, and even in some parts of Spain. In Germany and France it is obtained by means of artificial nitre-beds. They consist of the refuse of animal and vegetable bodies undergoing slow decomposition, and various decarburates and other earths. It has been ascertained that if oxygen gas is presented to azote at the instant of its disengagement, nitric acid is formed. This seems to explain the origin of the acid in the nitrates. The azote decomposed from these putrefying animal substances combines with the oxygen of the air. The potass is probably furnished, partly at least, by the vegetables and the soil.

The nitre is extracted from these beds by liquifying the earthy matters with water. This water, when sufficiently impregnated, is evaporated, and a brown-coloured salt obtained, known by the name of crude nitre. It consists of nitre, common salt, nitrate of lime, and various others. The foreign salts are either separated by repeated crystallizations, or by washing the salt repeatedly with small quantities of water; for the foreign salt being more soluble are taken up first.

Nitre, when quick, is obtained in six-sided prisms, terminated by six-sided pyramids; but for most purposes it is preferred in an irregular mass, because in that state it contains less water. The primitive form of its crystals, according to Hauy, is a rectangular hexahedron, composed of two four-sided pyramids applied base to base; two of the sides are inclined to the other pyramid at an angle of 120°; the other four are in the plane of the six-sided prism. The form of its integrant particles is the tetrahedron. The six-sided prism is the most common form which it assumes. Sometimes, instead of six-sided pyramids, these prisms are terminated by 18 facets, disposed in three ranges of six, as if three truncated pyramids were piled on each other; sometimes it crystallizes in tabular.

The specific gravity of nitre is 1.9309. Its taste is sharp, bitter, and cooling. It is very brittle. It is soluble in seven times its weight of water at the temperature of 60°, and in nearly its own weight of boiling water. It is not altered by exposure to the air.

When exposed to a boiling heat, part of the salt is evaporated away, and the remainder crystallized in an opaque mass, which has been called mineral crystal. When ever it melts it begins to disengage oxygen, and by keeping it in a red heat about the third of its weight of that gas may be obtained; towards the end of the process azotic gas is disengaged. If the heat is continued long enough the salt is completely decomposed, and pure potass remains behind.

It detonates more violently with combustible bodies than any of the other nitrates. When mixed with one-third part of its weight of charcoal, and thrown into a red-hot crucible, or when charcoal is thrown into red-hot nitre, detonation takes place, and one of the most brilliant products of that can be exhibited. The residuum is carbaceous potass. It was formerly called nitre fixed by charcoal. A still more violent detonation is produced by using phosphorus instead of charcoal. When
NITRIC

A mixture of nitré and phosphorus is struck smartly with a hot hammer a very violent detonation is produced. Nitre oxidizes all the metals at a red heat, even gold and platinum.

Nitre, according to Bergman, is composed of:

<table>
<thead>
<tr>
<th>Acid</th>
<th>Potass</th>
<th>Water</th>
</tr>
</thead>
<tbody>
<tr>
<td>31</td>
<td>61</td>
<td>8</td>
</tr>
</tbody>
</table>

According to the latest experiments of Kirwan, after being dried in the temperature of 70°, it is composed of:

<table>
<thead>
<tr>
<th>Acid</th>
<th>Potass</th>
<th>Water</th>
</tr>
</thead>
<tbody>
<tr>
<td>44.0</td>
<td>51.8</td>
<td>4.2</td>
</tr>
</tbody>
</table>

Nitre is decomposed by the following salts:
1. Sulphates of soda, ammonia, magnesia, alumina.
2. Murat and acetate of barytes.

One of the most important compounds formed by means of nitre is gunpowder, which consists of nitre and clay. It was afterwards deominated aquafortis, and spirit of nitre. The name nitre was first given it in 1767 by the French chemists; it was immediately before called nitric acid.

1. It is generally obtained in large manufactories by distilling a mixture of nitre and clay; but the acid procured by this process is weak and impure. Chemists generally prepare it by distilling three parts of nitre and one of sulphuric acid in a glass retort. The neck of the retort must be heated into a receiver, from which there passes a glass tube into a bottle with two months, containing a little water, and furnished with a tube of safety; which is a tube open at its upper end, and having its lower end plunged in water. The water prevents any communication between the external air and the inside of the apparatus.

The air, which has accumulated in the vessels, is to be formed within the vessels, the external air reaches down through the tube, and prevents any injury to the vessels. On the other hand, if air is generated in the vessels it forces the water up the tube, the height of which becomes thus the measure of the elasticity of the air in the vessels. By this convection the apparatus is in no danger of being broken, which otherwise might happen.

From the other mouth of this bottle there passes a tube into a pneumatic apparatus to collect the gas which is evolved during the process. The retort is to be heated gradually almost to redness. The nitric acid comes over, and is condensed in the receiver; while the common air of the vessels, and a quantity of oxygen gas which is evolved, especially towards the end of the process, passes into the pneumatic apparatus, and the water in the bottles is evaporated with some acid which is not condensed in the receiver.

The acid thus obtained is of a yellow colour, and almost always contains mutric and sometimes sulphuric acid. These may be removed by distilling it over again with a moderate heat, and changing the receiver after the first portion, which contains all the foreign acids, has passed. It still contains a quantity of nitric acid, to which it owes its colour and the red fumes which it exhales. This gas may also be expelled by the application of heat. Pure nitric acid remains behind, transparent and colourless, like water.

When newly prepared in this manner it is a liquid as transparent and colourless as water; but the affinity between its component parts is so weak, that the action of light is sufficient to drive off a part of its oxygen in the form of gas; and thus, by converting it partly into nitrous gas, to make it assume a yellow colour. Its taste is exceedingly acid and peculiar. It is very corrosive, and tinges the skin of a yellow colour, which does not disappear till the epidermis comes off. It is constantly emitting white fumes which have an acid disagreeable odour.

It has a strong affinity for water, and has never yet been obtained except mixed with that liquid. When concentrated it attracts moisture from the atmosphere, but not so powerfully as sulphuric acid. It also produces heat when mixed with water, owing evidently to the concentration of the water.

The specific gravity of the strongest nitric acid that can be procured is 1.583; but at the temperature of 60°, Mr. Kirwan could not procure it stronger.

As this liquid acid is a compound of two ingredients, namely, pure nitric acid and water, it becomes an object of the greatest consequence to ascertain the proportion of each of these parts. This problem has lately occupied the attention of Mr. Kirwan, who has endeavoured to solve it in the following manner:

He dried a quantity of crystallized carbonate of soda in a red heat, and dissolved it in water, in such a proportion that 367 grains of the solution contained 50.03 grains of alkali. He saturated 370 grains of this solution with 147 grains of nitric acid, the specific gravity of this solution being 1.234, and which contained 45.7 per cent. of acid, of the specific gravity 1.534, chosen by him as a standard. The carbonic acid driven off amounted to 14 grains. Adding 890 grains of water to the other 807, the quantity contained in the solution, at the temperature of 60°, was 1.0401. By comparing this with a solution of nitrate of soda, of the same density, he found that the salt contained in it amounted to 16.501 of the whole. There was an excess of acid of about two grains. The weight of the whole was 1439 grains; the quantity of salt consequently was 56.91 = 85.142 grains. The quantity of alkali was 50.05 + 14 = 56.05. The quantity of standard acid employed was 60.7. The whole therefore amounted to 102.75 grains; but as only 85.142 grains entered into the composition of the salt, the remaining 17.608 must have been pure water mixed with the nitric acid. But if 60.7 of standard acid contain 17.608 of water, 100 parts of the same acid must contain 26.38. One hundred grains of pure nitric acid, therefore, are composed of 73.62 parts of pure nitric acid and 26.38 of water.

Mr. Davy considers as pure acid the per-
with a portion of its oxygen nitrous gas and muriatic gas being evolved.

It is capable of oxidizing all the metals, except gold, platinum, and titanium. It appears, from the experiments of Scheffer, Bergman, Sage, and Tillet, that nitric acid is capable of dissolving (and consequently of oxidizing) a very minute quantity even of gold.

It even sets fire to zinc, bismuth, and tin, if it is poured on them in fusion, and to filings of iron if they are perfectly dry.

Nitric acid combines with alkalies, earths, and the oxides of metals, and forms compounds, which are called nitrates.

The order of its affinities is as follows:

Barytes, Potass, Soda, Strontian, Lime, Magnesia, Ammonia, Glucina, Alumina, Zirconia.

Nitric acid is one of the most important instruments of analysis which the chemist possesses; nor is it of inferior consequence when considered in a political or commercial view, as it forms one of the most essential ingredients of gunpowder. Its nature and composition accordingly have long occupied the attention of philosophers; and from their experiments it appears, that nitric acid is composed of azote and oxygen; consequently nitric gas is also composed of the same ingredients. And as nitric gas absorbs oxygen, even from common air, and forms with it nitric acid, it is evident that nitric acid contains more oxygen than nitric gas. But it is exceedingly difficult to ascertain the exact proportions of the component parts of this acid. Lavoisier concluded, from his experiments on the decomposition of nitre by charcoal, that nitric acid is composed of one part of azote and four parts of oxygen. But Davy has shewn that this decomposition is more complicated than had been supposed; and that Lavoisier's experiments by no means warrant the conclusion which he drew from them. Cavendish, on the other hand, concluded, from his experiments, that the acid which he formed, by combining together azote and oxygen by means of electricity, is composed of one part of azote and 2.346 of oxygen. With this result the late experiments of Mr. Davy corresponded very nearly. He formed his standard acid by combining together known quantities of nitrous gas and oxygen. According to him, 100 parts of pure nitric acid are composed of

29.5 azote
70.5 oxygen
100;

or 1 part of azote, and 3.39 of oxygen.

Nitric acid is seldom in a state of absolute purity, holding usually a certain portion of nitrous gas in solution. In this state it is distinguished by the name of nitrous acid; a compound of considerable importance. See Nitrous Acid.

NITRITES, are salts formed from nitrats, saturated with nitrous gas. See Nitrats.

The existence of nitrous acid was pointed out by Bergman and Scheele; the two philosophers to whom we are indebted for the first precise notions concerning the difference between nitric and nitrous acids. They could not be formed by combining directly nitric acid with the different earthy and alkaline bases; nor have any experiments made to combine nitrous gas with the nitrats been attended with success.

The only method of obtaining these salts at present known, is that which was long ago pointed out by Bergman and Scheele. It consists in exposing a nitrat to a pretty strong heat till a quantity of oxygen gas is disengaged from it. What remains in the retort after this process is a nitrite; but the length of time necessary for producing this change has not yet been ascertained with any degree of precision. If the heat is applied too long the nitrat will be totally decomposed, and nothing but the base will remain, as happened to some of the French chemists on attempting to repeat the process of Bergman and Scheele.

Nitrite of potass is the only salt formed by this process, of which an account has been given. Scheele's process for obtaining it is as follows: Fill a small retort with nitrate, and keep it red-hot for half an hour. When it is allowed to cool, it is found in the state of a nitrite. It deliquesces when exposed to the air; and red vapours of nitrous acid are exhaled when any other acid is poured upon it.

As the nitrates have never been examined by chemists, and as it has not even been determined whether any considerable number of the nitrats can be converted into these salts, it would be in vain, in the present state of our knowledge, to attempt a particular description of them. It may, however, be considered as exceedingly probable that no such salts as the nitrates of ammonium, gluclina, ytria, alumina, and zirconia, exist or can be formed, at least by the process of Scheele; for those bases are decomposed completely by the action of a heat too moderate to hope for the previous emission of oxygen gas.

From the few observations that have been made upon them, it appears that the nitrates are in general deliquescent, very soluble in water, decomposable by heat as well as nitrates; that their taste is cooling like that of the nitrats, but more acid and nitrous; that by exposure to the air they are gradually converted into nitrates by absorbing oxygen; but this change takes place exceedingly slowly.

NITRO-MURIATIC ACID. When muriatic acid is mixed with nitric acid, the mixture is nitro-muriatic acid, which was formerly known by the name of aqua-regia.

NITRIC ACID. The liquid at present called nitric acid by chemists, may be formed by causing nitrous gas to pass through nitric acid. The gas is absorbed, and the acid assumes a yellow colour; and its specific gravity is diminished. It is then denominated nitric acid. It is always in this state that it is seen perfectly clear in a mixture of sulphuric acid and nitre. The acid of commerce is always nitric acid. The nitric and nitrous acids were first distinguished with accuracy by Scheele.

The nature of nitric acid was first investigated by Dr. Priestley, who demonstrated, by very curious experiments, that it is a compound of nitric acid and nitrous gas. This opinion was embraced, or rather it was first fully developed, by Morveau. But the theory of Lavoisier, which supposed the difference between nitric and nitrous acids to depend merely on the first containing a greater proportion of oxygen than the second, for some time drew the attention of chemists from the real nature of nitric acid. Raymond published his dissertation in 1796, to demonstrate the truth of the theory of Priestley and Morveau; and the same thing has been done still more lately by Messrs. Thomson and Davy. At present it is allowed by every one, that nitric acid is merely nitric acid more or less impregnated with nitrous gas.

This being the case, and nitric acid being capable of absorbing very different proportions of nitrous gas, it is evident that there must be a great variety of nitrites, differing from each other in the proportion of nitrous gas which they contain; unless we choose to confine the term nitric acid to the compound formed by saturating nitric acid completely with nitrous gas.

When nitrous gas is placed in contact with nitric acid, the acid absorbs it slowly, and acquires first a pale-yellow colour, then a bright yellow. When a considerable portion of nitrous gas is absorbed, the acid becomes dark-orange, then olive, which increases in intensity with the gas absorbed; then it becomes of a bright green; and, lastly, when fully saturated, it becomes bluegreen. Its volume and its volatility also increase with the quantity of gas absorbed; and when fully saturated it assumes the form of a dense vapour, of an exceedingly suffocating colour, and difficulty combustible by water. In this state of saturation it is distinguished by Dr. Priestley by the name of nitrous acid vapour. It is of a dark-red colour, and passes through water partly without being absorbed. The quantity of nitrous gas absorbed by nitric acid is very great. Dr. Priestley found, that a quantity of acid, equal in bulk to four pennyweights of weight, absorbed 130 ounce-measures of gas without being saturated. The component parts of nitrous acid, its gravity and densities, may be seen in the following table, drawn up by Mr. Davy, from experiments made by him on purpose, with much precision:

<table>
<thead>
<tr>
<th>100 Parts.</th>
<th>Sp. Grav.</th>
<th>Nitric Acid</th>
<th>Water</th>
<th>Nitrous Gas</th>
</tr>
</thead>
<tbody>
<tr>
<td>Solid nitric acid</td>
<td>1.804</td>
<td>91.85</td>
<td>8.15</td>
<td>0.00</td>
</tr>
<tr>
<td>Yellow nitros</td>
<td>1.504</td>
<td>90.35</td>
<td>8.65</td>
<td>1.00</td>
</tr>
<tr>
<td>Bright yellow</td>
<td>1.504</td>
<td>89.09</td>
<td>8.91</td>
<td>2.00</td>
</tr>
<tr>
<td>Dark orange</td>
<td>1.450</td>
<td>88.51</td>
<td>7.49</td>
<td>3.56</td>
</tr>
<tr>
<td>Light olive</td>
<td>1.475</td>
<td>85.00</td>
<td>7.55</td>
<td>4.45</td>
</tr>
<tr>
<td>Dark olive</td>
<td>1.475</td>
<td>85.00</td>
<td>7.55</td>
<td>4.45</td>
</tr>
<tr>
<td>Bright green</td>
<td>1.476</td>
<td>84.8</td>
<td>7.74</td>
<td>4.76</td>
</tr>
<tr>
<td>Blue green</td>
<td>1.476</td>
<td>84.6</td>
<td>7.8</td>
<td>4.8</td>
</tr>
</tbody>
</table>

The colour of nitrous acid depends, in some measure, also on the proportion of water by which it is converted into yellow nitrous acid concentrated, a fourth part by weight of water is added, the colour is changed to a fine green; and when equal parts of water are added, it becomes blue. Dr.
Priestley observed, that water impregnated with this acid in the state of vapour becomes first blue, then green, and lastly yellow. A green nitrous acid became orange-coloured while hot, and retained a yellow tinge when cold. A blue acid became yellow on being heated in a closed glass vessel, but on cooling, became green, and afterwards a deep blue; and when exposed to air resumed its original colour. When nitric acid is exposed to heat the nitrous gas is expelled, and nitric acid remains behind. If this gas, however, is carried along with it a quantity of acid, especially if the acid is concentrated. But nitric acid vapour is not altered in the least by exposure to heat.

It is not altered by oxygen gas, common air, nor by azotic gas.

The simple combustibles and metals act upon it precisely as on nitric acid. It answers much better than nitric acid for inflaming oils and for similar bodies.

It converts sulphuric and phosphoric acids into sulphuric and phosphoric.

Nitrous acid vapour is absorbed by sulphuric acid, but seemingly without producing any change; if any change is produced, the mixture, the heat produced expels it in the usual form of red fumes. The only singular circumstance attending this impregnation is, that it disposits the sulphuric acid to crystallize.

 Nobility, a quality that enables, and raises a person possessed of it above the rank of a commoner.

The civil state of England consists of the nobility and gentry. The nobility are all those who are above the degree of knight, and under which term is included that of a baronet; namely, dukes, marquises, earls, viscounts, and barons. 1 Black. 396.

Noturnal, nocturnalibus, an instrument chiefly used at sea, to take the altitude or depression of some stars about the pole, in order to find the latitude, and hour of the night.

Some nocturnals are hemispheres, or pianophores, on the plane of the equinoctial. Those commonly in use among seamen are two; the one adapted to the polar star, and the first of the guards of the little bear; the other to the polar-star, and the pointers of the great bear.

This instrument consists of two circular plates (see Plate Miscel. figure 173), applied to each other. The greater, which has a handle to hold the instrument, is about two inches and a half in diameter, and is divided into twelve parts, agreeing to the twelve months, and each month subdivided into every fifth day; and so that the middle of the handle corresponds to that day of the year wherein the star here regarded has the same right ascension. If the instrument is fitted for two stars, the handle is made moveable. The upper left circle is divided into twenty-four equal parts for the twenty-four hours of the day, and each hour subdivided into quarters. These twenty-four hours are noted by twenty-four teeth, to be told in the night. Those at the hour 12 are distinguished by their length. In the centre of the two circular plates is attached a long index, A, movable upon the upper plate; and the three pieces, viz. the two circles and index, are moved by a rivet which is pierced through the centre with a hole, through which the star is to be observed.

To use the nocturnal.—Turn the upper plate till the long tooth marked 12, is against the day of the month on the under plate; then, bringing the instrument near the eye, suspend it by the handle with the plane of the instrument parallel to the equinoctial, and viewing the pole-star through the hole of the centre, turn the index about till, by the edge coming from the centre, you see the bright star, or guard, of the little bear (if the instrument is fitted to it); and then that tooth of the upper circle, under the edge of the index, is at the hour of the night on the edge of the hour-circle: which may be known without a light, by counting the teeth from the longest, which is for the hour 12.

Node. See Surgery.

Nodes. See Astronomy.

Nollans, in church history, Christian heretics in the 3d century, followers of Nonius, a philosopher, Ephebus, who is said to have been named Moses, sent by God, and that his brother was a new Aaron; his doctrine consisted in affirming that there was but one person in the Godhead, and that the World and the Holy Spirit were both given to God in consequence of different operations; that as creator he is called Father; as incarnate, Son; and as descending on the apostles, Holy Ghost.

Nolana, a genus of the monograph order, in the pentadactyl class of plants, and in the natural method ranking under the 43d order, asperulae. The corolla is campanulate; the style situated between the gnemus; the seeds are biconvex, and resemble berries. There is one species, an annual of Peru.

Nolle prosequi, is used where the plaintiff proceeds no farther in his action, and may be as well before as after a verdict, and is stronger against a plaintiff than a nonuit, which is only a default in appearance; but this is a voluntary acknowledgment that he has no cause of action. Impey's B. R.

Nommhires, in heraldry, is the next below the fess-point, or the very centre of the escutcheon.

Name, or Name, in algebra, denotes any quantity with a sign prefixed or added. There are many more signs with some other quantity, upon which the whole becomes a binomial, trinomial, or the like: thus a + b is a binomial, a + b + c is a trinomial, whose respective names or names are a and b for the first, and a, b, and c, for the second. See Algebra.

Nominate, in grammar, the first case in nouns which are declinable.

Non-appearance, a default in not appearing in a court of judicature. Attorneys subscribing verbo copiosa for appearing in court are liable to attachment and fine for non-appearance. If a defendant does not appear and fill bate upon a scire facias and rules given, judgment may be had against him. Non compos mentis, in law, is used to denote a person's not being of sound memory and understanding. Of these persons there are four different kinds, an idiot, a madman, a lunatic who has lucid intervals, and a drunkard; the first two are defined by law, and the latter by his own act and deed. In all these cases except the last, one that is non compos mentis shall not lose his life for felony or murder; but the drunkard can have no innocence on his reason, for, in the eye of the law, his drunkenness does not extenuate but aggravate his offence.

Non est inventus, a sheriff's return to a writ, that the defendant is not to be found.

Non-naturals, in medicine, so called because by their abuse they become the causes of disease. See Medicine. The old physicians have divided the vices into 12 classes, viz. the air, meats and drinks, sleep and waking, motion and rest, the passions of the mind, the retentions, and excretions.

Non-pros. If the plaintiff neglects to deliver a declaration for two terms after the defendant appears, or is guilty of other delays or defaults against the rules of law in any subsequent stage of the action, he is adjudged not to pursue his remedy as he ought; and then upon a nonsuit or non prossequitur is entered, and he is then said to be non-prost. 3 Black. 395.

Non-residence. See Residence.

Nonagesimal, or nonageinal degree, in astronomy, the circumference of the midheaven, is the highest point, or 90th degree, of the ecliptic, reckoned from its intersection with the horizon at any time; and its altitude is equal to the angle that the ecliptic makes with the horizon at their intersection, or equal to the distance of the zenith from the pole of the ecliptic. It is much used in the calculation of solar eclipses.

Nonagon, a figure having nine sides and angles. In a regular nonagon, or that whose angles and sides are all equal, each side is 1, its area will be 6.1818324 ? 2 of 70°, to the radius 1.

Nonius. See Vernier.

Non suit, in law, is where a person has commenced an action, and at the trial fails in his evidence to support it, or has brought a wrong action. There is this advantage attending a nonsuit, that the plaintiff, though he pays costs, may afterwards bring another for the same cause, which he cannot do after a verdict against him. Todd's R. B. Practice.

Nones, nones, in the Roman calendar, the fifth day of the months January, February, March, June, July, August, September, November, and December; and the seventh of March, July, and October. March, May, July, and October, had six days in their nones; because these alone, in the antient constitution of the year by Numa, had 31 days apiece, the rest having only 29, and February 30; but when Cæsar reformed the year, and made other months containing 31 days, he did not allot them six days of nones.

Norroy, the title of the third of the three kings at arms. See Heraldry.

Normal, a perpendicular forming with another line a right angle.

Norway rat. See Mus. N. O. SE. See Anatomy.

Notarial acts, are those acts, in the civil law, which require to be done under the seal of a notary, and which are admitted as evidence in foreign courts.

Notary, is a person duly appointed by the laws of the several countries, in Canada and the United States, to attest deeds and writings, to receive and administer oaths and notes foreign and inland bills of exchange.
and promissory notes, translates languages and attests the same, enters and extends ship's protests, &c.

NOTATION, in arithmetic and algebra, the method of expressing numbers or quantities by signs or characters appropriated for their purpose. See ALGEBRA, ARITHMETIC, CHARACTER, &c.

Notation, in music, the manner of expressing, or representing by characters, all the different sounds used in music. The ancient notation is very different from that of the modern. The Greeks employed for this purpose the letters of their alphabet, sometimes placing them erect, and sometimes inverting, mutilating, and combining them in various manners, so as to represent by them all the different tones, or chords used in their system. By a treatise of Alpyus, professedly written to explain the Greek characters, we find that they amounted to no less a number than 1240. Those were, however, rejected afterwards by the Latins, who introduced letters from their own alphabet, A, B, C, D, E, F, G, H, I, J, K, L, M, N, O, P, fifteen in number, and by which they expressed the sounds contained in the bidental. The Greek improvement was to express the notation, which at length took place, and which is in part adopted at the present day, we are indebted to St. Gregory, the first pope of that name; who reflecting that in his diaspora, the bones of the lichnos meson, or the middle tone, were but a repetition of those which preceded, and that every septenary in progression was precisely the same, reduced the number of letters to seven, viz. A, B, C, D, E, F, G; but to distinguish the second septenary from the first, the second was denoted by the small, and not the capital, Roman letters; and when it became necessary to extend the system farther, the small letters were doubled thus, na, bb, cc, dd, ee, ff, gg. The stave, consisting of a variable number of parallel lines, the application of which some attribute to Guido, was afterwards introduced; and this was again improved upon by the use of a row of small points, commas, accents, and certain little oblique strokes, occasionally interspersed in the stave, while also two colours, yellow and red, were used; a yellow line signifying the F, and a red line signifying that of F. Two methods of notation were long after employed for the violin and other stringed instruments, which were distinguished by the terms lyra-way and gamut-way; with this exception, that the literal notation for the flute is constantly called the tablature; concerning which, as also the notation by letters in general, it may be observed that they are a very inartificial practice, as was also the old model of notation for the flute and flageolet by dots.

NOTE is a minute, or short writing, containing some article of business; in which sense we say, promissory note, note of hand, bank note. See Bills of Exchange.

NOTES, in music, characters which by their different forms and situations on the staves, indicate the duration as well as the gravity or accent of the several sounds of a composition.

NOTICE, in law, is the making something known that a man was or might be ignorant of before, and it produces divergent effects; for by it the party that gives the same shall have some benefit, which otherwise he should not have laid; and by this means the party to whom the notice is given is made subject to some action or charge, that otherwise he would not have been liable to, and his estate in danger of being distrained or persecuted. The plaintiff and defendant are both bound at their peril to take notice of the general rules of the practice of the court; but if there is a special particular rule of court made for the plaintiff, or for the defendant, he is not bound to whom the rule is made ought to give notice of this rule to the other; or else he is not bound generally to take notice of it, nor shall be in contempt of the court although he does not observe it. 2 L. P. R. 254.

NOTONECTA, a genus of insects of the order hemiptera. The generic character is, snout inflected; antenna shorter than thorax; wings coriaceous on the upper part, and crossed over each other; hind feet edged with hairs, and formed for swimming. The principal species of this are,

1. The notonecta glauca, a very common aquatic insect, inhabiting stagnant waters; and generally measured about three parts of an inch is length, and the lower wings are marked along the edges by a row of minute black spots. This insect is usually seen swimming on its back, in which situation it bears a most striking resemblance to a boat in miniature, the hind legs acting like a pair of oars, and impelling the animal at intervals through the water. It preys on the smaller inhabitants of the water, and flies only by night.

2. Notonecta sticta is much smaller than the preceding, not measuring more than a quarter of an inch in length, and is of a yellowish-grey colour, with numerous transverse unilunate black lines or streaks; it is found in stagnant waters.

3. Notonecta minuta, is an extremely small species, with grey wings, marked by longitudinal dusky spots; like the two former it is an inhabitant of stagnant waters, but is not so far less frequent, as it is readily observable by the eye, on account of its very small size. There are 17 species.

NOTOXUS, a genus of insects of the coelohera order. The generic character is, antennae three-making; labium long and broad; clypeus short and obtuse; jaw one-toothed; thorax a little narrowed behind. There are 13 species, found in Europe and Asia.

NOVIATIANS, a christian sect which sprang up in the third century; so called from Novatian, a priest of Rome, or Novatus, an African bishop, who separated from the communion of pope Cornelius, whom Novatian charged with a criminal lenity towards those who had apostatised during the persecution of Decius. He denied the church's power of remitting mortal sins.

NOVEL, in the civil law, a term used for the constitutions of several emperors, as of Justin, Theodosius, Leo, and more particularly for those of Justinian. The constitutions of Justinius were called novels, either from their producing a great alteration in the face of the ancient law, or because they were made on new cases, and after the revivification of the ancient code, compiled by the order of that emperor. Thus the constitutions of the emperors Theodosius, Valentinian, Marcian, &c. were also called novels, on account of their being published after the Theodosian code.

NOUS, in grammar, a part of speech, which signifies things without any relation to time; as a man, a house, sweet, bitter, &c.

NUCLEUS, in general, denotes the kernel or core of anything, which is separated within a husk. The term nucleus is also used for the body of a comet, otherwise called its head.

NUDE CONTRACT, a bare promise, without any consideration, and therefore void.

NUISANCE, signifies generally any thing that works hurt, inconvenience, or damage, to the property or person of another. Nuisances are of two kinds, public or private nuisance, and either affect the public or the individual. The remedy for a nuisance is by action on the case for damages. Every continuance of a nuisance is a fresh nuisance, and a fresh action will lie.

NUMBER, kinds and distinctions of: Mathematicians, considering number under a great many relations, have established the following distinctions. Broken numbers are the same with fractions. Carried numbers are those which exceed the quantity of units, as 1, 2, 3, &c. whereas ordinal numbers are those which express order, as 1st, 2nd, 3rd, &c. Compound number, one divisible by some other number besides unity; as 12, which is divisible by 2, 3, 4, and 6. Numbers, as 12 and 15, which have some common measure besides unity, are said to be compound numbers and having themselves a common measure.

Cube number is the product of a square number by its root; such as 27, being the product of the square number 9, by its root 3. All cubic numbers whose root is less than 6, being divided by 6, the remainder is the root itself; thus 27-54 leaves the remainder 3, its root; 216, the cube of 6, being divided by 6, leaves no remainder; 343, the cube of 7, leaves a remainder 1, which added to 6, is the cube root; and 512, the cube of 8, divided by 6, leaves a remainder 2, which added to 6, is the cube root. Hence the remainder of the divisions of the cubes above 216, divided by 6, being added to 6, always gives the root of the cube; the remainder of 343 and 512 divided by 6, leaves 5 and 3, respectively, and consequently 11 the cube-root of the number divided. But the cube number above this being divided by 6, there remains nothing, the cube-root being 12. Thus the remainders of the higher cubes are to be added to 12, and not to 6, till you come to 18, when the remainder of the division must be added to 18; and so on ad infinitum.

Determinate number, is that referred to some given unit, as a tarry or three; whereas an indeterminate one, is that referred to unity in general, and is called quality. Homologous numbers, are those referred to the same unit; as those referred to different units are termed heterologous.

Whole numbers, are other called integers. See INTEGER.

Rational number, is one commensurable with unity; as a number incommensurable with unity, is termed irrational or a surd. See SURD.

In the same manner a rational whole number, is that wherein unity is an aliquot part; a rational broken number, that equal to some,
If out of pentagons, first pentagonal pyramids.

1. From the manner of summing up polygonal numbers, it is easy to conceive how the prime polygonal numbers are found, viz. 

\[(a - 2) n^2 + 3n - (a - 3) \]

6

the prime pyramids.

Number in grammar, a modification of nouns, verbs, &c. to accommodate them to the varieties in their objects, considered with regard to number.

NUMERAL, those letters of the alphabet which are generally used for figures as I, V, X, L, C, D, M. See ARITHMETIC, Characters, &c.

NUMERALS, in grammar, those words which express numbers; as, six, eight, ten, &c.

NUMERATION. See ARITHMETIC, Characters, &c.

NUMIDA, in ornithology, a genus belonging to the order of galéorn. On each side of the head there is a kind of coloured plume. A bird that has been killed, and the flesh is worked with care near the nostrils. The species called melagris, or Guinea hen, is a native of Africa. See Plate Nat. Hist, fig. 298. It is larger than a common hen. Its body is very much like that of a turkey; its plumage is all over a dark grey, very beautifully spotted with small white spots; there is a black ring round the neck; its head is reddish, and it is blue under the eyes. They naturally herd together in large numbers, and breed up their young in common; the females taking care of the broods of others, as well as of their own. Barbut informs us, that in Guinea they go in flocks of 200 or 300, perch on trees, and feed on worms and grasshoppers; that they are run down and taken by dogs; and that their flesh is tender and sweet, generally white, though sometimes black. They breed very well with us.

The white-breasted one is a mere variety, of which there are many; it is mostly found in Jamaica. The mitred, or numida mitrata, is a different and not a common species; it inhabits Madagascar and Guinea. The third species which Mr. Latham mentions is the crested, or numida crestatus. This species likewise inhabits Africa. Buton, which describes it at great length, calls it pintado. Linnaeus and Gmelin call it Numida melचa, &c. Ray and Willughby call it gallus gallicus, Gmelin Guineensis, &c. Mr. Pennant considers, and seems to prove, that the pintado had been early introduced into Britain, at least prior to the year 1777. But they seem to have been much neglected on account of the difficulty of rearing in common; for they occur not in our ancient bills of fare. They have a double caruncle at the chaps, and no fold at the throat.

NUNCIO, or Nintio, an ambassador from the pope to some catholic prince or state; or a person who attends on the pope's behalf at a congress, or an assembly of several ambassadors. The nuncio has a jurisdiction and may delegate judges in all the states where he resides, except in France, where he has no authority but that of a simple ambassador. See Ambassador.

NUNCUPATIVE will, denotes a last will or testament, only made verbally, and not put in writing. See WILL and TESTAMENT.

NUMERICAL, in grammar, is a species of plants, cultivated for their beauty, their fragrance, and their fruit. The first number of this order is the rose, which is the symbol of love, and is the most admired of all flowers. The second number is the violet, which is the symbol of modesty. The third number is the tulip, which is the symbol of friendship. The fourth number is the lily, which is the symbol of purity. The fifth number is the orchid, which is the symbol of beauty. The sixth number is the magnolia, which is the symbol of grace. The seventh number is the daisy, which is the symbol of innocence. The eighth number is the chamomile, which is the symbol of peace. The ninth number is the violet, which is the symbol of modesty. The tenth number is the lily, which is the symbol of purity. The eleventh number is the orchid, which is the symbol of beauty. The twelfth number is the magnolia, which is the symbol of grace. The thirteenth number is the daisy, which is the symbol of innocence. The fourteenth number is the chamomile, which is the symbol of peace. The fifteenth number is the violet, which is the symbol of modesty. The sixteenth number is the lily, which is the symbol of purity. The seventeenth number is the orchid, which is the symbol of beauty. The eighteenth number is the magnolia, which is the symbol of grace. The nineteenth number is the daisy, which is the symbol of innocence. The twentieth number is the chamomile, which is the symbol of peace. The twenty-first number is the violet, which is the symbol of modesty.
The ground intended for the flower-nursery should be well situated to the sun; and defended from strong winds by plantations of trees, or by buildings. The soil also should be light and dry, especially for bulbous-rooted flowers; for in this nursery the offsets of all bulbous-rooted flowers should be planted, and remain there till they become blooming roots, when they should be removed into the pleasure-garden, and planted either in beds or borders, according to the goodness of the flowers. These flowers may also be raised in the nursery from seed. The seedlings auriculae, polyanthuses, ranunculus, amaranth, carnations, &c., should be raised in this nursery, where they should be preserved till they have flowered, when all those should be marked that are worthy of being transplanted into the flower-garden: this should be done in their proper seasons; for all these seedling flowers ought not indiscriminately to be exposed to public view in the pleasure-garden, because it always happens, that there are great numbers of ordinary flowers produced among them, which will then make but an indifferent appearance.

NUT. See Corylus.

NUT-GALLS. See Galls.

NUTATION, in astronomy, a kind of tremulous motion of the axis of the earth, whereby, in each annual revolution, it is twice inclined to the ecliptic, and as often returns to its former position. Sir Isaac Newton observes, that the moon has the like motion, only very small, and scarcely sensible.

NUTMEG. See Myristica.

NUTRITION. See Digestion, Material Medica, and Physiology.

NUX VOMICA, a flat, compressed, round fruit, about the breadth of a shilling, brought from India. See Stramonium.

NYCTANTHES, Arabian Jasmine, a genus of the monogynia order, in the dicotyledon class of plants; and in the natural method ranking under the 54th order, spermati. The corolla and calyx are actinoid: the perianth is dioc criminals. There are seven species, the most remarkable of which are: 1. The arbor tristis, or sorrowful tree. This tree, or shrub, the part of the Frangipani, grows naturally in sandy places in India, particularly in the islands of Ceylon and Java, where it is procured in great abundance, and attains the height of 18 or 20 feet. It rises with a four-cornered stem, bearing leaves that are oval, and taper to a point. The flowers, which are white and highly odorous, having a sweet delectable smell emulating the best honey, consist of one petal deeply divided into eight parts, which are narrower towards the stalk, and dilated towards the summit. The fruit is dry, capsular, membranaceous, and compressed.

It is generally asserted of this plant, that the flowers open in the evening, and fall off the succeeding day. Fabricus and Paludanus, however, restrict the assertion, by mentioning, from actual observation, that this effect is found to take place only in such flowers as are immediately under the influence of the solar rays. Grimmius remarks in his Laboratorium Ceylonicum, that the flowers of this tree afford a fragrant water, which is cordial, refreshing, and frequently employed with success in inflammations of the eyes. The tube of the flower, when dried, has the smell of saffron; and being pounded and mixed with sanders-wood, is used by the natives of the Malabar coast for imparting a grateful fragrance to their bodies, which they rub or anoint with the mixture.

2. The angustifolia, of which the flowers are white, inexpressibly fragrant, and generally appear in the warm summer-months. Strong loin is its proper soil.

NYMPH, among naturalists, that state of winged insects between their living in the form of a worm, and their appearing in the winged or most perfect state. See Entomology.

NYMPHÆA. See Anatomy.

NYMPHÆA, the water-lily, a genus of the monogynia order, in the polyandria class of plants; and in the natural method ranking under the 54th order, holorac. The hermaphrodite calyx is quinquepartite; there is no corolla; the stamina are five; there is one pistil; the fruit a plum inferior. The male calyx is quinquepartite, no corolla, and ten stamina. There are two species: 1. The integrifolia, entire-leaved, and 2. The dentilicata, or serrated-leaved tupelo.

The entire-leaved tupelo-tree, in its native soil and climate, grows to near 20 feet high; in this country its size varies according to the nature of the soil or situation. In a moist rich earth, well sheltered, it comes to near 20 feet; in others, that are less so, it makes slower progress, and in the end is proportionally lower. The branches are very numerous; and it rises with a regular trunk, at the top of which they generally grow. In England they seldom produce fruit.

The serrated-leaved tupelo-tree grows usually nearly 30 feet in height; and divides into branches near the top like the other. The leaves are oblong, pointed, of a light green colour, and come out without order on long footstalks. The flowers come out from the wings of the leaves on long footstalks. They are small, of a greenish-colour; and are succeeded by oval drupes, containing sharp-pointed nuts, about the size of a French olive.
the fourteenth letter of our alphabet.

As a numeral, it is sometimes used for eleven; and with a dash over it thus Ο', for eleven thousand. In the notes of the antients, Ω. CON. is read opus conductum; Ω. C. Q. opera consilique; Ω. D. M. opera, donum, munus; and Ω. L. O. opus localum.

In music, the Ω, or rather a circle, or double CO, is a note of time called by us a semi-breve; and by the Italians circulo. The Ω is also used as a mark of triple time, as being the numeral of all figures.

OAK. See Quercus.

OAKAM, old ropes untwisted, and pulled out into loose hemp, in order to be used in caulking the seams, tree-nails, and bends of a ship, for stopping or preventing leaks.

OAR, in navigation, a long piece of wood, for moving a vessel by rowing. Oars for ships are generally cut out of fir-timber, those for barges are made out of New England or Dantzick-oaken, and those for boats, either out of English ash, or fir rafters from Norway.

OAT. See Avena.

OATH, an affirmation or denial of any thing before one or more persons, who have the authority to administer the same, for the discovery and advancement of truth and right. See Affidavit.

OBEISAN, a truncated, quadrangular, and slender pyramid, raised as an ornament, and frequently charged either with inscriptions or hieroglyphs.

Obeisans appear to be of very great antiquity, and to be found traced to posterity precepts of philosophy, which were cut in hieroglyphical characters: afterwards they were used to immortalize the great actions of heroes, and the memory of personages. The first obelisk mentioned in history was that of Ramesses king of Egypt, in the time of the Trojan war, which was forty cubits high. Phurus, another king of Egypt, raised one of forty-five cubits; and Ptolemy Philopappus, another of eighty-eight cubits, in memory of Arian. Augustus erected one at Rome in the Campus Martius, which served to mark the hours on an horizontal dial, drawn on the pavement. They were called by the Egyptians the fingers of the sun, because they were made in Egypt also, to serve as dials or gnomons to mark the hours on the ground. The Arabs still call them Pharos's needles, whence the Italians call them aqua, and the French aiguilles.

The proportions in the height and thickness are nearly the same in all obelisks; their height being nine or nine and a half, and sometimes ten times, their thickness; and their diameter at the top never less than half, and never greater than three-fourths, of that at the bottom.

OBLATE, flattened, or shortened; as an oblate spheroid, having its axis shorter than its middle diameter, being formed by the rotation of an ellipse about the shorter axis.

OBLATENESS. See Earth, figure of.

OBLIGATION, a bond containing a penalty, with a condition annexed, either for payment of money, performance of covenants, or the like. This security is called a specialty. Co. Lit. 172. See Bond, and Deed.

OBLIQUE, in geometry, something slanting, or that deviates from the perpendicular. Thus, an oblique angle, is either an acute or obtuse one; that is, any angle except a right one.

OBLIQUE PLANES. See Dialling.

OBLONGATA MEDULLA. See Anatomy.

OBOLUS, in antiquity, an ancient Athenian coin, worth a penny farthing. Among ancient physicians; obolus likewise denoted a weight, equal to ten grains.

OBOLARIA, a genus of the angiosperma order, in the didynamia class of plants; and in the natural method ranking under the 40th order, personate. The calyx is bifid; the corolla campanulate and quadrifid; the capsule unilocular, bivalved, and polyspermous; the stamens rising from the divisions of the corolla. There is one species, a herb of Virginia.

OBSELYRATORY, a place destined for observing the heavenly bodies; being generally a building erected on some eminence, covered with a terrace for making astronomical observations.

The principal instruments for a fixed observatory are, a large fixed quadrant, or a circular divided instrument, chiefly for measuring vertical angles; a transit instrument; an equatorial instrument; a chronometer, or regulator; one or more powerful telescopes; a fixed zenith telescope; and a night telescope.

The quadrants, or quarter of a circle, divided into 90°, and each degree subdivided into minutes or smaller parts, has been made of various sizes; some of them having a radius even of eight or nine or more feet in length. When those quadrants do not exceed one or two, or at most three feet, in radius, they are generally fixed upon their particular stands, which are furnished with various mechanical contrivances, that are necessary to place the plane of the quadrant perpendicular to the horizon, and for all the other necessary adjustments. But large quadrants are fixed upon a strong wall by means of proper clamps; hence they have been commonly called mural quadrants, and are situated in the plane of the meridian of the observatory. In either of those quadrants an index, which reaches from the centre to the edge of the arch, moves round that centre, or round a short axis which passes through that centre so as to be moveable with its extremity all round that arc, and thus point out on the divisions of the arch, the angle which it forms with the horizon, or with the vertical line, in any given situation.

This index carries a telescope, through which the observer looks at any particular object, whose altitude he wishes to determine.

Plate Observatory, &c. fig. 1. represents a simple construction of a small moveable quadrant, and fig. 2. represents a mural quadrant. Of the quadrant fig. 1. CEI is the arc divided into 90°, and generally subdivided into smaller divisions, such as half degrees, or third parts of each degree, &c. The centre of the arch is at A, and the whole is connected together by means of strong metallic bars, as is shown between the letters ABC in the figure: in the centre A, a short axis is fixed perpendicular to the plane of the instrument, and to the upper part of this axis is fastened the index AD, which carries the telescope. This index generally has a small lateral projection, as at E, upon which the nonius or vernier is marked, by which means the minutes or smaller parts of each degree may be discerned. (See Vernier.)

The screw P, commonly called the tangent screw, with a nut that may be fastened to any part of the arch BC, screws likewise into the extremity of the index, and is useful for moving the index gently, or more accurately than by the immediate application of the hand to the index itself.

Since the index is suspended at one end, viz. at A, if the other end D happens to be disengaged from the screw P, the lower end D of the index will naturally come down to C, on account of its own weight, and that of the telescope. Now, in order to avoid this tendency downwards, an arm Y of brass or iron, is frequently affixed to the upper part of the index, which carries the leaden weight Z, sufficient to balance the weight of the index and telescope; so that by this means, even when disengaged from the screw P, the index will remain in any situation in which it may be left. The whole frame ABC is supported upon a strong vertical axis FS, the lower part of which turns into the pedestal OKM, and carries an index SX, which moves upon the divided horizontal circle O, fixed to the pedestal. This serves to fix the plane of the quadrant in any azimuth that may be required. The lower part of the pedestal has three claws, with a screw m in each; by which means the axis FS may be set truly perpendicular. The plummet AO, suspended at A, serves to show when the edge AC of the instrument is truly perpendicular, or when the first division of the arch at C is exactly in the vertical which passes through the centre A of the quadrant are BC. The weight of the plummet generally moves in a glass of water, which is fixed upon the arm GR; the object of which is to check the vibrations of the pendulum; which others we would be easily moved by every breath of air, and...
would continue to move for a considerable time after. We do not mention the bases of these screws, which are applied to read off the divisions at E and F, as the coincidence of the plummet-line with a dot marked upon the arc at C, as matters that need no particular description.

The eye-tube of the telescope, AB, there are certain slender wires, placed in the focus of the eyepiece, and perpendicular to the axis of the telescope, which enable the observer to distinguish more accurately when the object that is seen is through the telescope, reaches the axis of the telescope, or, as it is more commonly called, the line of collimation. Now, when the stars or planets are observed at night, those wires in the eye-tube cannot be seen; therefore, to render them visible, an arm or wire is fixed occasionally at the end of the telescope, which arm holds a small piece of ivory or card, set at the meridian of the eyepiece, so as to shine upon the aboved-mentioned ivory or card, the reflection of the light from it into the tube of the telescope will enable the observer to distinguish the wires at the same time that he beholds the celestial object.

The mural quadrant, fig. 2, is a larger instrument like the above, excepting that it has no stand; and its index is prevented from bending on account of its great length, by means of metallic bars, a, b, & c. This instrument is firmly fixed upon a wall exactly in the plane of the meridian of the observatory, for which purpose it has clamps, screws, and other adjustments. It has likewise a plummet.

This plummet is undoubtedly the principal instrument of an observatory; for by observing the times by the clock, of the arrival of any celestial object to the meridian, the right ascension of that object is had immediately; and its declination is shown at the same time by the index of the quadrant upon the divided arch; deducting the inclination of the equator, which is given by the latitude once ascertained of the observatory. It is by this means that exact catalogues of the places of the fixed stars have been made.

The transit instrument consists of a telescope of any convenient length, fixed at right angles to a horizontal axis, which is supported at its two extremities; and the instrument is generally situated so that the line of collimation of the telescope may move in the plane of the meridian. The use of this instrument is to observe the precise time of the celestial body's passage across the meridian of the observatory.

Fig. 3. exhibits a transit instrument. N M is the telescope; in the eye-tube of which are seen the wires, a, b, c, situated so as to divide the eye-lens. F E is the horizontal axis, in the middle of which the telescope is steadily fixed; so that by moving the telescope, the axis is forced to turn round its two extremities, A and D, which red to the notches of two thick pieces, T, S, of bell-metal, such as are delineated separately and magnified, at X and Z. Those pieces are generally fixed up on two pillars, either of cast iron, on which is better, or stone, as are shown in the figure; and they are constructed so as to be susceptible of a small motion by means of slips and screws, viz., the piece FF, which is fixed, and to which the axis of the circle is to be placed the telescope in the direction of any particular celestial body, when that body crosses the meridian; which inclination is equal to the collimation of the plane of the telescope, or the determination of the situation of the celestial body, according as that declination is north or south.

To adjust the clock by the sun's transit over the meridian.—Note the times by the clock, when the following parallel of the moon's limb touch the cross wires. The difference between the middle time and 12 hours, shews how much the mean, or time by the clock, is faster or slower than the time of right ascension, for that day; to which the equation of time being added, will show the time of mean noon for that day, by which the clock may be adjusted.

In the astronomical or equatorial sector, an instrument for finding the difference in right ascension and declination between two objects, the distance of which is too great to be observed by the micrometer, was invented by Hipparchus. A and B represent an arc of a circle, containing 10 or 12 degrees well divided, having a strong plate CD for its radius, fixed to the middle of the arch at D; the radius is applied to the side of the sector H I, and the instrument is so regulated that a joint fixed to it, so that the plane of the sector may be always parallel to the axis HI; which being parallel to the axis of the earth, and plane of the sector will always be parallel to the plane of some horary circle. Let a telescope CE be movable about the centre C of the arch AB, from one end of it to the other, by turning a screw at G, and let the plane of the horizon AB cut by the index at each transit; then in the difference of the arcs, the difference of the declinations, and by the difference of the times, we have the difference of the right ascensions of the stars.

The dimensions of this instrument are these: The length of the telescope, or the radius of the sector, is 24 feet; the breadth of the radius, near the end C, is 1½ inches; and at the end D two inches. The breadth of the limb AB is 1½ inches; and its length six inches, containing ten degrees divided into quarters, and numbered from each end to the other. The telescope carries a mosaic or subdividing plate, whose length, being equal to sixteen quarters of a degree, is divided into fifteen equal parts; which, in effect, divides the limb into minutes, and, by estimation, into smaller parts. The length of the square axis of the figures is eight inches.
and its thickness is about a quarter of an inch; the diameters of the circles are each 3 inches; the thickness of the plates, and the other measures, may be taken at the direction of a workman.

This instrument may be rectified, for making observations, in this manner: by placing the intersection of the hairs at the same or equal distance from the plane of the sector, as the centre of the object-glass, the plane described by the line of sight during the circular motion of the telescope upon the limb will be sufficiently true, or free from central curvature: which may be examined by suspending a long plumb-line at a convenient distance from the instrument; and by fixing the plane of the sector in a vertical position, and then by observing, while the telescope is moved by the screw along the limb, whether the cross hairs appear to move along the plumb-line.

The axis b f o (see figure below) may be elevated nearly parallel to the axis of the earth, by means of a small common quadrant; and its error may be corrected by making the line of sight follow the circular motion of any of the circum-polar stars, while the whole instrument is moved about its axis b f o, the telescope being fixed to the axis a for this purpose; let the telescope k l be directed to the star a, when it passes over the highest point of its diurnal circle, and let the division cut by the monis be then noted; then after twelve hours, when the star comes to the lowest point of its circle, having turned the instrument half-round its axis to bring the telescope into the position m n; if the cross hairs cover the same star supposed at b, the elevation of the axis b f o is exactly right; but if it is necessary to move the telescope into the position w z, in order to point to this star at c, the arc m n, which measures the angle m f o or b f o, will be known; and the axis b f o must be depressed half the quantity of this given angle if the star passed below o, or must be raised so much higher if above o; and thus the trial must be repeated till the true position of the axis is attained. By making the like observations upon the same star on each side the pole, in the six o'clock hour-circle, the error of the axis, towards the east or west, may also be found and corrected, till the cross-hairs follow the star quite round the pole: for, supposing a o p b c to be an arch of the meridian, make the angle a f p equal to half the angle a f c, and the line f p will point to the pole; and then the angle a f p, which is the error of the axis, will be equal to half the angle h f o, or m f o, found by the observation; because the difference of the two angles a f b, a f c, is double the difference of their bases a f o and a f p. Unless the star is very near the pole, allowance must be made for refractions.

Equatorial or portable observatory: an instrument designed to answer a number of useful purposes in practical astronomy, independently of any particular observatory; it may be made to serve all the purposes of the observatory and performs most of the useful problems in the science.

The principal parts of this instrument (fig. 3) are: 1. The azimuth or horizontal circle A, which represents the horizon of the place, and moves on axis b, called the vertical axis. 2. The equatorial or hour circle C, representing the equator, placed at right angles to the polar axis D, or the axis of the earth, upon which it moves. 3. The semicircle of declination, E, on which the telescope is placed, and moving on the axis of declination, or the axis of motion of the line of collimation F. These circles are measured and divided as in the following table:

<table>
<thead>
<tr>
<th>Measure of the various circles, and divisions on them,</th>
<th>Azimuth circle or hour circle</th>
<th>Vertical semi-circle, for declination</th>
</tr>
</thead>
</table>
| Radius divided to, when the telescope is in the declination-circle | 3° | 5 1
| Degrees, when the telescope is in the equator-circle | 1° | 5 1
| Measures of the several circles, and divisions in the declination-circle | 3° | 5 1
| Degree in time | 1° | 5 1

1. The telescope in this equatorial may be brought parallel to the polar axis, as in the figure, so as to point to the pole-star in any part of its diurnal revolution; and thus it has been observed near noon, when the sun has shone very bright. The apparatus for correcting the error in altitude occasioned by refraction, which is applied to the eye-end of the telescope, and consists of a slide G moving in a groove or dovetail, and carrying the several eye-stubs of the telescope, on which slide there is an index corresponding to 5 small divisions engraved on the dovetail; a small circle called the refraction-circle, H, moveable by a finger-screw at the extremity of the eye-end of the telescope, which circle is divided into half-minutes, one entire revolution of it being equal to 3° 18', and by its motion raises the centre of the cross hairs on a circle of altitude; and like a quadrant of an inch and a half radius, with divisions on each side, one expressing the degree of altitude of the object viewed, and the other expressing the minutes and seconds of error occasioned by the refraction, corresponding to that degree of altitude: to this quadrant is joined a small round level K, which is adjusted partly by the pinion that turns the whole of this apparatus, and partly by the index of the quadrant; for which purpose the refraction-circle is set in the same minute, i.e. which the index points to on the line of collimation; and if the minute, i.e., given by the quadrant exceeds the 3° 18' contained in one entire revolution of the refraction-circle, this must be set to the excess above one or more of its entire revolutions; and if the difference of the cross hairs will appear to be raised on a circle of altitude to the additional height, which the error of refraction will occasion at that altitude.

The principal adjustment in this instrument is that of making the line of collimation to describe a portion of an hour-circle in the heavens; in order to which, the azimuth-circle must be truly level; the line of collimation, or some corresponding line represented by the small brass rod M parallel to it, must be perpendicular to the axis of its own proper motion; and this last axis must be perpendicular to the polar axis. On the brass rod M there is occasionally placed a hanging level N, the use of which will appear in the following adjustment.

The azimuth-circle may be made level by turning the instrument till one of the levels is parallel to an imaginary line joining two of the feet-screws; then adjust that level with these two feet-screws; turn the circle half-round, that is, 180°; and if the bubble is not then right, correct half the error by the screw belonging to the level, and the other half error by the two feet-screws; repeat this till the bubble comes right; then turn the circle 90° from the two feet-screws, and set the bubble right, if it is wrong, by the foot-screw at the end of the level; when this is done, adjust the other level by its own screw, and the azimuth-circle will be truly level. The hanging level must then be fixed to the brass rod by two hooks of equal length, and made truly parallel to it; for this purpose make the polar axis perpendicular or nearly perpendicular to the horizon; then adjust the levels at the extremity of the declination-semicircle, reverse the level, and if it is wrong, correct half the error by a small steel screw that lies under one end of the level, and the other half error by the pinion of the declination-semicircle; repeat this till the bubble is right in both positions. In order to make the brass rod on which the level is suspended, at right angles to the axis of motion of the telescope or line of collimation, make the polar axis horizontal, or nearly so; set the declination-semicircle to 0°, turn the hour-circle till the bubble comes right; then turn the declination-circle to 90°; adjust the bubble by raising or depressing the lower axis first by hand till it is nearly right, afterwards tighten with an iron key the socket which runs on the arch with the polar axis, and then apply the same iron key to the adjusting screw at the end of the said arch till the bubble comes quite right; then turn the declination-circle to the opposite 90°; if the level is not then right, correct half the error by the aforesaid adjusting screw the other end of the arch, and the other half error by the 2 screws which raise or depress the end of the brass rod. The polar axis remaining nearly horizontal as before, and the declination-semicircle at 0°, adjust the bubble by the
hour-circle; then turn the declination-semi-circle to 90°, and adjust the bubble by raising or depressing the polar axis; then turn the hour-circle all round, and if the bubble is wrong, correct half the error by the polar axis, and the other half-error by the two pair of capstan-screws at the feet of the two supports on one side of the axis of motion of the telescope. But this axis will be at right angles to the polar axis. The next adjustment is to make the centre of cross hairs remain on the same object, while you turn the refuse tube quite round by the pinion of the refractive instrument; for this adjustment, set the index on the slide to the first division of the dovetail; and set the division marked 18° on the refractive-circle to its index; then look through the telescope, and with the cross-hairs precisely over the hour-circle, and the second of the hour-circle at end of the eye-tube that contains the first eye-glass; repeat this correction till the half of the hairs remains on the spot you are looking at during an entire revolution. If you make the line of collimation parallel to the brass rod on which the level hangs, set the polar axis horizontal, and the declination-circle to 90°; adjust the level by the polar axis; look through the telescope on some distant horizontal object, and correct, by the centre of the cross hairs; then invert the telescope, which is done by turning the hour circle half-round; and if the centre of the cross hairs does not coincide with the same object as before, correct half the error by the uppermost and lowermost of the four small screws at the eye-end of the large tube of the telescope; this correction will give a second object now covered by the centre of the hairs, which must be adopted instead of the first object; then invert the telescope as before; and if the second object is not covered by the centre of the hairs, correct half the error by the same two screws which were used before: this correction will give a third object, now covered by the centre of the hairs, which must be adopted instead of the second object; repeat this operation till no images are seen in the hour-circle, exactly to 12 hours (the declination-circle remaining at 90° degrees as before); and if the centre of the cross hairs does not cover the last object fixed on, set it to that object by the two remaining small screws at the eye-end of the large tube, and then the line of collimation will be parallel to the brass rod. For rectifying the nunius of the declination and equatorial circles, lower the telescope as many degrees, minutes, and seconds, below 0° or 180° on the declination-circle; as equal to the complement of the latitude; then elevate the polar axis till the bubble is horizontal, and thus the equatorial circle will be elevated to the co-latitude of the place; set this circle to 6 hours; adjust the level by the pinion of the declination-circle; then turn the equatorial circle exactly 12 hours from the last position; and if the bubble is wrong, correct one half of the error by the equatorial circle, and the other half by the declination-circle; then turn the equatorial circle back again exactly 12 hours from the last position; and if the level is still wrong, repeat the correction as before till it is right when turned to either position; that being done, set the nunius of the equatorial circle exactly to 0°, and the nunius of the declination circle exactly to 0°.

The principal uses of this equatorial are,

1. To find the meridian by one observation only: for this purpose elevate the equatorial circle to the co-latitude of the place, and set the declination-semicircle to the same declination for the day and hour of the day; then move the azimuth and hour circles both at the same time, either in the same or contrary directions, till you bring the centre of the cross hairs in the telescope exactly to cover the centre of the sun; when that is done, the index of the hour-circle will give the apparent or solar time at the instant of observation; and thus the time is gained, though the sun is at a distance from the meridian; then turn the hour-circle till the index points precisely at 12 o'clock, and lower the telescope to the horizon, in order to find that point there in the covering of your glass, and that point is your meridian mark found by one observation only; the best time for this operation is three hours before or three hours after 12 at noon

2. To point the telescope on a star, though not on the meridian, in full day-light. Have elevated the equatorial circle to the co-latitude of the place, and set the declination-semicircle to the star's declination, move the index of the hour-circle till it shall point to the precise time of which the star is then distant from the equator, found in tables of the right ascension of the stars, and the star will then appear in the glass. Besides these uses peculiar to this instrument, it is also applicable to all the purposes to which the principal astronomical instruments, viz., a transit, a quadrant, and an equal-altitude instrument, are applied.

Of all the different sorts of chronometers or timekeepers, a pendulum-clock, when properly constructed, is undoubtedly capable of giving the most correct indication of the rising and setting of the sun, and other stars; but it has some very great objection, viz., the danger of its being damaged or destroyed, or the pendulum or other parts being lost. Hence it is very useful for finding the positions of stars, or small comets, or to see the arrangement of a great number of stars in one view.

The principal instruments that are at present used for marine navigation, or for the purposes of sight, are, instruments called Hadley's sextant, or quadrant, or octant; a portable chronometer; and a pretty good telescope. With these few instruments, the latitude, longitudes, hours of the day or night, and several other problems used in navigation, may be accurately solved. See Optics, and Astronomy.

OBSDIAN, in mineralogy, called also the Iceland agate, is found either in detached masses, or in rounded pebble-like rocks. It has the appearance of black stone. It is usually invested with a grey or opaque crust. Its fracture is conchoidal. Specific gravity 2.35 nearly. Colour black, or greyish-black; texture very dense; green. Very brittle. It melts into an opaque grey mass. It is composed of 69 silica. 22 alumina. 9 iron.

OBTURATOR. See Anatomy.

OCCULIALES. See Anatomy.

OCCULT, in geometry, is used for a line that is scarcely perceptible, drawn with the point of the compasses, or a leaden pencil. These lines are used in several operations, as the raising of plains, designs of buildings, &c.; or to separate things as being by separate. They must be effaced when the work is finished.

OCCULTATION, of perpetual, is a parallel in an oblique sphere, as far distant from the depressed pole, as the elevated pole from the horizon. All the stars between this parallel and the depressed pole, never rise, but lie constantly hid under the horizon of the place.

OCCUPATION, or Occupancy. The law of occupancy is founded upon the law of nature, and is simply the taking possession of those things, which before belonged to nobody; and this is the true ground and foundation of all property. In the civil law it denotes the possession of such things as at present properly belong to no private person, but are capable of being made so; as by seizing or taking of spoil in war, by catching wild beasts of the field, as, birds and beasts of game, &c. or by finding the same before undiscovered, or lost by their proper owners.

OCCUPIERS of soil, in the civil law, are the persons who are the owners of the several parts of the land. What is the ownership is to be made, that the market may be not overlooked, and Seen that all is carried fairly and equally between the land and the tenant.
OCEAN, in geography, that vast collection of salt and navigable waters, in which the two continents, the first including Europe, Asia, and Africa, and the last America, are inclosed like islands. The ocean is distinguished into three grand divisions: 1. The Atlantic ocean, which divides Europe and Africa from America, which is generally about three thousand miles wide. 2. The Pacific ocean, or South-sea, which divides America from Asia, and is generally about ten thousand miles wide; and 3. The Indian ocean, which separates the East Indies from Africa, which is in three thousand miles wide. The other seas which are called oceans, are only parts or branches of these, and usually receive their names from the countries they border upon.

OCHNA, a genus of the monotypy order, in the polyandra class of plants; and in the natural method ranking with those of which the order is doubtful. The corolla is pentagonal, the calyx pentaphyllous; the berries monomeric, and allow to a large roundish receptacle. There are three species, trees of the East Indies and South America.

OCHNE, in natural history, a genus of eart, slightly coherent, and composed of fine, smooth, soft, argillaceous particles, rough to the touch, and readily dispersible in water. It is a combination of alumina and red oxide of iron. Ochres are of various colours, as red, blue, yellow, brown, green, &c.

OCHROMA, a genus of the pantanal order, in the monadelphia class of plants; and in the natural method ranking under the 37th order, columnae. The corolla consists of six petals, three of which are external, and the other three internal; the anthere unispore, and form a spiral pillar round the style; the capsule is long, and has five loculums, which contain a number of black round seeds. Of this there is only one species, viz. the ochroma lagouas, the wood of which is known as rock wood. That part of the tree grown in Jamaica, is of speedy growth, and rises to about 25 or 30 feet. The flowers are large and yellow. The capsules are about five inches long, rounded at the extremity, and when dry fall off in five longitudinal segments, and leaves the fruit greatly resembling a hare's foot. The bud is short, soft, and silky: it is used sometimes to stuff beds and pillows; but, like other vegetable down, is apt to get into cloths: an insipid clear gum exudes from the tree when wounded. The bark is tough, and its fibres are in a reticulated form; it might be made into ropes. The dried wood is so very light and buoyant, as to be used by the fisheries in Jamaica for their nets instead of pieces of cork.

OCYCHLUM, or OCYVM, basil, a genus of the class and order pentandria trigyna. The calyx is five-toothed; the petiole, erect, angular, three-lobed; glabrous; the capsule three, approximately, one-celled, two-seeded.

OCINUM, or OCYMN, basil, a genus of the didymion gymnosperma class of plants, with a bilabiated cup; its flower is monopetalous, and the last Anthere is divided into male and female parts. There are four in number, are contained in the cup, which closes for that purpose. There are 25 species. Both the herbage and seed of basil are used in medicine, and are said to be good in disorders of the lungs, and to promote the menses.

OCTAGON, or OCTAGON, in geometry, is a figure of eight equal and adjacent angles; and this, when all the sides and angles are equal, is called a regular octagon, or one which may be inscribed in a circle. If the radius of a circle circumscribing a regular octagon be $r$, and the side of the octagon be $s$; then

$$ s = 2r \sin \left( \frac{\pi}{8} \right) 
$$

OCTAGON, in fortification, denotes a place that has eight sides, and eight openings, instead of the four sides and four gates of a square. OCTAHEDRON, or OCTAEDRON, in geometry, one of the five regular bodies, consisting of eight equal and equilateral triangles. The square of the side of the octahedron is to the square of the diameter of the circumscribing sphere, as 1 to 2. If the diameter of the sphere is $2$, the solidity of the octahedron inscribed in it will be $1,3333\ldots$ nearly. The octahedron is two pyramids put together at their bases; therefore its solidity may be founded by multiplying the square of the base, by one third of the perpendicular height of one of them, and then doubling the product.

OCTANDRIA, the 16th class in Linneus's sexual system; consisting of plants with hermaphrodite flowers, which are furnished with eight stamina, or male organs of generation. See Botany.

OCTANT, or OCTILE, in astronomy, that aspect of two planets, wherein they are distant an eighth part of a circle, or 45°, from each other.

OCTAVE, in music, an interval containing seven degrees, or twelve semitones, and which is the first of the consonances in the order of generation. The most simple perception that we can have of two sounds is that of unison, which, resulting from equal vibrations, are as one to one; the next to this in simplicity is the octave, which is in double computation as one to two. The harmonies of two sounds have a perfect agreement, which distinguishes them from any other interval, and contributes to give them that unisonous effect which induces the common ear to confound them, and take them indifferently for one sound. This interval is called an octave, because moving diatonically from one term to the other, we produce eight different sounds. The octave comprehends all the primitive and original sounds; so that having established a system, or series of sounds, in the extent of an octave, we can only prolong that series by repeating the same order in a second octave, and again in a third, and so on, in which all we shall not find any sound that is not the replica of some sound in the adjoining octave.

The complete and rigorous system of the octave requires three major tones, two minor, and two major semitones. The tempered system is of five equal tones, and two semitones, forming together seven diatonic degrees.

ODE. See Poetry.

ODONTOGNATHUS, a genus of fishes of the order apodes. The generic character of this animal is to be found by multiplying the soft lamina or process on each side the upper jaw; gill-membrane five-rayed.

Acuteed odontogathus. The genus odontogathus consists of a single species, of which the following is the description. The head, body, and tail, are very compressed; the lower jaw, which is longer than the upper, is very much elevated towards the other when the mouth is closed, insomuch as to appear almost vertical; and is lowered somewhat in the manner of a drawbridge when the mouth is opened. The fish is onely', like a small scaly boat, very transparent, furrowed beneath, and finely denticulated on the margins; this lower jaw, in the act of depression, draws forwards two flat, irregular laminae, of a scale also scaly, a little beyond their posterior end, and larger at their origin than at their tips, denticulated on their anterior margin, and attached, one on one side and the other on the opposite, to the most prominent part of the snout; when the mouth is closed again, these pieces apply themselves on each side to one of the operations, which they represent the exterior denticulated border; in the middle of these jaws is a thin triangular point, which is pointed and free in its movements; the gill covers, which are composed of several pieces, are very transparent at the hind part, but scaly and of a bright silver-colour in front. The gill-membrane is also scaly, and has five rays; the breast is terminated below by a sharp carina furnished with eight crooked spines; the carina of the belly is also furnished with twenty-eight spines, disposed in two longitudinal rows; the lower fin is very long, and extends almost as far as the base of the tail-fin, which is of a forked shape; the dorsal fin is placed on the tail, properly speaking, at about three quarters of the whole length of the animal, but is extremely small. The general length of this fish is three decimetres, and its colour, so far as may be conjectured from specimens preserved for some time in spirit, is a bright silver. It is a native of the American seas, and is common about the coasts of Cayenne, where it ranks in the number of edible fishes.

OECONOMY, animal, comprehends the various operations of nature, in the generation, and multiplication of animals. See Anatomy, Physiology, Comparative Anatomy, Digestion, &c.

OEDEMA. See Surgery.

OEDERA, a genus of the synangia polygamous class and order; the calyx many-flowered; corollas tubular, hermaphroditic, with one or two female ligules below; recept. clasped, down of several chafts. There are two species, herbs of the Cape.

OENANTHE, water (or hemlock) drowort: a genus of the digyna order, in the pentanthera class of plants; and in the natural method ranking under the 43th order, umbellate. The leaves are disform; those of the disk sessile and barren; the fruit crowned with the calyx. There are 11 species, of which the most remarkable is the crocata, or hemlock drowort, growing frequently on the banks of ditches, rivers, and lakes, in many parts of Britain. The root and leaves of this plant are a strong poison; several persons have perished by eating it through the inadvertence either of misguiding the people, which last it much resembles in its leaves. So exceedingly deleterious is this plant, that Mr. Lightfoot tells us he has heard the like Mr. Christopher d'Ethret, the celebrated botanic painter say, that while he
was drawing it, the smell or effluvia rendered him so giddy, that he was several times obliged to quit the room, and walk out in the fresh air to recover himself; but recollecting at last what might be the probable cause of his headache if he opened the door and windows of the room, and the free air then enabled him to finish his work without any more returns of the giddiness. Mr. Lightfoot informs us, that he has given a spoonful of the juice of this plant to a dog, but without any other effect than that of making him very sick and stupid. In about an hour he recovered; and our author has seen a goat eat it with impunity. To such of the human species as will allow, it is an article of diet.

The cubit, or culex, as it is called, is a large white insect, which breeds in any part of a plant, a vomit is the best remedy.

Loebel, Ray, and others, call this vegetable oenantha cicuta ficte. It grows in great plenty all over Pembrokeshire, and is sold by the gynas roots for a fingered root; it is much used by them in cataplasmns for the felon or worst kind of whitlow. They eat some parts of it, but carefully avoid the roots or stee. This is a species of a most pestilential nature, and never fail to prove instantly fatal unless a proper remedy is applied.

OENOTHIRA, tree-prunrose: a genus of plants in the order of the octandria class of plants, and included in the natural method ranking under the 17th order, calycanthia. The calyx is quadrifoli; the petals four; the capsule cylindrical beneath; the seeds naked. There are 11 species; the most remarkable of which are: 1. The biennis, or common biennial tree-prunrose, with large bright-yellow flowers. 2. Octovalvis, or octovalved, smooth, biennial tree-prunrose, with large bright-yellow flowers. 3. The fruiticea, or shrubby narrow-leaved perennial tree-prunrose, with clusters of yellow flowers, succeeded by pedicellate, acute-angled capsules. 4. The punica, or long-petalled tree-prunrose, with bright-yellow flowers, succeeded by acute-angled capsules.

These plants are exotic from America; but are all very hardy, prosper in any common soil, and have been long in the English gardens; especially the three first sorts; but the oenothera biennis is the most commonly known.

OEPHTAGHUS. See Anatomy.

OESTRUS, a genus of insects of the order diptera; the generic character is, antennae trisetulac, very short, sunk; face broad, depressed, vesicular; mouth, a simple orifice; feelers two, barbiculate, sunk; tail infe- ric. All the oestrus or gad-fly is remark- able, like that of ichneumon, for the singular residence of its larva; viz. beneath the skin, or in different parts of the bodies of quadrupeds.

The principal European species is the oes- trus bovis, or ox-gadfly. This is about the size of a common bee, and is of a pale yellowish-brown colour, with the thorax marked by four longitudinal bands, the abdomen by a black bar across the middle, the tip being covered with tawny or orange-coloured hairs; the wings are pale brown, and unspecialled. The female of this species, when ready to deposit her eggs, fastens on the back of a boar or cow, and piercing the skin with the tube situated at the tip of the abdomen, deposits an egg in the puncture; she then proceeds to another spot at some distance from the former, repeating the same operation at intervals on many parts of the animal's back.

This insect is very injurious to cattle, and causes them severe pain on the animal on which it is practised; and it is for this reason that cattle are observed to be seized with much violent hor- ror when apprehensive of the approach of the females. She flies with incredible rapidity, and endeavouring to escape their tormentor by taking refuge in the nearest pond; it being observed that this insect rarely attacks cattle when standing in water.

In the puncture of the skin thus bored by the gadfly, the several eggs hatch, and the larvae, by their motion and suction, cause so many small swellings or abscesses beneath the skin, which growing gradually larger, become externally visible, exhibiting so many tubercles an inch or more in diameter, with an opening at the top of each, through which may be observed the larva, imbedded in a purulent fluid; its appearance is that of an oval, whitish, pale-colored worm, while young, but growing gradually darker as it advances in age, till at the time of its full growth it is entirely brown. It is chiefly in the months of August and September that the eggs of this insect remain in the ground through the ensuing winter, and till the latter part of the next June, before they are ready to undergo their change into chrysalids. At this period they force themselves out from their punctures, falling to the ground, each creeps beneath the first convenient shelter, and lying in an inert state becomes contracted into an oval form, but without casting the larva out of the integument which dries and hardens round it. When the included insect is ready for exclusion, it forces open the top of the pupa or chrysalis coat, and emerges in its perfect form, having remained within the chrysalis somewhat more than a month.

Though the history of this insect in its larval state has long ago been detailed with sufficient accuracy by Vailimieri, Reaumur, and other entomologists, it has been very generally confounded, and that even by Linnaeus himself, with a very different species, resembling it in size, but which is bred in the stomach and intestines of horses, and of which the larva being no other than the whitish rough maggots which carriars call by the title of bots. This insect is the oestrus cinereus; it is a little smaller than the oestrus bovis, and is of a yellowish-brown colour, with a dusky band along the thorax, and the tip of the abdomen of similar colour; the wings are whitish, with a pale dusky bar across the middle of each, and two dusky spots at the tip.

The most common in which the young larvae or bots are introduced into the stomach and bowels of the animal they infest is singularly curious. When the female has been impregnated, and the eggs are sufficiently large, she seeks among the horses a subject for her purpose, and approaching if on the wing, she holds her body nearly upright in the air, and her tail, which is lengthened for the purpose, curved inwards and upwards, in this way she approaches the part where she designs to deposit her egg; and suspending herself for a few seconds before it, suddenly darts upon it, and leaves her egg ad-
colour of the food, and shews that the chyle, a they receive it, is not perfect city gale.

They attain their full growth about the latter end of May, and are coming from the horns from the places where they have been, or sometimes later. On drooping to the ground they find out some convenient retreat, and change to the chrysalis; and in about six or seven weeks the fly appears.

Oestrus ovatus, or the sheep-fly, is so named from its larva inhabiting the nostrils and frontal sinuses of sheep in particular, though it is also found in similar situations in deer and some other quadrupeds. It is a smaller species than either of the two preceding, and is of a whiter-grey colour, with the thorax marked by four longitudinal black streaks, and the abdomen speckled with black. The larvae are nearly as large as those of the oestrus equi, and, according to the observations of Mr. Clark, are of a delicate white colour, flat on the under side, and convex on the upper; having no spines at the divisions of the segments, though they are provided with tentacles at the small end. The other is a proper name, or margin. When young these larvae are perfectly white and transparent; but as they increase in size the upper side becomes marked with two transverse brown lines on each segment and a prominent spot on the side. They move with considerable quickness, holding with their tentacles a fixed point, and drawing up the body towards them. When full-grown they fall through the nozzles to the latter end of June, or chrysalis state, lying on the ground, or adhering to some blade of grass. The fly proceeds from the chrysalis in the space of about two months.

The other British oestrus are the oestrus harrassoria of Linnaeus, whose larvae, like that of the oestrus equi, resides in the stomachs of horses; and the oestrus veteranus of Mr. Clark, the larva of which is also found in similar situations. The oestrus harrassoria is described by Linnaeus as a species of one common window-fly, with p. dusky wings, brown thorax, abdomen white at the base, black in the middle, and red at the tip. The oestrus veteranus is not uncommon in the oestrus equi, and is entirely of a ferruginous colour, with the abdomen more dusky towards the tip. The oestrus tarandi inhabits Lapland, and deposits its eggs on the back of the rein-deer, and is often fatal to them. See Plate Nat. Hist. fig. 399.

The other exotic oestrus are probably numerous, but are at present very little known.

Whether the formidable African fly, described by Mr. Bruce under the name of zimb or tsitsikala, may be referred to this genus or not, we shall not pretend to determine; there are however some particulars in its history which would lead one to suppose it an oestrus.

"This insect," says Mr. Bruce, "is a proof how fallacious is the judge by appearances. If we consider its small size, its weakness, want of variety or beauty, nothing in the creation is more contemptible and insignificant. Yet prying from these to his history, and to the account of his powers, we must confess the very great injustice we do him from want of consideration. We are obliged, with the greatest surprise, to acknowledge, that those huge animals the elephant, the rhinoceros, the lion, and the tiger, inhabiting the same woods, are still vastly his inferiors; and that the appearance of this small insect, nay, of the little animal, seems to occasion, or occasion more trepidation, movement, and disorder, both in the human and brute creation, than would whole herds of these monstrous animals collected together, though their number were a tenfold proportion greater than it really is.

"This insect is called zimb; it has not been described by any naturalist. It is in size very little larger than a bee, and his very small, though not so small, as is certainly a tenfold proportion greater than it really is. As soon as this appears, and their buzzing is heard, all the cattle forsake their food, and run wildly about the plain, till they die, worn out in their anxiety to pursue it. What enables the shepherd to perform the long and toilsome journeys across Africa is the camel, emphatically called the ship of the desert. Though his size is immense, his strength and his strong, and his hair covered with a thick skin, defended with strong hair, yet still he is not capable to sustain the violent punctures the fly makes with his proboscis. In fact must lose no time in removing to the lands of Atbara; for when once attacked by this fly, his body, head, and legs, break out into large, big, which, well, break, and putrify, to the certain destruction of the carrier. The insect is the rhinoceros, who, by reason of their enormous bulk, and the vast quantity of food and water they daily need, cannot shoot to desert and dry places as the season may require, are obliged to roll themselves in mud and mire, which, when dry, coats them over like armour, and enables them to stand their ground against this winged assas.

I have found some of these tubercles upon almost every elephant and rhinoceros I have seen, and attribute them to this cause." There are at least twelve species of this insect.

OFFENCE, is any act committed against any law. Offences are either capital or not so called. Capital are those for which an offender shall lose his life; not capital, where the offender may lose his lands and goods, &c. For, or suffer corporal punishment, or both, but not of loss of life. High treason, petit treason, and felony, constitute capital offences; other offences, not capital, include the remaining part of criminal offences or pleas of the crown, and come under the denomination of misdemeanours.

OFFERINGS. Obligations and offerings pertain of the nature of duties; and all persons who, by the laws of this realm, ought to pay their offerings, shall yearly pay to the parson, vicar, proprietary, or their deputies, or farmers of the parishes where they dwell, at such four offering days as heretofore within the space of four years last past have been accustomed; and in default thereof, shall pay for the said offering at Easter following. 2 and 3 Ed. VI. c. 13.

OFFICE, is that function, by virtue whereof a person has some employment in the affairs of another. An office is a right to exercise any public or private employment, and to take the fees and emoluments thereunto belonging, whether public as those of magistrates, or private as of bailiffs, receivers, &c. The statutes 2 and 6 Edward VI. c. 10, declares all securities given for the sale of offices unlawful. And if any person shall bargain or sell, or take any reward, or promise to pay, for any of the several offices of any of the several persons, concerning the revenue, or the keepers of the king's castles, or the administration and execution of justice, unless it is such an office as had been usually granted by the justices of the peace, or by common pleas, or by justices of assizes, every such person shall not only forfeit his right to such office, or to the nomination thereof, but the person giving such reward, &c. shall be disabled from the future.
OFFICERS, staff, are such as, in the king’s presence, bear a white staff or wand, and at other times, on their going abroad, have it carried before them by a footman bareheaded; such are the lord steward, lord chamberlain, lord treasurer, &c.

The waul, or billet, is taken for a commission, and at the king’s death each of these officers breaks his staff over the hearse made for the king’s body, and by this means lays down his commission, and discharges all his interior office.

OFFICERS, subaltern, are all who administer justice in the name of subjects; as those who act under the earl marshal, admiral, &c. In the army, the subaltern officers are the lieutenants, cornets, ensigns, serjeants, and corporals.

OFFICIAL, in the canon law, an ecclesiastical judge, appointed by a bishop, chapter, abbot, &c. with charge of the spiritual jurisdiction of the diocese. Of these there are two kinds, the one is in a manner the vice-governor of the diocese, and is called by the canons officials principals, and in our statute-law, the bishop’s chancellor. There is no appeal from his court to the bishop, his being the bishop’s courts. The other called officials foraneus, and is appointed by the bishop when the diocese is very large; he has but a limited jurisdiction, and has a certain extent of territory assigned him, within the dioceses.

OFFING, or OFFIN, in the sea-language, that part of the sea a good distance from shore, where there is deep water, and no need of a pilot to conduct the ship; thus, if a ship from shore is seen sailing out to sea, they say, she stands for the offing; and if a ship, leaving the shore near her, has another a good way without her, or towards the sea, they say, that ship is in the offing.

OIL, which is of such extensive utility in the arts, was known at a very remote period. It is mentioned in Genesis, and during the time of Abraham was even used in lamps. The olive was very early cultivated, and oil extracted from it in Egypt. Cerrops brought it from Sais, a town in Lower Egypt, where it had been cultivated from time immemorial, and taught the Athenians to extract oil from it. In this manner the use of oil became known in Europe. But the Greeks seem to have been ignorant of the method of procuring light by means of lamps till after the siege of Troy; at least Homer never mentions them, and constantly describes his heroes as lighted by torches of wood. There are two classes of oils exceedingly different from each other; namely, fixed oils and volatile oils.

Fixed oils are distinguished by the following characters:
1. Liquid, or easily becoming so when exposed to a gentle heat. 2. An inebriating feel. 3. Very combustible. 4. A mild taste. 5. Boiling point not under 600°. 6. Insoluble in water and alcohol. 7. Leave a greasy stain upon paper.

The oils which are called also fat or examined fats, are numerous; and are obtained, partly from animals and partly from vegetables, by simple expression. As instances may be mentioned, white-oil or train-oil obtained from the blubber of the whale; olive-oil, obtained from the fruit of the olive; linseed-oil and almond-oil, obtained from linseed and almond-kernels. Fixed oils may also be extracted from poppy-seeds, hemp-seeds, beechnuts, and many other vegetable substances.

It deserves attention, that the only part of vegetable oils that is fixed, or solid in cold water, are found in the seeds of biologically plants. In animals they are usually deposited in the liver, though they are found also in the eggs of fowls.

All these oils differ from each other in several respects, but there also possess many particulars in common. Whether the oily principle in all the fixed oils is the same, and whether they owe their differences to accidental ingredients, is not yet completely ascertained, as no proper analysis has hitherto been made; but it is not improbable, as all the oils hitherto tried have been found to yield the same products. In the present state of our knowledge, it would be useless to give a particular description of all the fixed oils, as even the differences between them have not been accurately ascertained.

Fixed oils are considered at present as composed of hydrogen and carbon. Lavoisier analysed olive-oil by burning a given portion of it in oxygen gas, by means of a particular apparatus. During the combustion there was consumed

<table>
<thead>
<tr>
<th>Of oil</th>
<th>15.79 grains</th>
<th>troy</th>
</tr>
</thead>
<tbody>
<tr>
<td>Of oxygen gas</td>
<td>50.86</td>
<td></td>
</tr>
</tbody>
</table>

Total 66.65

The products were carbonic acid and water. The carbonic acid obtained amounted to 44.50 grains; the weight of the water could not be accurately ascertained, but as the whole of the substances consumed were converted into carbonic acid and water, it is evident, that if the weight of the carbonic acid is subtracted from the weight of these substances, there must remain precisely the weight of the water. Mr. Lavoisier accordingly concluded, by calculation, that the weight of the water was 22.15 grains. Now the quantity of oxygen in 44.50 grains of carbonic acid is 32.04 grains, and the oxygen in 22.15 grains of water is 18.32 grains; both of which taken together amount to 50.86 grains, precisely the weight of the oxygen gas employed.

The quantity of charcoal in 44.50 grains of carbonic acid is 12.47 grains; and the quantity of hydrogen in 22.15 grains of water is 3.32 grains; both of which, when taken together, amount to 15.79 grains, which is the weight of the oil consumed.

It follows, therefore, from this analysis, that 15.79 grains of olive oil are composed of

- 12.47 carbon
- 3.32 hydrogen

Olive-oil therefore is composed of about

1. Carbon 71
2. Hydrogen 21
100.

This however can only be considered as a very imperfect approximation towards the truth.

Fixed oil is usually a liquid with a certain degree of viscosity, adhering to the sides of the glass vessels in which it is contained, and fanning streaks. It is never perfectly transparent, having always a certain degree of colour; most usually it is yellowish or greenish. Its taste is sweet, or nearly insipid. When fresh, it has little or no smell. Its specific gravity varies from 0.9403 (the specific gravity of linseed-oil) to 0.9153 (the specific gravity of olive-oil).

Fixed oil is insipid in cold water. When the two liquids are agitated together, the water loses its transparency, and acquires the white colour and consistency of milk. This mixture is known by the name of emulsion. When allowed to stand, the oil soon separates, and swells upon the surface of the water.

Fixed oil does not evaporate till it is heated to about 600°. At that temperature it boils, and may be distilled over; but it is always somewhat altered by the process.

Some water and sebaceous acid seem to be formed, and a little charcoal remains in the retort, and the oil obtained is lighter, more fluid, and has a stronger taste, than before.

Oil thus distilled was formerly distinguished by the name of philosophical oil.

Fixed oil, when in the state of vapour, takes fire on the approach of an ignited body, and burns with a brilliant flame. It is upon this principle that candles and lamps burn.

The tallow or oil is first converted into the state of vapour in the wick; it then takes fire, and supplies a sufficient quantity of heat to convert more oil into vapour; and this process goes on while any oil remains.

The wick is necessary to present a sufficiently small quantity of oil at once for the heat to act upon. If the heat was sufficiently great to keep the temperature of 600°, no wick would be necessary, as it is obvious from oil catching fire spontaneously when it has been raised to that temperature.

When exposed to the action of cold, fixed oils lose their fluidity, and are converted into ice; but this change varies exceedingly in different oils.

When fixed oils are exposed to the open air or to oxygen gas, they undergo different changes according to the nature of the oil:

1. Some of them dry altogether, without losing their transparency, when exposed to a cold atmosphere.
2. Others lose all their transparency, when exposed to a warm atmosphere.

These are distinguished by the name of drying oils, and are employed by painters. Linseed-oil, nut-oil, poppy-oil, and hempseed-oil, possess this property; but linseed-oil is almost the only one of this class employed in this country as a drying oil. The cause of this peculiarity has not been completely investigated; but it is well known that these oils possess the drying quality at first but imperfectly. Before they can be employed by painters, they must be boiled with a little litharge. During this operation the litharge is partly reduced to the metallic state. Hence it has been conjectured that drying oils owe their peculiar properties to the action of oxygen; which is supposed either to constitute one of their component parts, or to convert them into drying oils by diminishing their hydrogen.

2. Other fixed oils, when exposed to the atmosphere, gradually become thick, opaque, and white, and assume an appearance very much resembling wax or tar oil. These have been distinguished by the term fat oils. Olive-oil, oil of sweet almonds, of rape-seed, and of linen, belong to this class.

When oil is poured upon water, so as to
form a thin layer on its surface, and is in that manner exposed to the atmosphere: these changes are produced much sooner. Berthollet, who first examined these phenomena with attention, ascribed them to the action of light; but Senebier observed that no such change was produced on the oil though ever so long exposed to the light, provided air was excluded; but that it took place on the admission of oxygen gas, whether the oil was exposed to the light or not. It cannot be doubted, then, that it is owing to the action of either light or air, that these substances underwent a change. But it is supposed at Pelletier to be the consequence of the simple absorption of oxygen and its combination with the oils.

3. Both these classes of oils, when exposed in considerable quantity to the action of the atmosphere, undergo another change, well known under the name of rancidity. But the fat oils become rancid much more readily than the drying oils. Rancid oils are thick, have usually an oil-smell, and a disagreeable vegetable red to blue, and have the smell and taste of septic acid. During the change which they undergo, some drops of water also appear on their surface. The rancidity of oils is due to the variation of quantity of oxygen in them. This, together with the water, is evidently the consequence of a partial decomposition.

Fixed oils readily dissolve sulphur when assisted by heat. The solution assumes a reddish colour. When distilled, they give over a great quantity of sulphuretted hydrogen gas. When the solution is allowed to cool, the sulphur is deposited in crystals. By this process, Pelletier obtained sulphur in regular octahedrons. They likewise dissolve a small proportion of phosphorus when assisted by heat. These oily phosphorus emit the smell of phosphuretted hydrogen, and yield, when distilled, a portion of that gas. When rubbed in the open air, or when spread upon the surface of other bodies, they appear luminous in consequence of the combustion of the phosphorus. When saturated with phosphorus, and allowed to cool, the phosphorus crystallizes in octahedrons, as Pelletier ascertained.

Charcoal has no sensible action on fixed oils; but when they are filtered through charcoal-powder, they are rendered pure, the charcoal retaining their impurities. Neither hydrogen nor azotic gas has any action on fixed oils.

Fixed oils have scarcely any action upon metals; but they combine with several metallic oxides, and form compounds known by the name of plasters. See PLASTER.

They cause to acquire a brown colour to cities and earthen, and form with them compounds called soaps. The fat oils enter into these combinations much more readily than the drying oils. See SOAP.

Fixed oils readily absorb nitrous gas in considerable quantities, and at the same time become much thicker and specifically heavier than before.

Sulphuric acid decomposes fixed oils, at least when concentrated. It renders them thick and brown; when nitric acid is poured upon the drying oils, it inflames them without action; but it does not produce that effect upon the fat oils, unless it is mixed with a portion of sulphuric acid.

The affinities of fixed oils are as follows:

- Lye, Anomia
- Barytes, Oxide of mercury
- Fixed alkalies, Other metallic oxides
- Magnesia, Alumina

The importance of fixed oils is well known. Some of them are employed as seasoners of foods; some are burnt in lamps; some form the basis of soap; not to mention their utility in painting, and the many other important purposes which they serve.

OILS, volatile, called also essential oils, are distinguished by the following properties:

1. Liquid; often almost as liquid as water; sometimes viscid.
2. Very combustible.
3. An astringent and a strong fragrant odor.
4. Boiling point not higher than 219°.
5. Soluble in alcohol; and imperfectly in water.
6. Evaporate without leaving any stain on paper.

By last test it is easy to discover whether they have been adulterated with any of the fixed oils. Let a drop of the volatile oil fall upon a sheet of writing-paper, and then be gently heated. If it evaporate without leaving any stain upon the paper, the oil is pure; but if it leaves a stain, it has been contaminated with some fixed oil or other.

Volatile oils are almost all obtained from vegetables, and they exist in every part of plants; the root, the bark, the wood, the leaves, the flower, and even the fruit; though they are never found in the substance of the cedarys; whereas the fixed oils, on the contrary, are almost always contained in these bodies.

When the volatile oils are contained in great abundance in plants, they are sometimes obtained by simple expression. This is the case with the oil of oranges, of lemons, and of bergamot; but in general they can only be obtained by distillation. The part of the plant containing the oil is put into a distilling apparatus, which is distill'd off by the application of a moderate heat. The oil comes over along with the water, and spins upon its surface in the receiver. By this process are obtained the oils of peppermint, thyme, lavender, and a great many others, which are prepared and employed by the perfumer. Others are procured by the distillation of resinous bodies. This is the case in particular with oil of turpentine, which is obtained by distilling a kind of resinous juice, called turpentine, that exudes from the juniper.

The greater number of volatile oils are liquid, and some of them are as transparent and colourless as water. This is the case with the oil of turpentine; but for the most part they are colored. Some of them are yellow, as the oil of lavender; some brown, as the oil of rhododendrons; some blue, as the oil of blue-french juniper; but the greater number of volatile oils are yellow or reddish-brown.

Their odors are so various as to defy all description. It is sufficient to say, that all the fragrance of the vegetable kingdom resides in the volatile oils. Their taste is always acrid, hot, and exceedingly unpleasant. Their specific gravity is for the most part less than that of water, but some volatile oils, as those of canella and sassafras, are heavier than water. The specific gravity of the volatile oils varies from 0.8097 to 1.0534.

Water dissolves a small portion of volatile oils, and acquires the odor of the oil which it holds in solution.

When heated, they evaporate very readily and without alteration. They are much more combustible than fixed oils, owing to their greater volatility. They burn with a bright white flame, exhale a great deal of smoke, deposit much soot, and consume a greater proportion of the oxygen of the atmosphere than fixed oils. The products of combustion are therefore much carbonic acid gas. From these facts it has been concluded that they are composed of the same ingredients as the fixed oils, but that they contain a greater proportion of hydrogen.

Soap.

When the volatile oil is exposed to the action of light in close vessels, and excluded from common air, undergo very singular changes. Their colour becomes deeper, they acquire a great deal of consistency, and their specific gravity is considerably increased. The cause of these changes is but imperfectly known. Tinsley, to whom we are indebted for these interesting researches, has proved that light is a necessary agent. It was supposedformerly that these changes were occasioned by the absorption of oxygen; and when oxygen is present, it has been ascertained that it is absorbed; but Tinsley has proved that the same changes go on when oxygen is excluded, and he supposes that exposure to the action of light in close vessels, and exclusion from common air, is the cause of them. If this is the real cause, the quantity of light fixed must be enormous; for as the specific gravity of the oils is increased considerably while the bulk continues the same, it is evident that the absolute weight must be increased proportionally. One circumstance, however, renders this conclusion somewhat doubtful, at least in its full extent; and that is, that the greater part of change acts always proportionally to the quantity of the oil and the quantity of air contained in the vessel.

When exposed to the open air their colour becomes gradually deeper, and they acquire consistency, while they exude at the same time a very strong odour. The air around, as Priestley first ascertained, is deprived of its oxygen, a quantity of water is formed, and the oil at the same time assumed the form of resin.

Volatile oils dissolve sulphur and phosphorus, and the solutions have nearly the same properties as those made by means of fixed oils.

They have no action on the metals, and
seem scarcely capable of combining with the metallic oxides.

They combine only imperfectly, and in small quantities, with alkaloids and earths. The French chemists have proposed to give these combinations the name of savonettes, but these denominations have not been adopted by chemists:

They absorb nitrates gas in great abundance, and with great facility, and seemingly decompose it, acquiring a thick consistency and a greasy appearance, as if they had absorbed oxygen.

Sulphuric acid decomposes volatile oils; carburetted hydrogen gas is emitted, and charcoal is precipitated. Nitric acid inflames them, and converts them into water, carbonic acid, and charcoal. Oxymuriatic acid converts them into substances analogous to resins.

Volatile oils are applied to a great number of uses. Some of them are employed in medicine; some of them, as oil of turpentine, are much used to dissolve resins, which are afterwards employed as varnishes; not to mention their employment in painting and in perfumery.

Besides the oils which exist ready formed in the vegetable and animal kingdoms, there are a variety of others which are obtained when animal or vegetable bodies are distilled by means of a heat above that of boiling water.

These oils have received the appellation of empyreumatic, because they are formed by the action of the fire.

The following is a list of the plants which yield the fixed oils occurring usually in commerce:

<table>
<thead>
<tr>
<th>Plant</th>
<th>Part</th>
<th>Oil of</th>
<th>Colour</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Linum usitatissimum</td>
<td>Leaves</td>
<td>Wormwood</td>
<td>Green</td>
</tr>
<tr>
<td>2. Acorus calamus</td>
<td>Root</td>
<td>Sweet flag</td>
<td>Yellow</td>
</tr>
<tr>
<td>3. Myrrhus pimenta</td>
<td>Fruit</td>
<td>Jamaica pepper</td>
<td>Yellow</td>
</tr>
<tr>
<td>4. Anethum graveolens</td>
<td>Seeds</td>
<td>Thyme</td>
<td>Yellow</td>
</tr>
<tr>
<td>5. Angelica archangelica</td>
<td>Root</td>
<td>Angelica</td>
<td>White</td>
</tr>
<tr>
<td>6. Pinpinella asarum</td>
<td>Seeds</td>
<td>Anise</td>
<td>White</td>
</tr>
<tr>
<td>7. Illicium anisatum</td>
<td>Leaves</td>
<td>Sassafras</td>
<td>Yellow</td>
</tr>
<tr>
<td>8. Artemisia absinthium</td>
<td>Leaves</td>
<td>Bergamot</td>
<td>Yellow</td>
</tr>
<tr>
<td>9. Citrus aurantium</td>
<td>Fruits</td>
<td>Cajupe</td>
<td>Green</td>
</tr>
<tr>
<td>10. Melicoccus leucodendron</td>
<td>Capsules</td>
<td>Cloves</td>
<td>Yellow</td>
</tr>
<tr>
<td>11. Eugenia caryophyllata</td>
<td>Seeds</td>
<td>Caraways</td>
<td>Yellow</td>
</tr>
<tr>
<td>12. Carum carvi</td>
<td>Seeds</td>
<td>Card. seeds</td>
<td>Yellow</td>
</tr>
<tr>
<td>13. Anemonum cardamonum</td>
<td>Roots</td>
<td>Cardamom</td>
<td>Yellow</td>
</tr>
<tr>
<td>14. Carina acutis</td>
<td>Leaves</td>
<td>Chervil</td>
<td>Sulph. yellow</td>
</tr>
<tr>
<td>15. Scancia cina</td>
<td>Leaves</td>
<td>Chamomile</td>
<td>Yellow</td>
</tr>
<tr>
<td>16. Matricaria chamomilla</td>
<td>Petals</td>
<td>Cinnamon</td>
<td>Yellow</td>
</tr>
<tr>
<td>17. Laurus cinnamomum</td>
<td>Bark</td>
<td>Lemons</td>
<td>Yellow</td>
</tr>
<tr>
<td>18. Citrus medica</td>
<td>Seeds</td>
<td>Scurry grass</td>
<td>Yellow</td>
</tr>
<tr>
<td>19. Cocos nucifera</td>
<td>Extract</td>
<td>Copal</td>
<td>White</td>
</tr>
<tr>
<td>20. Coparia officinalis</td>
<td>Seeds</td>
<td>Coriand. seed</td>
<td>White</td>
</tr>
<tr>
<td>21. Coriandra sativum</td>
<td>Seeds</td>
<td>Pimento</td>
<td>Yellow</td>
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<tr>
<td>22. Crocus sativus</td>
<td>Pistils</td>
<td>Saffron</td>
<td>Yellow</td>
</tr>
<tr>
<td>23. Piper cubeba</td>
<td>Seeds</td>
<td>Coheb pepper</td>
<td>Yellow</td>
</tr>
<tr>
<td>24. Laurus cubilaban</td>
<td>Bark</td>
<td>Cuhilan</td>
<td>Yellow</td>
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<td>25. Citrus citratus</td>
<td>Seeds</td>
<td>Cammi</td>
<td>Yellow</td>
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<td>26. Anethum graveolens</td>
<td>Seeds</td>
<td>Fennel</td>
<td>White</td>
</tr>
<tr>
<td>27. Croton eleuteria</td>
<td>Seeds</td>
<td>Cascarilla</td>
<td>Yellow</td>
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<tr>
<td>28. Croton eleuteria</td>
<td>Roots</td>
<td>Galanga</td>
<td>Yellow</td>
</tr>
<tr>
<td>29. Hyssopus officinalis</td>
<td>Seeds</td>
<td>Hyssopus</td>
<td>Yellow</td>
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<tr>
<td>30. Juniperus communis</td>
<td>Seeds</td>
<td>Juniper</td>
<td>Green</td>
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<tr>
<td>31. Lavendula spica</td>
<td>Flowers</td>
<td>Lavender</td>
<td>Yellow</td>
</tr>
<tr>
<td>32. Laurus nobilis</td>
<td>Berries</td>
<td>Laurel</td>
<td>Brownish</td>
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<td>33. Prunus vulgaris</td>
<td>Leaves</td>
<td>Laurel</td>
<td>Yellow</td>
</tr>
<tr>
<td>34. Lavandula officinalis</td>
<td>Roots</td>
<td>Loveage</td>
<td>Yellow</td>
</tr>
<tr>
<td>35. Mentha pulegium</td>
<td>Leaves</td>
<td>Mace</td>
<td>Yellow</td>
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<td>36. Myristica moschata</td>
<td>Seeds</td>
<td>Marjoram</td>
<td>Yellow</td>
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<tr>
<td>37. Origanum majorana</td>
<td>Leaves</td>
<td>Marigold</td>
<td>Yellow</td>
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<td>38. Ruta graveolens</td>
<td>Resin</td>
<td>Motherwort</td>
<td>Blue</td>
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<tr>
<td>39. Matricaria parthenium</td>
<td>Plant</td>
<td>Plantain</td>
<td>White</td>
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<tr>
<td>40. Melissa officinalis</td>
<td>Leaves</td>
<td>Balm</td>
<td>White</td>
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<tr>
<td>41. Mentha piperita</td>
<td>Leaves</td>
<td>Peppermint</td>
<td>White</td>
</tr>
<tr>
<td>42. Pimenta officinalis</td>
<td>Flowers</td>
<td>Millefoil</td>
<td>Blue and green</td>
</tr>
<tr>
<td>43. Achillea millefolium</td>
<td>Leaves</td>
<td>Neroli</td>
<td>Orange</td>
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<td>44. Citrus aurantium</td>
<td>Leaves</td>
<td>Orange</td>
<td>Brown</td>
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<td>45. Origanum comosum</td>
<td>Seeds</td>
<td>Origanum</td>
<td>Brown</td>
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<tr>
<td>46. Aujium persicum</td>
<td>Seeds</td>
<td>Parsley</td>
<td>Yellow</td>
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<tr>
<td>47. Pinus sylvestris &amp; abies</td>
<td>Wood and resin</td>
<td>Turpentine</td>
<td>Yellow</td>
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<tr>
<td>48. Piper nigrum</td>
<td>Seeds</td>
<td>Pepper</td>
<td>Pepper</td>
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<td>49. Rosmarinus officinalis</td>
<td>Plant</td>
<td>Rosemary</td>
<td>Yellow</td>
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<tr>
<td>50. Mentha pulegium</td>
<td>Flowers</td>
<td>Pennyroyal</td>
<td>Yellow</td>
</tr>
<tr>
<td>51. Genista canariensis</td>
<td>Root</td>
<td>Rhodium</td>
<td>Yellow</td>
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<tr>
<td>52. Roo n crtalinum</td>
<td>Petals</td>
<td>Rose</td>
<td>Colourless</td>
</tr>
<tr>
<td>53. Ruta graveolens</td>
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</tr>
<tr>
<td>54. Juniperus sabina</td>
<td>Leaves</td>
<td>Sage</td>
<td>Green</td>
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<td>55. Salvia officinalis</td>
<td>Seeds</td>
<td>Thyme</td>
<td>Yellow</td>
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<tr>
<td>56. Santalum album</td>
<td>Flowers</td>
<td>Santalum</td>
<td>Yellow</td>
</tr>
<tr>
<td>57. Laurus sassafras</td>
<td>Root</td>
<td>Sassafras</td>
<td>Yellow</td>
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<tr>
<td>58. Satureja hortensis</td>
<td>Leaves</td>
<td>Saturejas</td>
<td>Yellow</td>
</tr>
<tr>
<td>59. Thymus serpyllum</td>
<td>Leaves &amp; flowers</td>
<td>Satureja</td>
<td>Yellow</td>
</tr>
<tr>
<td>60. Valeriana officinalis</td>
<td>Root</td>
<td>Thyme</td>
<td>Yellow</td>
</tr>
<tr>
<td>61. Kameranis rotunda</td>
<td>Root</td>
<td>Valerian</td>
<td>Green</td>
</tr>
<tr>
<td>62. Amomum Zinziber</td>
<td>Root</td>
<td>Ginger</td>
<td>Yellow</td>
</tr>
<tr>
<td>63. Andropogon crameanum</td>
<td>Root</td>
<td>Green</td>
<td>Brown</td>
</tr>
</tbody>
</table>

Several of the gum-resins, as myrrh and galbanum, yield an essential oil; and likewise the bakahuhs, as benzoin, &c.

OIL-MILL. See OLEA.

OLAX, a genus of the triandria monogy- minus class and order. The calyx is entire, trilob; corolla funnel-form, trilob, next four; berry three-celled, many-seeded. There is one species, a tree of Ceylon.

OLDENLANDIA, a genus of the tetran- dria monogy-nous class and order. Its characters are these: the emplacement of the flower is permanent, sitting upon the gynoecium. The flower has four oval petals, which spread open, and four stamens, terminated by small

summits; it has a roundish germen, situated under the flower, crowned by an indented stigma; the germen afterwards turns to a globular capsule, with two cells filled with small seeds. There are sixteen species, herbs of the Cape, &c.

OLD-WIFE, OR WRAASE. See LABRUS.

OLEA, the olive-tree, a genus of the mo- nogy-nous order, in the diandria class of plants; and in the natural mono-class, ranking under the 44th order, saperda. The corolla is ova- drid, with the segments nearly ovate. The
fruit is a monomerosous plum. There are
seven species; the most remarkable are:
1. The European, or common olive-tree,

2. The capensis, or Cape box-leaved olive.

3. Olea adstringens, the flower of which is

4. Olea edulis, the fruit of which is

5. Olea ilicifolia, the fruit of which is

6. Olea leucophylla, the fruit of which is

7. Olea nereifolia, the fruit of which is

OLE
good; in fact, it is the home of the best

OLIBRANUM, a dry resinous substance

OLYMPIC GAMES, were solemn games,

OLYRA, a genus of the tribe olive order,

OMBRE, a game at cards, played by 2, 3,
or 5 persons; in all other respects resembling

OMENTUM, See Anatomy.

OMINUM, a term in use among stock-

OMBREllas, a genus of the tribe olive order,

ONCHICHILOID, a genus of insects of the

ONCHERON, sea laws of, certain laws rela-
ting to maritime affairs, made in the time of
Richard I. when he was at the island of
Oloner.

These laws, being accounted the most

excellent sea-laws in the world, are recorded
in the black book of the admiralty.

OLIBRANUM, a dry resinous substance

obtained from the juniperus lydec, and

elitely collected in Arabia. It is the frank-

incense of the ancients. It is in transparent

baskets about the size of a saltshaker, and

its colour is yellow. It has little taste, and

when burnt diffuses an agreeable odour. Al-

cohol dissolves it; and with water it forms a

milky liquid. When distilled, it yields a

small quantity of volatile oil. Specific grav-

ity, 1.73.

OLIVE. See Olea.

OLYMPIC GAMES, were solemn games,
famous among the ancient Greeks, so called
from Olympian Jupiter, to whom they were

dedicated.

OLYRA, a genus of the tribe olive order,
in the monocera class of plants, and in the

natural method ranking under the 2nd order,
and the 4th family. The male caroll; the

female caroll; the corolla a bearded

gluce; the female calyx an unilitorous,

patulous, and ovate glume; the style is

bifid, and the seed caralligialis. There are

two sorts, or species of the plant, which

were the true olive, and the bastard olive.

OLYRA, a genus of the tribe olive order,
in the monocera class of plants, and in the

natural method ranking under the 4th order,
and the 4th family. The male caroll; the

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two sorts, or species of the plant, which

were the true olive, and the bastard olive.

OLYRA, a genus of the tribe olive order,
Body above convex, beneath flat and smooth; head small, and placed beneath, which, when the animal is in motion, is perpetually changing its form and size, and drawn in when at rest; mouth placed lengthways, and continually varying its shape from circular to oblong; feelers retracible, resembling those of a slug, and apparently tipped with eyes; arms dilutable, solid, compressed, and somewhat palatable when fully expanded.

**ONION.** See **Allium.**

**ONISCUS,** a genus of insects of the order Aptera: the generic character is; legs fourteen; antennæ setaceous; body oval. Of this genus, which consists of more than 40 species, the best known is the **Oniscus asellus,** popularly known by the name of Wood-louse. It is a very common insect in gardens, fields, &c. and is observed in great quantities under the banks of decayed trees, beneath stones in ditches, &c. Its general length is about half an inch, or rather more, and its colour livid brown; the larger specimens often exhibiting a double series of pale spots down the back: like the rest of the genus, it feeds on the exuviae of the smaller insects.

2. **Oniscus armadillo,** or the medical woodlouse, is of somewhat larger size than the preceding, much darker colour, and of a polished surface: it is equally common with the preceding species, and is found in similar situations; when suddenly disturbed or handled, it rolls itself up into a completely globular form, in the manner of the curious quadrupeds called armadillos, frequently remarked in this state for a very considerable length of time, or so long as it is anyways disturbed. Swammerdamer relates a ludicrous mistake of a servant-maid, who, finding in the garden a great many in this globular state, imagined the said discoverer of the handsome materials for a necklace, and betook herself to stringing them with great care; but on suddenly perceiving them unfold, was seized with a panic, and ran shrieking into the house.

Though considered as of but slight importance in the present practice of physic, these animals once maintained a very respectable station in the materia medica, under the title of millepedes.

3. **Oniscus aquaticus** is a native of the clearer kind of stagnant waters, and is of the general size and colour of the **Oniscus asellus,** but has a more lengthened form, and with longer limbs in proportion; the two last legs being bident. This species is viviparous, and of a considerably prolific nature.

Among the marine insects of this genus the largest is the **Oniscus etheraon,** measuring two inches in length: its general form and colour resemble that of the **Oniscus asellus,** but the four lower pair of legs are longer in proportion, the three first pair being very small and short; the tail is long and pointed. It is a native of the European seas, and is found about rocks, &c. It is of a strong fabric, the divisions of the upper part being of an almost calcareous nature. This animal is capable of living several days in fresh water.

**ONOCLEA,** a genus of the class and order Cryptogamia filices. The capsules are under the recurved and contracted pinnales of the frond, resembling pericarps. There are two species.

**ONONIS,** or **Anonis, rest-harrows,** in botany. See **Anonias.**

**ONOPORDUM,** a genus of the class and order Syngenesia; polygama equilatera. The essential character of this genus is its scariosa coronata recept. honey-combed. There are seven species, one of them well-known under the name of **Ononis holanthus** or pig-leaves.

**ONOSMA,** a genus of the monogynia order, in the superorder thalictriflorae, and the natural method ranking under the 41st order, asperifolia. The corolla is campanulated, with the throat present; there are four stamens. There are three species, rock plants of the South of Europe.

**ONYX,** in natural history, one of the semi-pelucid gems, with variously-coloured zones, but none red; being composed of crystal, being formed from a very small admixture of earth, and made up either of a number of flat plates, or of a series of coats surrounding a central nucleus, and separated from each other by veins of a different colour, resembling zones or belts. We have four species of this genus: 1. A bluesh-white one, with brown spots. 2. A very pure onyx, with snow-white veins. 3. The jasp-onyx, or honey onyx, with green zones. 4. The brown onyx, with bluish-white zones. The antient attributed wonderful properties to this onyx, and imagined that when worn on the finger it acted as a cardiac; they have also recommended it as an astringent, but at present no regard is paid to it. The word in the Greek language signifies nail; the poets feigning this stone to have been formed by the Parce from a piece of Venus's nails, cut off by Cupid with one of his arrows. See **Chalcedony.**

**OLILET.** See **Pisolith.**

**OPACITY,** in philosophy, a quality of bodies which renders them impervious to the rays of light.

The cause of opacity in bodies does not consist, as was formerly supposed, in the want of rectilinear pores, pervious every way; but either in the unequal density of the parts, in the magnitude of the pores, or in their being filled with a matter, by means of which the rays of light in their passage are arrested by innumerable refractions and reflections, become extinct, or are absorbed.

**OPAL,** in mineralogy: this stone is found in many parts of Europe, especially in Hungary, in the Carpathians near the village of Czerminka. When first dug out of the earth it is soft, but it hardens and diminishes in bulk by exposure to the air. The substance in which it is found is a ferruginous sand-stone. The opal is always amorphous. Its fracture is conchoidal. Commonly somewhat transparent. Specific gravity from 1.958 to 2.549. The lowness of its specific gravity, in some cases, is to be ascribed to accidental cavities which the stone contains. These are sometimes filled with drops of water. Some specimens of opal have the property of emitting various-coloured rays, with a particular effusiveness, when placed between the eye and the light. The opals which possess this property are attributed by lapidaries to the epithet Oriental; and often by mineralogists by the epithet nobilis. This property rendered the stone much esteemed by the ancients. Opals acquire it by exposure to the sun. When thus divested this species is divided into five subspecies:

1. **Noble opal.** Lustre internal, glassy. Colour, usually light bluish-white. When its position is varied, it reflects the light of various bright colours. Specific gravity 2.114. Does not melt before the blow-pipe. When heated it becomes opaque, and sometimes is decomposed by the action of the atmosphere. Hence it seems to follow that water enters essentially into its composition. A specimen of this variety, analysed by Klaproth, contained

<table>
<thead>
<tr>
<th>90 silica</th>
<th>10 water</th>
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<tbody>
<tr>
<td>98.95</td>
<td>99.5</td>
</tr>
</tbody>
</table>

2. **Common opal.** Fracture imperfectly conchoidal. Lustre external and internal, grey or greyish. Its colours are very various: milk-white, yellows, reds, greens of different kinds. Influsible by the blow-pipe.

Specimens of this variety sometimes occur with ribs: these readily imbibe water, and therefore adhere to the tongue. Some opals gradually become opaque, but recover their transparency when soaked in water by imbuing that fluid. They are then called hydro-opals, or opals imbui. The constituents of the common opal, as ascertained by Klaproth, are

**Opal of Koseinutz.** Opal of Telkobanya

| 98.75 | 93.5 silica |
| 0.1   | 1.0 oxide of iron |
| 0.1   | 0.0 alumina |
| 0.0   | 5.0 water |

| 99.95 | 99.5 |

3. **Semi-opal.** Colours, various shades of white, grey, yellow, red, brown, often mixed together. Lustre glassy, sometimes greasy. Specific gravity 2.350. Influsible before the blow-pipe. Its constituents, as ascertained by Klaproth, are

**Semiopal of Telkobanya** Of Menal-montant

| 43.5 | 83.5 silica |
| 47.0 | 0.7 oxide of iron |
| 7.5  | 11.0 water |
| 1.0  | 1.0 alumina |
| 98.0 | 0.5 lime |

| 98.5 |

4. **Iridescent opal or wood-opal.** Colours, various shades of white, grey, brown, yellow, red. Found in large pieces, which have the form of wood. Lustre glassy, sometimes greasy. Fracture in one direction conchoidal, in another exhibiting the texture of wood. Usually opaque. Considered as fragments of wood impregnated with semi-opal.

5. Under the opal may be placed also the semi-opal, known by the name of cat's-eye. It comes from Ceylon, and is seldom seen by European mineralogists till it has been published by the lapidaries. Mr. Klaproth has described a specimen which he received in its natural state from Mr. Greville of London. Its figure was nearly square, with sharp edges, a rough surface, and a good deal of brilliancy. Its texture is imperfectly foliated. Lustre greasy. Specific gravity 2.629 to 2.66. Colour grey, with a tinge of green, yellow, or white, or brown, with a tinge of yellow or red. In certain positions it re-
OPH

seeks a splendid white, as does the eye of a cat: hence the name of this stone. Two specimens examined by Klaproth, the first from Ceylon, the other from Malabar, were comped of 93.50 93.60 silica 1.75 2.00 alumina 1.50 1.50 lime 0.25 0.25 oxide of iron, 98.50 98.25

OPATRUM, a genus of insects of the coleoptera order; the generic character is antennae unimorphic, thicker towards the top; head projecting from a cavity in the thorax; thorax a little flattened, margined; shells immarginate, longer than the abdomen. There are about 25 species of this genus. OPERATION. See Surgery.

OPERATIONS in chemistry. See Chemistry.

OPECULARIA, a genus of the class and order tetrandria monocotyledon: the flower is compound, stamens, with the exception of one, one-leaved. There are three species, insignificant herbae of New Holland, &c.

OPICHYPHALUS, a genus of fishes of the order thoracii; the generic character is head coated with dissimilar scales; body elongated.

1. Ophichthus punctatus: length about ten inches; dorsal fin commencing at no great distance from the head, and continued nearly to the tail; fins of moderate breadth, and of a dusky colour spotted with black; anal-fin of similar shape and colour. Native of India, inhabiting rivers and lakes, and considered as a desirable and wholesome food.

2. Ophichthus striatus: length about twelve inches; shape rather longer than that of the preceding species. Native of India, inhabiting lakes, where it often grows to a much larger size than first mentioned. It is in equal esteem as a food with the former species, and even recommended as a proper diet for convalescents. Native name warli. There is one other species.

OPHIDUM, a genus of fishes of the order spadoni; the generic character is: head somewhat naked; teeth in the jaws, palate, and throat; branchiostegal membrane seven-rayed, pinnate; body ensiform.

1. Ophidium microcephalum: the head of this fish is small; the upper jaw rather longer than the lower, and both beset with a great many small teeth; the lips are strong and fleshy; in the throat are several small teeth; between the eyes and mouth are four small pores. It is commonly found of the length of eight or nine inches, and sometimes twelve or fourteen; and is met with in all parts of the Mediterranean sea, and in great plenty in the Adriatic. It is often taken by nets in Provence and Languedoc with other kinds of fish, and is most common during the summer season. It is not considered as an elegant fish for the table, the flesh being rather coarse. It feeds on small fishes, crabs, &c. &c.

The ophidium aculeatum, or prickly ophidium, inhabits the freer rivers in India, feeds on worms and a fat kind of earth, is esculent and long. See Plate Nat. Hist. fig. 300. There are four species.

OPHIOGLOSSUM, adder's tongue, a genus of the natural order of lilies, in the cryptogamia class of plants. The spike is articulated, flat, and turned to the two sides, with the articular or joints opening across. There are nine species, of which the only remarkable one is the vulgatum, or common adder's-tongue, a plant of a native of several places of Britain, growing in meadows and moist pastures. The country-people make an ointment of the fresh leaves, and use it as a culinary condiment with which to dress fish.

OPHORIHIZA, a genus of the monocotyledon order, in the pantophylla class of plants, and in the natural method ranking under the 47th order, stellatae. The corolla is funnel-shaped; the capsule, twin, bicolor, and sparsely hairy. There are three species, most remarkable of which is the Asiaticum, or true lignum colubrum. The root of this is known in the East Indies to be a specific against the poison of that most dreadful animal called the hooded serpent.

The true root is called munus, for the following reason: There is a kind of wasel in the East Indies, called munguta by the natives, mungo by the Portuguese, and munkas by the Dutch. This bites the hooded serpent, as the cat does the mouse with us. As soon as the serpent appears, the wasel attacks him; and if she chances to be bitten by him, she immediately runs to find a certain vegetable, called in her tongue, which she returns, and renews the fight. That celebrated traveller Kempter, who kept one of these wasels tame, that ate him, lived with him, and was his companion wherever he went, says he saw one of these battles between her and the serpent, but could not certainly find out what root the wasel looked for. But whether the wasel first discovered this anti-dote or not, it is an infallible remedy against the bite of the hooded serpent. And he undertakes to ascertain.

OPHYLLOXYN, a genus of the monacorum order, in the polygama class of plants, and in the natural method ranking with those of the former order. The herman phoridactylus calyx is quinquefoliatus; the corolla quinquefida and funnel-shaped, with a cylindrical nectarium within its mouth. There are two species, shrubs of the East Indies.

OPHRA, a genus of the monogyna order, in the order of the spadoni class. The involucrum is bivalvular and trilobate; the corolla is tetrapteral above; the berry unicellular. There is one species, a shrub of Africa.

OPHITES, in church history, christian heretics, so called both from the veneration they had for the serpent that tempted Eve, and the worship they paid to a real serpent. They pretended that the serpent was Jesus Christ, and that he taught men the knowledge of good and evil. They distinguished between Jesus and Christ: Jesus they said was born of the Virgin, but Christ came down from heaven to be united with him; Jesus was crucified, but Christ had left him to return to heaven.

OPHRYS, thyrsibe, a genus of the dianthus order, in the gynandra class of plants, and in the natural method ranking under the 7th order, orchideae. The nectarium is a little carinated below. There are 34 species; but the most remarkable are the following: 1. The ovata, oval-leaved ophrys, or common thyrsibe, has a bulbous fleshy root, crowned by two oval, broad, obtuse, veined, opposite leaves; an erect, succulent, green stalk, six or eight inches high, naked above, and terminated by a loose spike of greenish flowers, having the lip of the nectarium entire, and crested. The flowers of this species resemble the figure of gnats. 2. The spiralis, spiral orchis, or triple ladies'-tresses, with a cluster of oval, pointed, ribbed leaves; erect simple stalks, 1½ feet high, terminated by long spikes of white odoriferous flowers, hanging to one side, having the lip of the nectarium entire, and crested. 3. The nitis-avis, or bird's-nest; with loose spikes of pale-brown flowers, having the lip of the nectarium bifid. 4. The anthropophora, man-shaped ophrys, or man-orchis; with spikes of greenish flowers, representing the figure of a naked man: the lip of the nectarium linear, tripartite, with the middle segment longest and bent. There is a variety with brownish flowers tinged with green. 5. The insectifera, or insect-orchis, has spikes of insect-shaped greenish flowers, having the lip of the nectarium cleft. This wonderful species exhibits flowers in different varieties, that represent singular figures of flies, bees, and other insects, and are of different colours in the varieties. 6. The monogyne, or musky ophrys, with a loose spire of yellowish musky-scented flowers.

OPHTHALMIA. See Medicine.

OPH. See NARCOTIC PRINCIPLE, Papaver, and Materia Medica.

OPOBALSAMUM, or halm of Gilead, a resin obtained from the amyris olfactorius, a tree which grows in Arabia, especially in the mountains of Mecca. It is so much valued by the Turks, that it is rarely imported into Europe. Little is therefore known of its composition. It is said to be at first turbid and white, and of a strong aromatic smell, and of a bitter, acid, astrangent taste; but by keeping, it becomes limpid and thin, and its colours change first to green, then to yellow, and at length it assumes the colour of gum, and is used in pastes. Opopanax, a resin obtained from the pasinaca oponax, a plant which is native of the countries round the Levant. The gum-resin is obtained by wounding the roots of the plant. The milky juice, when dried in the sun, constitutes the opopanax gum, of a redish-yellow colour, and white within: taste bitter and acid. With water it forms a milky solution. Its specific gravity is 1.62.

OPUSC. See Diodo Phys.

OPPOSITE SECTIONS, are two hyperbolas made by cutting two opposite cones by the same plane. See CONIC SECTIONS.

OPPOSITION, in astronomy, is that aspect or situation of two stars or planets, wherein they are diametrically opposite to each other, or 180° asunder.

OPPOSITION in geometry, the relation of two things, between which a line may be drawn perpendicular to both.

OPTATIVE MOOD, in grammar, that which serves to express an ardent desire or wish for something. In the English language we have neither optative nor subjunctive mood.

OPTICS, the science which explains the properties of light.

Optical definitions and principles.

1. Light is a matter, the particles of which...
are extremely small, and by striking on our visual organs, give us the sensation of seeing.

2. The particles of light are emitted from various luminous bodies, such as the sun, a fire, a torch, or candle, &c. &c. It is reflected or sent back by what are termed opaque bodies, or those which have no power of affording light in themselves.

3. Whether collected or reflected, always moves in straight or direct lines, as may easily be proved by looking into a bent tube, which evidently obstructs the progress of the light in direct lines.

4. Parallel rays, or rays of light, is usually meant the least particle of light that can be either intercepted or separated from the rest. A beam of light is generally used to express something of an aggregate or mass of light greater than a single ray.

5. Parallel rays are such as proceed equally distant from each other through their whole course. The distance of the sun from the earth is so immense, that rays proceeding from the body of the sun are generally regarded as parallel.

6. Converging rays are such as, proceeding from any body, approach nearer and nearer, and tend to unite in a point. The form of rays this tendency to unison in a single point has been compared to that of a candle-extinguisher; it is in fact a perfect cone.

7. Diverging rays are those which, proceeding from a point, continue to recede from each other, and exhibit the form of an inverted cone.

8. A small object, or a small single point of it, by a ray of light diverging, or indeed proceed in any direction, is sometimes called the radiant, or radiant point.

9. Any parcel of rays, diverging from a point, considered as separate from the rest, is called a pencil of rays.

10. The focus of rays is that point to which converging rays tend, and in which they unite and intersect, or cross each other. It may be considered as the apex or point of the cone; the focus of a plane mirror, because it is the point at which burning-glasses burn most intensely.

11. The virtual or imaginary focus is that supposed point behind a mirror or looking-glass, from which the rays would have naturally united, had they not been intercepted by the mirror.

12. Plane mirrors or speculums are those reflecting bodies, the surfaces of which are perfectly plain or even, such as our common looking-glasses. Convex and concave mirrors are those the surfaces of which are curved.

13. An incident ray is that which comes from any body to the reflecting surface; the reflecting ray is that which is sent back or reflected.

14. The angle of incidence is the angle which is formed by the line which the incident ray describes in its progress, and a line drawn perpendicularly to the reflecting surface: and the angle of reflection is the angle formed by the same perpendicular and the reflected ray; thus, (Plate I. Optics, fig. 1) \[ \angle i \] is the angle of incidence, and \[ \angle r \] the angle of reflection.

15. By a medium optician means any thing which is transparent, such as void space, air, water, or glass, through which consequently the rays of light can pass in straight lines.

16. The rejection of the rays of light is their being bent, or deviated out of their course, in passing obliquely from one medium to another of a different density, and which causes objects to appear broken or distorted when they are placed at different distances.

17. It is from this property of light that a stick or an oar which is partly immersed in water appears broken.

18. A lens is a transparent body of a different density from the surrounding medium, commonly glass, and used by opticians to collect or disperse the rays of light. They are in general either convex, that is, thicker in the middle than at the edges, which collect, and by the force of refraction converge the rays, and consequently magnify; or concave, that is, thinner in the middle than at the edges, which by the refraction disperse the rays of light, and diminish the objects that are seen through them.

19. Vision is performed by a continuance of this kind. The crystalline humour, which is seated in the fore-part of the human eye, immediately behind the pupil, is a perfect convex lens. At every therefore object is rendered visible by beams or pencils of light, which proceed or diverge from every point of the object, the crystalline lens collects all these divergent rays, and causes them to converge on the back part of the eye, where the optic nerve is spread out; and the points where each pencil of rays is made to converge on the retina, are exactly correspondent to the points of the object from which they proceed. As, however, from the great degree of convergence which this continuance will produce, the pencils of light proceeding from the extreme points of the object will be made to cross each other before they reach the retina, the image on the retina is always inverted. (See Plate II. fig. 23.)

20. The magnitude of the image painted on the retina will also, it is evident, depend on the greatness or obscurity of the angle under which the pencil of rays proceeding from the extremity of the object enters the eye. For it is plain, that the more open or obscure the angle, is the greater the tendency of these rays to meet in a point and cross each other; and the sooner they cross each other after passing the crystalline lens, the larger will be the inverted image painted on the retina. (See Plate II. fig. 24.)

21. The visual angle, therefore, is that which is made by two rays proceeding from the extreme points of any object to the eye; and on the measure of that angle, the apparent magnitude of every visible object will depend.

22. The prism used by opticians is a triangular piece of glass, which has the power of separating the rays of light.

History of discoveries. The most ancient hypothesis which leads to the true theory of light and colours, is that of the Platonics, viz. that light, from whatever it proceeds, is propagated in a straight line; that when it is reflected from the surfaces of polished bodies, the angle of reflection is equal to the angle of incidence. To this may be added the opinion of Aristotle, who supposed that rainbows, halos, and moor mists, were occasioned by the reflection of the sun's beams in different circumstances. We have reason to believe, that the use of convex glasses, both as magnifiers and as burning-glasses, was not unknown to the ancients, though the theory was not understood. The magnifying power of glasses, and some other optical phenomena, were also largely treated of by Alhazen, an Arab philosopher of the twelfth century. These observations were followed by those of Roger Bacon, who demonstrated by actual experiment, that a small segment of a glass globe would greatly assist the sight of old persons; and from this the idea of the air was suggested by these two philosophers, it is not unreasonable to conclude, that the invention of spectacles proceeded. Concerning the actual author of this useful invention, we have no certain information; but it was generally known about the beginning of the fourteenth century.

In the year 1573, Maurolycus, a teacher of mathematics at Messina, published a treatise on vision, in which he declared, that the crystalline humour of the eye is a lens, which collects the rays of light proceeding from external objects, and throws them on the retina, or optic nerve. From this principle, he was led to discover the reason of what are called short and imperfect sights. In the one case, the rays converge too soon; in the other, they do not converge soon enough. Hence short-sighted persons are relieved by a concave glass, which causes the rays to diverge in some degree before they enter the eye, and renders it more difficult for them to converge so fast as they would otherwise; and from this is understood the crystalline humour. Hence too he proves that a convex lens is of use to persons who have weak but long sight, by causing the rays to converge sooner, and in a greater quantity, than would otherwise happen. He was the first also that solved a problem which had caused much perplexity in the ancient schools, respecting the sun's image appearing round, though the rays that form it are straight and parallel. He considered, as the rays of light are constantly proceeding, in every direction, from every part of the sun's disk, that they must be crossing each other from the extremes of the aperture of the eye; so that every such point will be the apex of two cones of which the base of the one is the sun's disk, and that of the other his image on the opposite wall. The whole image, therefore, consists of a number of images, all of which are circular; the image of the sun formed in such images must be circular also; and it will approach the nearer a perfect circle, the smaller the aperture, and the more distant the image.

Nearby the same time Johannes Baptista Porta, of Naples, invented the camera obscura; and his experiments upon it induced him to invent the instrument, by the introduction of which into the eye, vision is performed; for it is proper to mention, that before his time the opinion was almost general, that vision depended upon what was termed visual rays, proceeding from the eye. In this the system of Porta corresponds nearly with that of Maurolycus; but it ought to be remarked, that the discoveries of each of these two philosophers were
unknown to the other. He shews, moreover, that a detect of light is remedied by the dilatation of the pupil, which contracts involuntarily when a drop of tr. The refractive index is as follows: when the light is faint and languid.

One Fletcher, of Breslaw, in 1571, endeavoured to account for the phenomena of the rainbow, by a double reflection and one refection; but Antonio de Dominus, whose treatise was published in 1611, was the first who came near to the true theory. He describes the process of the ray of light through each drop of the falling rain; he shews that it enters the upper part of the drop, where it suffers one refection; that it is reflected once, and then refracted again, so as to come directly to the eye of the spectator: why this refraction should produce the different colours, he reserved for Sir Isaac Newton to explain.

The latter part of the sixteenth century was illustrious for the invention of telescopes. It is generally allowed to have been causal. That effect of refraction, which causes the rays of a point to converge into a point, a medium thicker in the middle, to converge to a point, and also that which takes place when they pass through one thicker at the extremities, had been long observed; and the assistance was to convev from convexity into concavity, had brought them into common use. The inventor of the telescope is not certainly known. The most probable account is, that the Zacharius Jansen, a spectaclemaker of Middelburgh, trying the effect of a convex and concave glass united, found that, placed at a certain distance from each other, they had the property of bringing distant objects apparently nearer to the eye. An account which is very commonly received, is, that some of his children playing in his shop with spectacle-glasses, perceived that when they held two of these glasses between their fingers, at a certain distance from each other, the dial of the clock appeared greatly magnified, but in an inverted position. From this their father adopted the idea of adjusting two of these glasses on a board, so as to converge to a point. They were greatly improved by Galileo, who constructed one which magnified 33 times, and with this he made all his wonderful astronomical discoveries.

The rationale of telescopes was, however, not explained till Kepler, who described the nature and the degree of refraction, when light passed through denser or rarer mediums, the surfaces of which are convex or concave; namely, that it corresponds to the diameter of the circle of which the convexity or concavity are portions of arcs. He suggested some improvements in the construction of telescopes, which, however, were left to others to put in practice.

To the Jansens we are also indebted for the discovery of the microscope; an instrument depending upon exactly the same principles as the former. In fact, it is not improbable, that the double lens was first applied to the observation of near but minute objects, and afterwards to the same principles, to objects which appeared minute on account of their distance.

Much attention was given by Kepler to the investigation of the law of refraction; but he was able to advance no nearer the truth than the observation, that when the incident ray does not make an angle of more than 30 degrees with the perpendicular, the refracted ray proceeds in an angle which is about two thirds of it. Many disputes arose about the time of Kepler (1600) upon this subject, but it appears that little was effected by them in the cause of truth.

Kepler was more successful in pursuing the discoveries of Maurolycus and B. Porta. He demonstrated that images of external objects were formed upon the optic nerve by the feet of rays coming from every part of the object; he also observed, that these images are inverted; but this circumstance, he says, is rectified by the mind, which, when an impression is made on the lower part of the retina, considers it as made by rays proceeding from the higher parts of the object. Habits is supposed to reconcile us to this deception, and to teach us to direct our hands to those parts of objects from which the rays proceed. Tycho Brahe, observing the appearance and dissipation of the sun in solar eclipes, imagined that there was a real diminution of the disk; by the force of the sun's rays; but Kepler said, that the disk of the moon does not appear less in consequence of being unlighted. The moon does not appear as at other times, but is really, in consequence of its being enlightened. For pincers of rays from such distant objects generally come to their faci before they reach the retina, and consequently diverge and spread when they reach it. For this reason, he adds, different persons may imagine the disc to be of different magnitudes, according to the relative eye of sight.

The sixteenth century also many improvements were made in perspective; the ingenious device, in particular, of the reformation of distorted images by concave or convex spectacles, was invented, but it is uncertain by whom.

The true law of refraction was discovered by Snellius, the mathematician professor at Leyden; but not living to complete it, the discovery was not published till 1621. The theory was explained by professor Huygens. Some discoveries of lesser importance were made at this time, among others by Descartes, who truly explained the nature and cause of the figures of rainbows; though he did not give any account of the colours; he however considered the small portion of water, at which the ray issues, as having the effect of a prism, which was known to have the property of exhibiting the light, transmitted through it, coloured.

In 1635, the curious discovery of Scherler was published at Rome, which ascertains the fact, that vision depends upon the images of external objects upon the retina. For taking the eye of an animal, and cutting away the coats of the back part, and presenting different objects before it, he displayed their images distinctly placed on the retina or optic nerve. The same philosopher demonstrated by experiment, that the pupil of the eye is enlarged in order to view remote objects, and continued when we view those which are near. He showed, that the rays proceeding from any object, and passing through a small hole in a pasteboard, cross one another before they enter the eye; for if the edge of a knife is held on the side next the eye, and is moved along till it is in part covers the hole, it will first conceal from the eye that part of the object which is situated on the opposite side of the hole.

Towards the middle of the seventeenth century, the velocity of sound was observed by some members of the Royal Academy of Sciences at Paris, particularly Cassini and Roemer, by observing the eclipses of Jupiters satellites. About the same time Mr. Boyle made his experiments on colours. He proved that sound did not affect the eye by a native, but reflected light, a circumstance which, however, at this day, we should scarcely believe was ever necessary to be proved by experiment. By admitting also a ray of light into a dark room, and letting it fall on a sheet of paper, he demonstrated, that white reflected much more light than any other colour; and to prove that white bodies reflect the rays outwards, he adds, that common burning-glasses will not, for a long white, burn or discolor white paper; on the contrary, a concave mirror of black marble did not reflect the rays of the sun with near so much power, nor did a parallelogram. A similar effect was verified by a tile, one half of the surface of which was white, and the other black.

Some experiments were made about this time on the difference of the refractive powers of bodies; and the first attempts to the great discoveries by means of the prism was made by Grimaldi, who observed, that a beam of the sun's light, transmitted through a prism, disperses it into a spectrum, and a concave mirror of black marble did not reflect the rays of the sun with near so much power, nor did a parallelogram. A similar effect was verified by a tile, one half of the surface of which was white, and the other black.

The reader will soon perceive how very imperfect all the preceding discoveries were in comparison with those of Sir Isaac Newton. Before this time, little or nothing was known concerning colours; even the remark of Grimaldi respecting the oblong figure of the sun, made by transmitting the rays through a prism, was unknown to our most philosophic, having been published only the year before. This fact, however, which he had observed himself, was, it appears, the first circumstance which directed the attention of Newton to the investigation of the theory of colours. Upon measuring the coloured image, which was made by the light admitted into a dark chamber through a prism, he found that its length was five times greater than its breadth. Such an account was by no means what was expected. The most observable circumstance induced him to try the effect of two prisms, and he found that the light, which by the first prism was diffused into an oblong, was by the second reduced to a circular form, as regular as it had passed through neither of them. After many conjectures and experiments relative to the cause of these phenomena, he at length applied to them what he calls the experimentum crucis. He took two boards, and opening the one close to the window, so that the light might be admitted through a small hole made in it, and after passing through a prism might fall on the other board, which was placed at about twelve feet distance, and in which there was also a small aperture, in order that some
of the incident light might pass through it. Behind this hole, in the second board, he also placed a prism, so that the light, after passing both the boards, might suffer a second refraction before it reached the wall. He then moved the first prism in such a manner as to make the several parts of the image cast upon the wall pass successively through the hole in it, that he might observe to what places on the wall the second prism would refract them. The consequence was, that the coloured light, which formed one end of the rainbow in its refraction, was now seen greater than that at the other end; in other words, rays or particles of light of one colour were found to be more refrangible than those of another. The true cause, therefore, of the parts of the image being everywhere different, was proved by the experiment, that light was not homogeneous, but consisted of different particles or rays, which were capable of different degrees of refrangibility, according to which they were transmitted through the prism to the opposite wall. It was further evident from these experiments, that as the rays of light differ in refrangibility, so they are also different in exhibiting particular colours, some parts of the colour of the rainbow, that is, of yellow, blue, &c. and of these different-coloured rays, separated by means of the prism according to their different degrees of refrangibility, the reflecting figure on the wall was composed. But to try the experiment, the great variety of experiments, by which he demonstrated these principles, or the extensive application of them, would lead us too much from our design. It is sufficient to say, that he applied his principles to the satisfactory explanation of the colours of natural bodies, of the rainbow, and of most of the phenomena of nature where light and colour are concerned; and the almost everything since it was proved by the experiment, that light was not homogeneous, but consisted of different particles or rays, which were capable of different degrees of refrangibility, according to which they were transmitted through the prism to the opposite wall.

The discovery of the different refrangibility of the component rays of light suggested designations for the construction of telescopes, which were before unthought of, and in the creative hand of Newton led to some no less extraordinary improvements in them. It is evident, that since the rays of light are of different refrangibilities, the more refrangible will converge to a focus much sooner than the less refrangible, consequently that the whole beam cannot be brought to a focus in any one place, and that the focus of every single glass will be a circular space of considerable diameter, namely, about one fifty-fifth of the aperture of the telescope. To remedy this, he adopted Gregory's idea of a reflector, with such improvements as have been the basis of all present instruments of this kind.

When a science has been carried to a certain degree of perfection, subsequent discoveries are too apt to be considered as of little importance. The real philosopher will not, however, regard the discoveries on light and colours, since the time of Newton, as unworthy his attention. By a mere accident, a very extraordinary property in some bodies of infusing light and afterwards emitting it in the dark, was observed. A showemaker of Bologna, being in quest of some chemical secret, calcined, among other things, some stones of a particular kind, which he found at the bottom of Monticelli quarries; and casually observed, that when these stones were carried into a dark place, after having been exposed to the light, they possessed a self-illuminating property. These stones dis- covered the same property in other substances.

Baldwin, of Misnia, dissolving chalk in aqua-fortis, found that the residuum, after distillation, exactly resembled the Bolognian stone; and it now has the name of Baldwin's phosphorus; and M. Du Fay observed the same property in all substances that could be reduced to a salt by burning only, or after solution in nitric acid. These facts seem to establish the materiality of light.

Some very accurate calculations were made about the year 1729 by Dr. Bradley, which afforded a more convincing proof of the velocity of light than the ordinary experiment of the earth in its orbit. Nor must we forget M. Bouguer's very curious and accurate experiments for ascertaining the quantity of light which was lost by reflection, the most decisive of which was made upon a chamber divided in two rays, of which he contrived should be reflected, and the other fall direct on the opposite wall; then by comparing the illuminations of the apertures by which the light was admitted (that through which the direct ray proceeded being much smaller than that through which the reflected ray was suffered to pass, and the illumination on the wall being equal in both), when enabled to form an exact estimate of the quantity of light which was lost. To prove the same effect with candles, he placed himself in a room perfectly dark, with a book in his hand, and having a white candle in the next room, which he had brought nearer to him till he could just see the letters, which were then 24 feet from the candle. He then received the light of the candle reflected by a looking glass, and upon the book, and compared the illuminations of the book from the source of the light (including the distance from the book to the looking-glass) to be only 13 feet; whence he concluded, that the quantity of direct light is to that of reflected as 376 to 253; and similar methods were pursued by him for measuring the proportions of light in general.

The speculations of Mr. Melville concerning the blue shadows which appear from opaque bodies in the morning and evening, when the atmosphere is clear, are far from uninteresting. These phenomena he attributes to the power which the atmosphere possesses of separating and dividing the rays of light. The refraction of rays, the blue, violet, &c. and upon this principle he also explained the blue colour of the sky, and some other phenomena.

The same period produced Mr. Dollond's great improvement in the construction of telescopes. It consists in using three glasses of different refractive powers, crown and flint glass, which correct each other. The great dispersion of the rays which the flint-glass produces, is the effect of the lead, and is in proportion to the quantity of that metal which is used in its composition. Mr. Mariette noted the refractive powers of different classes to be in proportion to their specific gravity.

Several discoveries and improvements have been made since the time of Newton that exhibiting optics which relate more immediately to vision. One of these is not only curious in itself, but led to the explanation of several circumstances relating to vision.

M. De la Motte, a physician of Dantzic, has endeavoured to verify an experiment of Scheiner, in which a distant object appeared multiplied when viewed through several holes made with the point of a pin in a card, not far distant from one another. He prepared five concave glasses, each but not withstand all his labour, he was unable to succeed, till a friend happening to call upon him, he desired him to make the trial, and it answered perfectly. This friend was short-sighted; and when he applied a concave glass close to the object, which seemed multiplied before, now appeared but one.

The last, though not least, successful advances in the business of optics were made by Mr. Delaval, who, in a paper read before the Philosophical Society of Manchester, in 1784, has endeavoured, with great ingenuity, to explain the permanent colours of opaque bodies. The majority of philosophers, who have treated of light and colours, have, he observes, supposed that certain bodies or surfaces reflected only one kind of rays, and therefore exhibited only one permanent colour; on the contrary, Mr. Delaval, by a variety of well-conducted experiments, evinced, that colours are exhibited, not by reflection, but by transmitted light. This he proved by covering one-pronged glass, and other transparent coloured media, on the further surface, with some substance perfectly opaque, when he found they reflected no colour, but appeared perfectly black. He also observed that the various colours of all vegetable, mineral, and animal substances, are found, when cleared of heterogeneous matters, to be perfectly white; that the rays of light are in fact reflected from these white substances, but not being covered, of which they are covered; that these media serve to intercept and impede certain rays in their passage through them, while, a free passage being left to others, they exhibit, according to these circumstances, different colours. This he illustrates by the fact remarked by Dr. Halley, who, in diving deep into the sea, found that the upper part of his hand, when extended into the water from the diving-bell, reflected a variety of colour, while the under part appeared perfectly green. The conclusion is, that the more refrangible rays were intercepted and reflected by particles contained in the sea-water, and were consequently reflected back by the under part of the hand; while the red rays, which were permitted to pass through the water, were in the same manner reflected by the upper part of the hand, which therefore appeared of a red rose-colour. The following passage, our author thinks, transmit coloured light with the greatest strength, which have the strongest refractive power.
OPTICS.

It has been sometimes considered as a distinct substance, sometimes as light, but it is still more a mixture of delicate colours, and is greatly affected by the action of light. Experiments have been made upon the same substances by exposing them to both heat and moisture in the dark, and also by exposing them to the light in the vacuum of an air-pump, and it was found by all these experiments, that the change of colour was to be ascribed to the action of light.

With respect to the emission of light, it is easily accounted for upon other principles; and the arguments founded upon the electric spark not being sensibly diminished, will meet with a satisfactory solution by considering the extreme rarity of light, and the minuteness of its particles.

It is, therefore, almost universally agreed by the moderns, that light consists of a number of extremely minute particles, which are actually projected from the luminous body, and convey their property upon the optic nerve. Concerning the nature of these particles, or rather of the matter of which they consist, there is less unanimity in the philosophical world.

The first remark about the property of light is its amazing velocity. In the short space of one second a particle of light traverses an extent of 170,000 miles, which is so much swifter than the progress of a cannon-ball, that the light is enabled to pass a space in about eight minutes which could not have passed with the ordinary velocity of a cannon-ball in less than 32 years. The velocity of light is also found to be uniform, whether it is original, as from the sun, or reflected only, as from the planets.

The mode of calculating the velocity of light is a branch of astronomy. It will suffice, therefore, in this place to remark, that by mathematical observations made upon the transit of Venus in 1761 and 1769, the diameter of the earth's orbit was found to be about 163,636,000 geographical miles. When, therefore, the earth happens to be on that side of her orbit which is opposite to Jupiter, an eclipse of his satellites, or any other appearance in that direction, will appear to take place 15 or 16 minutes later than it would have done if the earth had been on that side of her orbit which is nearest to Jupiter. From the very accurate observations of Dr. Bradley, it appears, that the light of the sun passes from that luminary to the earth in eight minutes and twelve seconds.

The next property of light to which it is proper to advert is, that it is detached from every luminous or visible body in all directions, and constantly moves with the velocity of a particle of light. It is evident that the particles of light move continually in right lines, since they will not pass through a bended tube; and since a beam of light is in part intercepted by any intervening body, the shadow of that body will be bounded by right lines passing from the luminous body, and meeting the lines which terminate the interceding body. This being granted, it is obvious, that the rays of light will be emitted from every luminous body in every direction; since, whatever may be the distance at which a spectator is placed from any visible object, every point of the surface which is turned towards him is visible to him, which could not be upon any other principle.

The rarity of light, and the minuteness of its particles, are not less remarkable than its velocity. If indeed the Creator had not formed its particles infinitely small, their excesive velocity would be the most sensible discomfort. It was demonstrated, that light moves about two millions of times as fast as a cannon-ball. The force with which moving bodies strike, is in proportion to their masses multiplied by their velocities; and consequently, if the particles of light were equal in bulk to the two-millionth part of a grain of sand, we should be no more able to endure their impulse than that of sand-shot point-blank from the mouth of a cannon. The rarity of light is also demonstrable from the facility with which they penetrate glass, crystal, and other solid bodies, which have their pores in a rectilinear direction, and that without the smallest diminution of their speed; as well as from the circumstance of their not being able to remove the smallest particle of microscopic dust or matter which they encounter in their progress. A further proof of this, is, if a candle is lighted, and there is no obstacle to obstruct its rays, it will fill the whole space within two miles around it almost instantaneously, and before it has lost the least sensible part of its intensity.

To the velocity with which the particles of light are known to move, may in a great measure be attributed the extreme rarity and tenuity of that fluid. It is a well-known fact, that the effect of light upon the senses is instantaneous, but continues for a considerable time. Now we can scarcely conceive a more minute division of time than the 150th part of a second. If, therefore, one inch point of the sun's surface emits 150 particles of light in one second, we may conclude that this will be sufficient to afford light to the eye without any seeming intermission; and yet, such is the velocity with which light proceeds, that still 1000 miles distant from each other.

If it was not indeed for this extreme tenuity of the fluid, it would be impossible that the particles should pass, as we know they do, in all directions and in every direction within the sphere of our observation. In all probability the splendour of all visible objects may be in proportion to the greater or less number of particles which are emitted or reflected from their surface in a given space of time; and if we even suppose 300 particles emitted successively from the sun's surface in a single second, still these particles will follow each other at the immense distance of above 500 miles.

Of the reflection of light, or catoptrics. It has been already intimated, that the rays of light which proceed from any luminous body move always in straight lines, unless this direction or motion is changed by certain circumstances; and these are reflection, refraction, and inflection.

The great law of reflection, and which serves to explain all its phenomena, is this, that the angle of reflection is always equal to the angle of incidence, or incident light. This being intimated, that by the angle of incidence is meant the angle made by a ray of light with a perpendicular to the reflecting surface at the point where the ray falls; and by the angle of reflection, the angle which the ray
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The reason of this double image is, that a part of the rays are immediately reflected from the anterior surface of the glass, and thus form a second, and the greatest part of the rays penetrating the glass is reflected by the amalgam, and form the vivid image.

From the principles laid down, most of the phenomena of reflection may be explained. In plane mirrors, the image appears of its natural size, and at the same distance behind the glass as the object is before it. To understand perfectly the reason of this, it will be necessary to advert to the subject of vision, as formerly explained. It will be remembered, that by the spherical surface of the eye, and particularly by means of the crystalline humour which is placed in the middle of it, the rays of light are converged; and those from the extreme points of the object cross each other, so as to form an inverted image on that part of the optic nerve which is called the retina. The apparent magnitude of objects will consequently depend upon the size of the inverted image, or, in other words, upon the angle which the images of light forms, by entering the eye from the extremities of any object.

As therefore the angle of reflection is always equal to the angle of incidence, it will be evident on the inspection of fig. 11, that when the converging rays $Km$, $Ln$, proceeding from the extremities of the object $KL$, and falling on the mirror $ab$, are reflected to the eye at the angle of incidence, and consequently will cause the image $kl$ to be seen under an angle equal to that under which the object itself would have been seen from the point $i$, without the interposition of the mirror. The image $kl$ appears also at a distance behind the mirror $ab$, equal to that at which the object stands before it. For it must be remembered, that objects are rendered visible to our eyes not by a single ray proceeding from every point of an object, but that in fact penicils or aggregates of divergent rays proceed from every point of all visible objects, which rays are again, by the mechanism of the eye, converged to as many points on all those parts of the retina where the image is depicted. The point from which the rays diverge is called the focus of divergent rays; and the point behind a reflecting surface from which they appear to diverge, is called the virtual focus. Therefore, the angle of reflection is exactly equal to the angle of incidence, it is evident that the virtual focus will be at the same distance behind the mirror as the real focus is at before it.

Thus, in fig. 12, the diverged rays $cm$ will after reflection appear to diverge from the point $g$ which is behind the mirror $ab$, and that point for the reasons assigned (viz. no alteration being made in the disposition of the rays but only in the direction) will be at an equal distance behind the mirror with the luminous point $c$ before it.

As every part of the image appears at a distance behind the mirror equal to that at which the object stands before it, and as the object $KL$ (fig. 11) is inclined or cut out of the vertical position, the image $kl$ appears also inclined. Hence it is evident, that to exhibit objects as they are without any degree of distortion, looking-glasses should be always hung in a vertical position, that is, at right angles with the wall of the apartment.

It is clear, however, that what has pre-
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ceded, that the case must be very different with those mirrors, the surfaces of which are spherical, whether convex or concave. Of the former it has been shown that their property is to scatter and disperse the rays of light, to render it visible, not to collect them in parallel, to diminish the convergence of converging rays, and to augment the divergence of those which diverged before. The first-obvious effect of these mirrors, therefore, must be to exhibit the image of the object which is opposed to them smaller than it is in reality. For the angle under which the rays strike the eye of the observer, must necessarily be smaller in proportion to the convexity of the mirror. Suppose, for instance, the object CD (fig. 13.) placed before the convex mirror ab; the two rays CE and DD, which proceed from the extremities of the object, and which, without the interposition of the mirror, would converge at f, are reflected less convergent, and unite at i, forming an angle much more acute than they would otherwise have done. The consequence, therefore, of the visual angle being so much more acute, is, that the image given proportionately smaller than the object itself.

The second effect of this dispersion of the rays is, that the image appears at a less distance behind it would have been done in a plane mirror. To understand this effect, it is necessary again to advert to a principle of optics which has been just stated, viz. that objects are rendered visible not by a single ray of light proceeding from every point of the object, but that from every minute point of the surface of every visible object pencils of divergent rays proceed, which are again converged on the retina of the spectator’s eye.

Suppose then G (fig. 14.) a luminous point of any visible object, from which a pencil of divergent rays proceed, and fall upon the convex mirror ab: these rays, agreeably to the nature of these mirrors, are reflected more divergent, and have their fictitious point of reunion (or virtual focus) g much nearer to the eye and to the surface of the mirror, than they would otherwise have. The image, therefore, of the object FG, instead of being at a distance behind the mirror equal to the distance at which the object stands before it (as would be the case in a plane mirror), will appear at a smaller distance, and this distance will always be diminished in proportion to the convexity of the mirror.

For the same reasons an object of a certain size, placed either perpendicularly or obliquely before a convex mirror, will necessarily appear curved or bent, because the different points of the object are not at equal distances from the surface of the mirror. All these effects will be very apparent from inspecting one of those small glass globes, lined with the common amalgam for making looking-glasses, which are sometimes suspended in old-fashioned apartments. In these the company seated in the room or round the table, are represented by the glass; it would have not at a certain distance behind as in plane looking-glasses, but very near the surface of the mirror, and always in some degree curved or distorted.

The effects and phenomena of concave mirrors will obviously, from what has been said, he the direct contrary to those of the convex kind. The surface of concave mirrors is generally spherical (or in the form of a globe); though that is not always the most convenient for optical purposes, but what is least difficult to the workman.

The general effect of concave mirrors is, that we have already seen, to render the rays more convergent. The point in which the converging rays unite is called the focus of the mirror, and cannot be the same for all the rays incident on a concave surface. The parallel rays ab, de (fig. 15.), are converged by the mirror at the point F, which is distant from the mirror one-fourth of the diameter of that circle, of which the mirror is a part or section; and this is the point which is called the circle of parallel rays, and it is the real or principal focus of the mirror. The converging rays fg, hi, are reflected upon the same principle more convergent, and unite at K, nearer to the surface of the mirror than the principal focus. In fine, the divergent rays Rm, and Rn, which proceed from the point R, beyond the mirror, are reflected at the point G, nearer to the mirror than the principal focus, as for instance at K, they would still be reflected divergent, and would proceed one towards f and the other towards h.

Plane and convex mirrors exhibit, as has been already mentioned, the image behind the glass or mirror, and in a situation conformable to that of the object; but concave mirrors show the image behind when the object is placed between the principal focus and the mirror, and then the image is larger than the object. Let AB (fig. 16.) be the object placed before the concave mirror EF, and nearer to the mirror than its principal focus. The two pencils of rays AE, BF, which proceed from the extremities of the object, and which, without the interposition of the mirror, would converge at d, are reflected more convergent, and unite at D; and making an angle greater than they otherwise have done, the image ab is consequently greater than the object.

This image too appears at a greater distance behind the mirror than the object is at before it. The reason of this is, if we suppose A (fig. 17.) a point of any object placed nearer to the mirror than the principal focus, whence a pencil of divergent rays proceed, and falling on the mirror, are (according to the principles before laid down) reflected less divergent, and consequently have their virtual or imaginary focus at a greater distance, than if the object had been placed before a plane mirror.

If, on the contrary, the object is placed farther from the mirror than the principal focus, as for instance at e, the rays eh, ed, being only moderately divergent when they come in contact with the mirror, are reflected convergent, and will represent at E an image of the object. If the eye, therefore, is within a certain distance from the face (to o for example) for the rays to cross each other, it will perceive the image suspended in the air at E between the mirror and itself. The reason of this depends upon what has already been stated. Employed visible to our pupils by pencils of divergent rays from every point of that object; it therefore ceases to be visible if these rays are converged to a point, and this happens when the object is nearer to the mirror than the principal focus.

To render, therefore, an object that situated so as to produce a real image behind the mirror, it is necessary that it should proceed so far beyond the place of the image E, as to allow the rays to cross each other, and meet the eye in a state of divergence.

The image is in this case always inverted. Such is the image ab of the object AB (fig. 18.). From this quantity of the concave reflector to form the image of an object, in these cases, before the reflector, many deceptions have been produced, to the great surprise of the ignorant spectator. He is made to see a bottle half full of water invest-ed in the air without losing a drop of its contents; as he advances into a room, he is tempted to exclaim with Macbeth, “Is this a dagger I see before me?” and when he attempts to grasp it, it vanishes into the air.

A variety of similar appearances may be represented, which are all produced by means of a concave mirror, having an object before it strongly illuminated, care being taken that only the rays of light, which the object shall fall upon the concave reflector or, placed in such a manner that the image shall be in the middle of the adjoining room; or, if in the same room with the object and reflector, a screen must be interposed as to prevent the spectator from discovering them. A hole is then made in the partition between the two rooms, or in the screen, through which the rays pass by which the image is formed. The spectator then, when he looks his eyes upon the partition of the screen, will, in certain situations, receive the rays coming through this small aperture. He will see the image formed in the air; he will have no idea, if not previously acquainted with optics, of the nature of the deception; and may either be amused, according to the inclination of his friends, with tempting fruit, or be terrified at the sight of a ghostly apparition.

Since it is the property of a concave mirror to cause those rays which are parallel to its surface to converge to a focus; and since the solar rays, from the immense distance of that body, may be considered as parallel; concave mirrors prove very useful in making looking-glasses; and the focus of parallel rays, or principal focus, is their focus or burning-point.

Cylindrical mirrors, such as that represented in fig. 19., are employed more for the purpose of amusement than of philosophy. They are called mixed mirrors, because they produce at the same instant the effects of plain and of convex mirrors. Suppose, for instance, GF (fig. 20.) to be the height of such a mirror, and AB an object placed before or rather below it; all the rays shall proceed from the points A, B, C, D, E, falling on the surface GF of the mirror, and reflected to the eye at O, will represent the images of these different points at a, b, c, d, e, as they would be represented in air; and with respect to these, the dimensions of the object will not be altered in the corresponding image. But since the mirror is also curved, if we suppose the space g, f, y, (fig. 21.) to represent a part of its circumference, the rays Ag, Bg, Cg, Dg, Eg, FG, being reflected to the eye at Z, will exhibit all these points A, L,
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The refracti4n of light is attributed by Sir Isaac Newton to the principle of attraction; and perhaps onn the most satisfactory proofs of this theory is the known fact, that the change in the direction of the ray com- 
or the angle of incidence, is not when it comes in contact with the refracting medium, but a little before it 
stream surface, and the incursion aug-
nt in proportion to the density of this medium. 
induced principle will account for the 
phenomenon of light passing more easily, 
the greater the angle of incidence. 

In passing from a dense medium to a rare 
medium, however, there is a certain degree of ob-
lized angle at which the refracti4n is changed 
to the point of contact. It is beyond any doubt, 
right angle, that in refracting light in a rare 
medium, if the angle of incidence exceeds a 
ertain limit, but will be reflected back. 

Thus a ray of light will not pass out of glass 
to air, if the angle of incidence exceeds 40° 11; 
out of water into air, if the angle of incidence exceeds 59° 20.

As the rays of light, in passing from a dense 
medium to a rarer, are refracted from the 
perpendicular, in fact are bent or inclined 
towards the eye of the spectator, who looks 
at an object in the denser medium while 
sanding at its side, the reason will be clear 
why the bottom of a river appears to us 
earer than it really is. If the spectator 
stands on a bank just about the level 
of the water, it is about one-third deeper 
than it appears; and why an oar, partly in 
and partly out of the water, seems broken. 
Let Qio (fig. 26.) represent an oar, the part iQ 
being out of, and the part Qo being 
in the water; the rays diverging from o 
will appear to di-
verge from i nearer to the surface of the water, 
and every point in no will be found nearer to the 
surface than its real place, and the 
part jo will appear to be connected with 
the angle of incidence PQA. 
On this account also, a 
fish in the water appears much nearer 
the surface than it actually is; and a skilful 
mannikin, in shooting at it, will aim 
ciderly below the place which it seems 
to occupy.

On the same principle a common experim-
tent is explained. Put a shilling into a 
ason, and walk back from it till the shilling 
just obscured by the rim of the basin; then 
by pouring water into the basin, the shilling 
stantly appears; for by what has been said 
above, the object, being now in a denser 
medium, is made to appear nearer to its surface. 

As the refraction must in all cases depend on 
the density of the ray, that part of any 
body which is most immersed will seem to be 
most materially altered by the refraction. 
When, however, the object extends to 
great depth in the water, the figure is not 
materially distorted, but if the object is of 
a considerable size, and extending to a great 
depth, those rays which proceed from the 
more distant extremities come in a more obli-
quent direction on their emergence into the
air, and they consequently suffer a greater refraction than the rest. Thus a straight leaden pipe, when near the bottom of a deep water is to be curved, and a flat brass seems deeper in the middle than near the sides.

To these laws of refraction is to be attributed the difference between the real and the apparent rising of the sun, moon, and stars, above the horizon. The horizontal refraction is something more than half a degree, whence the sun and moon appear above the horizon when they are entirely below it. From the loss of light by this process, the perigee decreases to the zenith. Refraction is increased by the density of the air, and consequently it is greatest in cold countries than in hot; and it is also affected by the degree of cold or heat in the same country.

Parallel rays, if refracted, preserve their parallel direction both in entering and in passing out of a refracting medium, provided the two surfaces of the refracting medium are parallel. The two rays, EA, EA, (fig. 27.) after refraction, approach the perpendiculars pp, continue parallel as before, the reason of which is evident on the principles already established; for the ray AC, (Pl. II, fig. 3.) on coming in contact with the surface of the medium, will continue its course in the straight line CB, but being refracted at the point of contact C, it approaches the perpendicular EF, and comes out at a.

After coming out of the refracting medium, if we suppose the surface GH parallel to EF, it ought to proceed to H, having deviated from the perpendicular in the same degree in which it approached it on its first refraction; and thus it continues parallel to the line CB, which is that in which it would have proceeded if it had not been intercepted by the medium.

This parallelism cannot subsist if the two surfaces KI, III, (fig. 4.) are inclined, as in the figure; because, if the ray entering at a, and emerging at b, the object A will be seen from the point B on e, which is out of its true place.

Converging rays become less convergent in passing from a rare to a denser medium, as from air into water; and on the contrary, their convergence is increased by passing from a dense to a rarer medium, as from water into air. (See fig. 1.) In the same manner, diverging rays become less divergent in passing out of a rare medium into one which is denser, and their divergence is increased by passing out of a dense into a rarer medium. (See fig. 2.) This fact is a necessary consequence of the general law of refraction: but it will satisfactorily explain why an object under water, though not apparent to an eye above the surface than it really is, and why all objects appear magnified seen through a mist; for in all these cases, the converging rays, by which we see the extreme points of objects, meet, and which during their passage through the water, &c, were refracted towards the perpendicular, on their emergence into the air are made more suddenly to converge, and consequently the visual angle is rendered more acute.

It is evident, that when parallel rays fall upon a spherical plane, that ray only which penetrates to the centre or axis will proceed in a direct course; for all the rest must necessarily make an angle more obtuse, in proportion to their distance from the centre; they are therefore more divergent or converging, according to the nature of the medium on which they are incident. If they fall on the convex surface of a medium denser than that which they leave, as in passing from air into glass, they will converge, as may be seen in Plate II. fig. 2., where that phenomenon is represented; for the parallel rays, ka, kg, (fig. 10.) falling in an oblique direction on the refracting medium terminated by the convex surface Ed, they will be refracted, and will, if they approach perpendicularly on Ed, or any other surface them, will continually have a tendency to unite towards the axis AB.

It is however proper to remark, that the point at which they join the axis AB will be distant from the surface of the refracting medium, in proportion as the point on which they fall on the convex surface is distant from that axis; because the more distant that point is, from the convex surface, the more the rays near it will be divergent or convergent, and the more they will be spread or gathered on the convex surface of the medium.

If the ray bH joins the axis at k, but the ray fg does not join the axis till it arrives at D.

Rays already convergent, falling on the convex surface of a dense medium, will be acted upon differently according to circumstances.

If their convergence is exactly proportioned to the convexity of the surface, they will not suffer any refraction; (see fig. 6.) because in that case one of the essentials is wanting to refraction, viz. the obliquity of the incidence; and each ray proceeds in a direct line to the centre of that circle, of which the convex surface is an arc or segment.

For instance, the rays cb and db, (fig. 11.) which tend to unite at C, the centre of the convex surface, may be considered as perpendicular, being the radii of the circle.

If the rays have a tendency to converge before they reach the centre of the convexity, they will then be rendered less convergent for instead of converging to a point at b, (fig. 7.), they will converge at B. The reason of this is evident; for the ray bH, (fig. 11.) which, if not intercepted, would meet the axis at k, nearer the surface of the refracting medium than the centre of curvature C, being refracted towards the perpendicular or radius DC, meets the axis only at o.

If, on the contrary, the rays have a tendency to converge beyond the centre of the convexity, they will then be rendered less convergent, as in fig. 8.; where their point of union, if not intercepted, would be c; but were, by the influence of the refraction, they are found to converge at C. For the ray gh, (fig. 11.) the length of which is towards k, is refracted towards the perpendicular or radius DC, and joins the axis at p.

If diverging rays fall on the convex surface of a denser medium, they are always rendered less divergent, as in fig. 9.; and they may be rendered parallel, or even convergent, according to the degree of divergence compared with the convexity of the refracting surface, on the principles already explained.

If rays pass from a dense to a rarer medium, the surface of the dense medium being convex, in this case parallel rays become convergent; for the parallel rays da, gb, (fig. 15.) when they reach the convex surface CD, instead of continuing their direct course, are refracted towards the perpendiculars ec, bc, and converge at k.

Converging rays are also rendered more convergent. Thus the rays eg, ni, which without any change in the medium, would have proceeded in the direction t and vice versa, are, in consequence of the refraction which they suffer, and which bends them from the perpendiculars ac, bc, unite at p.

Diverging rays, if they proceed from the point C, the centre of convexity, suffer no refraction, and will meet the rays already assigned, may be considered as perpendicular to the refracting surface, and consequently they are deficient in one of the causes of refraction, the obliquity of incidence.

If they proceed from a point which is nearer to the surface than the centre of convexity, such as n, they will be refracted from the perpendiculars ac, bc, and will be rendered more divergent towards s and z; in consequence of the refraction which they suffer, and which bends them from the perpendiculars ac, bc, and are consequently divergent.

If, on the contrary, the diverging rays come from a point such as q, beyond the centre of convexity, they will be rendered less divergent; for instead of going towards s and z, they will be refracted from the perpendiculars ac, bc, towards g, and are consequently divergent.

When rays pass from a rare into a dense medium, and the surface of the dense medium is concave, then parallel rays are rendered divergent, as in Plate II. fig. 13.; for the parallel rays ab, de, (fig. 17.) are refracted towards the perpendiculars fc and gc, and are consequently divergent.

Converging rays falling on the same concave surface will be rendered less convergent, as in fig. 14. For the rays ab, de, (fig. 18.) which would have converged at O, if their progress had not been intercepted, will be refracted towards the perpendiculars fc and gc, and will unite only at i. If the convergence was less, they might by the refraction be rendered parallel, or even divergent.

Diverging rays proceeding from any point nearer the refracting surface than the centre of concavity, they will be rendered less divergent, as in fig. 15. For the two diverging rays ik and lc, (fig. 19.) instead of proceeding to d and h, are refracted towards the perpendiculars fc and gc.

If, on the contrary, which is the most general case, the diverging rays proceed from a point more distant from the surface than the centre of concavity, their divergence will be increased, as in fig. 16. For the diverging rays ib and le, (fig. 19.) which tend towards m and s, a, are refracted towards the perpendiculars fc and gc, and become more divergent than they would otherwise have been.

When rays pass from a dense into a rarer medium, and the dense medium is terminated by a concave surface, then

Parallel rays become divergent; for the parallel rays de, gb, (fig. 15.) when they reach the concave surface CD, instead of continuing their course in the direct lines towards f and k, proceed towards m and p, being refracted from the perpendiculars ec, bc, and are consequently divergent.
Converging rays, if their point of convergence is precisely at C, the centre of the concavity $dV$, will not suffer any refraction, because they are perpendiculars, as already explained, therefore have no obliquity of incidence. If, on the other hand, the rays tend to a point, such as $a$, nearer the surface than the centre of the concavity C, then they are rendered more convergent; for the rays $ar, ar'$ which naturally tend to that point, are refracted from the perpendicular $Ca, Ca'$, and converge at $a$, nearer the concave surface.

Lastly, if the converging rays tend to a point $I$, which is beyond the centre C, they are rendered less convergent. For the rays $EI, EI'$, which would naturally unite at that point, are refracted from the perpendiculars $CI, CI'$, and unite at $I$, which is more distant still.

Diverging rays in the same circumstances are rendered more divergent. For the rays $E', E''$, diverging from the point $E$, instead of proceeding towards $a$ and $a'$, are refracted from the perpendiculars, and are directed towards $y$ and $z$.

From the property which all spherical convex surfaces have, of rendering parallel rays proceeding from the center medium, or convergent, glasses made in this form are very commonly used as burning-glasses; and as the sun's rays, proceeding from so vast a distance, may be considered parallel, the focus of parallel rays will of course be their burning-point.

A lens is a transparent body of a different density from the surrounding medium, and terminated by two surfaces, either both spherical, or the one plane and the other spherical, whether convex or concave. They are therefore generally distinguished by their forms, and are called plano-convex or plano-concave, or double convex or double concave; a lens which has one side convex and the other concave, is called a meniscus, or concave-convex lens. See Plate I. fig. 21.

It is evident, that in lenses there may be almost an infinite variety with respect to the degree of convexity or concavity; for every convex surface is considered as the segment of a sphere, the diameter and radius of which may be of any extent. Hence, when opticians speak of the length of the radius as applied to a lens, as for instance, when they say its radius is 3 or 6 inches, they mean that the convex surface of the glass is the part of a circle, the radius of which, or half the diameter, is 3 or 6 inches.

The axis of a lens is a straight line drawn through the centre of its spherical surface; and as the spherical sides of every lens are arcs of circles, the axis of the lens would pass exactly through the centre of that circle, of which its sides are arches or segments.

From what has been already stated, it is evident that the certain effect of a convex lens must be to render parallel rays convergent; to augment the convergence of converging rays; to diminish in like manner the divergence of diverging rays, and in some cases to make them parallel or even convergent, according to the degree of divergence or convexity comprised with the convexity of the lens. In what is called a double-convex lens, this effect will be increased in a duplicate proportion, since both surfaces will act in the same manner upon the rays; and since it has been proved, that parallel or convergent rays have their convergence equally augmented by being incident on the convex surface of a dense, or the concave surface of a rare medium.

These glasses: then most necessarily have the effect of magnifying glasses, since by the convergence of the rays the visual angle is increased, and consequently the image which is depicted on the retina is magnified proportionally larger.

The focus of those rays which come in a parallel direction to the glass, is called the focus of parallel rays, or principal focus. In the former, all the rays meeting at the length of the diameter of that circle, of which the convex surface is a segment; and in a double-convex lens, or one which is convex on both sides, the focus is as the distance of the radius, or half the diameter, of the circle of which the lens is a segment. This focus therefore is easily found upon mathematical principles. It may also be found, though not with equal exactness, by holding a sheet of paper between the glass and the rays of the sun, and observing the distance of the paper from the glass when the luminous spot on the paper is very small, and when it begins to burn; or when the focal length does not remain the same, that the focus may be found by holding the lens at such a distance from the wall opposite a window-sash, that the image of the sash may appear distinct upon the wall.

From this property in convex lenses, of rendering all rays in some degree convergent which fall upon their surfaces, it is evident that in all such cases there must be a point, which in general is at the focus, where pencils of rays proceeding from the extreme point of any object must first unite and then cross each other; and consequently an inverted image of the object will be exhibited at any distance beyond that point. This may be elucidated by a very easy experiment, viz. by holding a common reading or magnifying glass between a candle and a sheet of paper suspended on the wall, at a proper distance, when the image of the candle will appear on the paper inverted: and the reason of this is extremely clear; for it is evident, that the upper pencils after refraction, are those which proceeded from the upper part of the luminous body, and the under rays are those that came from below. The position is therefore only inverted, and the image remains unimpaired.

From the same property, convex lenses will cause many rays to enter the eye which would otherwise have been scattered or dispersed, and therefore objects seen through them appear clearer and more splendid than when viewed by the naked eye. If, however, the glass is very thick (as in high magnifiers), some of the rays which enter it will be reflected or sent back, and consequently the brilliancy of the image will suffer some diminution.

A large object seen through a lens which is very convex will appear deformed; and this proceeds from the refraction not being equal in all parts. Such cases also are of frequent occurrence, because the refraction at the edges of the lenses does not agree with that of the middle parts. The modes adopted for remedying these defects in optical glasses, will be hereafter explained.

The effects of a concave lens are directly opposite to those of the convex lens. In other words, by such a glass, parallel rays may be rendered divergent, converging rays have their convergence diminished, and diverging rays have their divergence augmented, in proportion to the concavity of the lens. These glasses then exhibit objects smaller than they really are, and render distant objects nearer, or more properly by diminishing the convergence of the rays proceeding from the extreme points of the object, the visual angle is rendered more acute, and the image painted on the retina is smaller, than it would have been had these rays not been intercepted in their natural progress; and by the divergence of the rays the object is represented with less clearness than it would otherwise have been. Moreover, in this case, a less quantity of light enters the pupil of the eye.

All concave lenses have a negative or virtual focus, which is a point corresponding with the divergence of parallel rays incident on the surface of the glass.

Light is, however, not so simple a substance as it may be supposed upon superficially considering its general effects; it is indeed found to consist of particles which are differently refrangible, that is, of some of them may be refracted more than others in passing through certain mediums, whence they are supposed by philosophers to be different in size. The common optical instrument called a prism, is a triangular piece of glass, through which if a pencil or collection of rays is made to pass, it is found that the rays do not proceed parallel to each other on their emergence, but produce an opposite wall, or any plane surface that receives them, an oblong spectrum, which is variously coloured, and it consequently follows that some of the rays or particles are more refrangible than others.

The spectrum thus formed is, perhaps, the most beautiful object which any of the experiments of science offers to our view. The lower part, which consists of the least refrangible rays, is of a lively red; which, higher up, by insensible gradations, becomes an orange; the orange, in the same manner, is succeeded by a yellow; the yellow, by a green; the green, by a blue; after which follows a deep blue or indigo; and lastly, a faint violet.

Of Vision. There is not any part of the animal frame which displays in a more satisfactory manner the wisdom and design of our Creator, than the eye. Its anatomical structure is however explained under the articles Anatomy and Physiology. It is only necessary at present to consider it as an optical instrument. The external coat or case, which forms the globe of the eye, is at the back part strong and opaque; the fore part is thin and transparent, so as to allow the rays of light; and it is therefore called the cornea; it has this resemblance to polished horn. It incloses three peculiar matters called the humour, which are of different densities. That in the anterior part, immediately under the cornea, is called the aqueous humour; that immediately behind is
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The crystalline humour, which is a double-convex lens of great refracting power, and therest of the eye is filled with a jelly-like substance called the vitreous humour. The iris, which is the coloured part of the eye, is a circular membrane which is perforated by a small hole, the pupil, through which the rays of light must pass to the crystalline humour.

The optic nerve enters at the under part, and is spread over the interior surface, at the back of the eye, in the form of a fine network, and therefore is called the retina. The student of optics will see from this, that the eye is altogether calculated to act as a convex lens of strong refractive power.

It has already been explained, that from every luminous point of a visible object, cones or pencils of light are emitted or reflected in every direction; but to produce vision, it is necessary that they should be concentrated, or converged to such a point as to make a forcible impression on the retina.

Thus from the luminous body A, Plate II. (fig. 22.) the rays r, r, r, are sent in various directions. Those which fall upon the transparent or concave cornea are refracted, and will proceed to such a manner as to enter the pupil a p, and in passing the crystalline lens or humour they suffer a second refraction, and are converged to a point or focus at the point a on the retina. Now it is evident, that if the rays could have passed the humour of the eye in their natural direction, that is, in the direction of the cone or pyramid CAC, they would have made upon the retina a very extensive but feeble image, as well as have left the experience could not produce distinct vision; to obviate this it is appointed by the all-wise Author of our existence, that by the force of the refraction which they suffer in the eye, they should form another cone opposed to the first at its base, and the apex of which is at a, and thus an impression sufficiently forcible to produce distinct vision is made on the retina.

In the preceding instance, the luminous body A was considered as a point; and what has been said of it will apply to every point of a visible object, which is capable of transmitting or reflecting to the eye a pencil or collection of rays. Thus we may easily suppose that from the arrow B, (fig. 23.) cones or pencils of light may be transmitted; these, like all pencils or collections of rays, coming from a point, will diverge, and will fall upon the eye in some degree divergent, or in the form of cones or pyramids.

The pencil of rays OEIF will then paint the extremity O in the point I; the pencil BMEN will also paint the extremity B in the point M; and since all the points between O and B are represented by C, D, E, etc., of course IM will be the image of OB. Hence it is evident, that by means of this refraction there are certain points at which the rays of light, after passing the pupil, cross each other, and the image which is formed on the retina is consequently inverted.

Artificial eyes are sold by the opticians, in which all the humours are made of different kinds of glass, and may be separated at pleasure.

At the back part, where the retina is supposed to be, there is an opaque lens, and light from the converged rays is placed a piece of ground glass, where the image from the opposed object is rendered in an inverted position, as in a camera obscura. The same effect may be produced with a natural eye, and the nature of vision may be thus experimentally demonstrated: if a person is taken fresh, the posterior costs dexterously arranged even to the vitreous humour, and if a piece of white paper is then placed at the part, the image of any bright object which is placed before the eye will be distinctly painted on the paper, but in an inverted position.

If the humours of the eye, through age or weakness, have shrunk or decayed, the cornea will then be too flat; and the rays, not being sufficiently bent or refracted, arrive at the retina before they are united in a focus, and would meet, if not intercepted, in some place behind it, as in Plate II. fig. 25. They therefore do not make an impression sufficiently correct and forcible, but form an indistinct picture on the bottom of the eye, and exhibit the object in a confused and imperfect manner. This defect of the eye is therefore remedied by a double-convex lens, such as the common spectacle-glasses, which, by causing the rays to diverge; and consequently, by being properly adapted to the case, will enable the eye to form the image in its proper place.

The rays of light being convergent, or reflected from a visible object in all directions, it must be plain that some of them from every part of it must reach the eye. Thus the object AB (Plate II. fig. 28.) is visible to an eye in any part where the rays AA, AB, AC, AD, AE, BD, BE, CE, CD, and CE, can both. Though rays are reflected from every part of the object to every part of the circumambient space, yet it is evident that only those rays which pass through the pupil of the eye can affect the sense; and those rays also give the ideas of colour, according to the properties of those bodies which transmit or reflect them.

As the direction in which the extreme pencils of light cross each other in the eye, bears a direct proportion to the angle at which they are transmitted from the object to the angle by which they are received at the eye, it is evident that the image formed upon the retina will be proportioned to the apparent magnitude; and thus we have our first ideas of the size and distance of bodies, which, however, in many cases are corrected by experience. The nearer any object is to the eye, the larger is the angle by which it will appear in the eye, and therefore the greater will be the apparent distance. In Plate II. fig. 24, let AB be an object viewed directly by the eye QR. From each extremity draw the lines AN and BM, intersecting each other in the crystalline humour at I. The direction of the rays in this direction is such as to be supposed to look at the object. The angle AIB is then the optical visual angle; and the line IK is called the optical axis, because it is the axis of the lens or crystalline humour continued to the object.

The apparent magnitude of objects, then, depending thus on the angle under which, they are seen, will evidently vary according to their distance. Thus different objects, AB, CD, EF, the real magnitudes of which are very unequal, may be situated at such distances from the eye as to have their apparent magnitudes all equal, if they are situated at such distances that the rays AN, BM, shall touch the extremities of each; they will then appear all under the same optical angle, and the diameter MN of each image of the retina will consequently be equal.

In the same manner objects of equal magnitude, situated at unequal distances, will appear unequal. For let AB and GH, two objects of equal size, be placed before the eye at different distances, HK and IS; draw the lines GP and HO, crossing each other at I; then OP, the image formed by the object GH on the retina, is evidently of a greater dimension than the object MN, which represents the object AB; in other words, the object GH will appear a hundred times as large as an object of the diameter TV, situated at the same place as the object AB.

To render the subject still clearer, suppose the object IJK (see Plate II. fig. 27.) to be at a hundred yards distance, it will form an angle in the eye at A. At two hundred yards distance the angle it makes will be twice as small in the eye at B. Thus to whatever moderate distance the object is removed, the angle it forms in the eye will be proportionally less, and therefore the object will be diminished in the same proportion.

Hence it follows, that objects situated at different distances, whose apparent magnitudes are equal, are to each other as their distances from the eye; and by the same rule, equal objects situated directly before the eye, have their apparent magnitudes in a reciprocal proportion to their distances.

This last proposition must, however, be received with some allowance; for it is only applicable to very small objects, with those to whom the sense is not corrected by the judgment. For if the objects are near, we do not judge of their magnitude according to the visual angle. Thus, if a man of six feet high is seen at the distance of six feet, under the very same angle as a dwarf of only two feet high at the distance of two feet, still the dwarf will not appear as large as the man, because the sense is corrected by the judgment.

In most cases, however, where the distance is considerable, the rule will be found accurate; and as it has its foundation in nature, most of the phenomena of vision will be explained by the simple principles here laid down. If the eye is placed above a horizontal plan, the different parts of this plain will appear elevated in proportion to their distance, till at length they will appear upon a level, because the principal reason why, if we stand on the sea-shore, those parts of the ocean which are at a great dis-
tance appear elevated; for the globular form of
the earth is not perceptible to the eye; and
it is very evident, that the apparent elevation of
the sea is far greater than the angle which a seg-
ment of the globe would form within any dis-
tance that our eyes are capable of reaching.

For the same reason, if a number of objects
are placed on the same plane and at the same
height before the eye, the more distant will
appear taller than the others; and if the
same objects are placed on a similar plane
above the eye, the more distant will appear
the lowest.

The distant parts of a long wall, for the
same reason, appear to a person who stands
near one end to curve, or incline towards
him. In the same manner the high wall of a
lofty tower seems to a spectator, placed di-
rectly under it, to bend over him, and
threaten him with instant destruction. If any
person inclined to make the experiment will
lie down on his back in a situation of this
description, at the distance of five or six feet
from the wall which he contemplates the
tremendous height, he will immediately be
understood to form an impression that the
wall is not much above his head.

If the distance between two objects forms
an insensible angle, the objects, though in re-
ality at some distance from each other, will
appear contiguous. This is ascribed by some
astronomers as the reason why the ring or
belt of Saturn appears as one mass of light,
while they contend that it is formed from a
number of little stars or satellites ranged with-
in a certain distance of each other.

If the eye is carried along, as in a boat,
without being sensible of its own motion, the
objects which are stationary on each side will
appear to move in a contrary direction. Thus
we attribute to the sun and the other heavenly
bodies a diurnal motion, which only affects
the earth which we inhabit.

If two or three objects at a considerable
distance, and on which the eye of the spec-
tator is fixed, move with equal velocity past
a third object which is at rest, the moving
objects will appear to be actually at rest, and
that which is stationary will appear to be in
motion. Thus the clouds which pass over
the face of the moon appear at rest, while the
moon itself appears to proceed rapidly along
in an opposite direction. This happens, be-
cause the eye, which is fixed upon the clouds,
follows their motion mechanically, and there-
fore the moon appears to move and not the
clouds; as in the boat we do not perceive its
motion, but conceive the banks are retiring
behind us.

If the centre of the pupil, that is, the op-
tic axis, is directed along the surface of any
slender object in a perfectly right line, this
line will appear only a point, because, in fact,
the eye views only that part visible.

An extended and distant arch, viewed by
an eye which is exactly in the same line, will
appear as a plane surface; because all the
parts appear equally distant, the curvature
with which we regard it will remain in the
same plane.

If a circle is viewed obliquely it will ap-
pear an oval, because the diameter which is
perpendicular to the eye is shortened; in
other words, the rays which proceed from
the centre make an angle so much the
more acute as the obliquity is greater; on
the contrary, the diameter which is parallel
to the eye is apparently extended.

Such are the general principles upon which
vision is performed; but the sense of sight is
limited not only with respect to distant ob-
jects, but with respect to those which are
near the eye. Thus we receive the image of
a book, or any other object, if held too
close to the eye, the letters or the object will
appear very indistinct and confused. This
distance varies with respect to different eyes.

The eye may be considered as having the
distance of one or two inches; but where the
eye is in a sound state, the point of distinct
vision varies from six to ten inches, or eight
inches as a medium.

To understand the reason of this, it is ne-
necessary to remember that objects are made
visible by cones of diverging rays proceed-
ing from every luminous point of an object;
but to have the object clearly painted on the
retina, the rays must not enter the pupil of
the eye too divergent. Indeed they ought to
come in almost a parallel direction, more
in the form of a cylinder than a cone, otherwise
the humours of the eye will not unite them
into one, and prepare them on the retina.

Thus, let ABCD (Plate III. fig. 2) be the
diameter of the pupil of the eye; O is then
a luminous point of any object sit-
uated at the distance of about six inches
and OD is a divergent ray proceeding
from this point. Let AC and BD then
be parallel rays. It will then be evident that
the divergency of the rays OC and OD is so
very small, that they are almost parallel when
they arise at the pupil and consequently
the eye will be able to converge them in such
degree as to produce distinct vision.

If, on the contrary, the point O was nearer
to the pupil, or if the pupil was larger, they
would fall more diverging upon the eye, and
the image of the object would be formed at
a point behind the retina, so as to be very in-
perfect and confused. Hence we may easily
perceive the use of a single lens of a short
focus, or high magnifying power, such as is
employed in the microscope. It en-
ables the divergent rays less divergent; and
consequently assists the eye in making them
converge to that point which is necessary
to distinct vision.

From the principles laid down it may eas-
ily be seen that objects at a very minute
distance are imperceptible to the naked eye.
If those objects could, consistently with distinc-


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When the eye, whatever the size of the lens, for the lenses FD and FE, if projected to the distance of A and B, would form an image exactly twice as large. "If, on the other hand, the eye is nearer to the lens than the focus, it will see the object still larger; and if it is further away, it will make the image smaller; and in all cases the visible part of the object will be to the lens, as the focal distance of the lens is to the distance of the eye."

From what has been said, the reason will be very plain why the following instruments have been seen through a double-convex lens, that is, a single microscope, will be in the proportion which the focus of the lens bears to the limits of distinct vision. Thus, suppose AB, fig. 1, to be that distance, or about six inches, so that the eye B can but just perceive the object A, and let the focal distance of the lens D be one-half of an inch; then since CD is but one-twelfth of AB, the length of the object at C will appear two times as large as at A, and its surface will appear magnified 144 times.

The most powerful single microscopes are very small globules of glass, which any curious person may make for himself by melting the ends of the threads of glass in the flame of a candle; or by taking a little fine powdered glass on the point of a very small needle, and melting it into a globule in that way. It was with such microscopes as these that Leeuwenhoek made all his wonderful discoveries, most of which are deposited in the British Museum.

The double or compound microscope differs from the preceding in this respect, that it consists of at least two lenses, by one of which an image is formed within the tube of the microscope; and this image is viewed through the eye-glass, instead of the object itself as in the single microscope. In this respect the principle is analogous to that of the telescope, only that, as the latter is intended to view distant objects, the object-lens is of a long focus, and consequently of a moderate magnifying power, and the eye-glass of a short focus, which magnifies considerably the image made by the object-lens. Whereas the microscope being intended only for minute objects, the object-lens is consequently of a short focus, and the eye-glass in this case is of so high a magnifying power.

A single figure will serve to explain the principles on which all these instruments are constructed. Suppose therefore LN (Plate III. fig. 3) to be the object-lens, and FG be the eye-glass. The object OB is placed a little beyond the principal focus of LN. The cones or pencils of rays then proceeding from the different points of the object, are by the lens made to converge to their respective foci, and form an inverted image of the object at D, on which a second eye-glass FG is placed; and the rays of each pencil will proceed in a parallel direction to the pupil of the eye.

The compound microscope was thus originally constructed of glasses, but it was found that what is called the field of view was too confined in instruments of this construction. For the pencil of rays which emanates from the point O of the object, and is converged by the lens to D, would of course afterwards diverging towards H, and therefore would never arrive at the lens FG, nor enter the eye. For the pencil of rays projected from a and b will be intercepted by the lens FG, and sent to the eye at E in a parallel direction. Hence if the object is large, a very small part of it will be visible, because several rays will fall without the eye-glass FG, and the field of view will consequently be very limited.

To remedy this inconvenience, a broad lens DE is interposed, either of a plano-convex, or of a double-convex, form. By this, it will be perceived that all the pencils which would have proceeded towards H and I, will be reflected to the eye-glass, and the figure will be completely formed as in the plate. This glass is called by opticians the body-glass, because it is situated in the body of the microscope. Some artists now make these instruments with two eye-glasses, made rather thin, which in some degree corrects what is called the aberration, or dispersion of the rays. In all these microscopes the object is seen in an inverted position; but this is of little importance with regard to small insects and other minute bodies.

The solar microscope is a kind of camera obscura, which, in a darkened chamber, forms the image of any object which is placed beyond the length of the tube of the microscope, by which it is understood to be a tube of double convex lenses, consisting of two lenses fixed opposite a hole in a board or window-shutter; one, which condenses the light of the sun upon the object (which is placed between them), and the other which forms the image. There is also a plain reflector placed without, moved by a wheel and pinion, which may be so regulated as to throw the sun's rays upon the outer lens. The reader may form some idea of this by inspecting the Plate III. fig. 12, of the camera obscura, only supposing the figures on the wall to be a microscopic object magnified by the lens. Mr. Adams's most ingenious invention, the laceral microscope, is also to be considered as a kind of camera obscura; only the light in this latter case proceeds from a lamp, instead of from the sun, which renders it convenient to be used at all times. But for a description of this elegant and most amusing instrument, we must refer to his Microscopical Essays.

From what has been said on the nature of the compound microscope, the principle of the telescope may be easily understood. The telescopes are, however, of two kinds; the one depending on the principle of refraction, and called the dioptric telescope; the other on the principle of reflection, and therefore termed the reflecting telescope.

The parts essential to a dioptric telescope are, the two lenses AD and EY (Plate III. fig. 4). As in the compound microscope, AD is the object-glass, and EY is the eye-glass; and these two lenses are combined in the tube, that the focus F of the one is exactly coincident with the focus of the other.

Let OB then represent a very distant object, from every point of which pencils of rays will proceed so little diverging to the several points of the image considered as nearly parallel; IM will then be the image which would be formed on a screen by the action of the lens AD. For supposing OA and BD two pencils of rays proceeding from the extremities of the object, they will unite in the focal point F, and intercept each other. But the point F is also the focus of the eye-glass EY; and therefore the pencil of rays, instead of going out of the eye, will pass through it in nearly a parallel direction, so as to cause distinct vision.

It is then plain that, as in the compound microscope, it is the image which is here contemplated, and that accustomed common sensation when people say the object is brought nearer by a telescope. For the rays, which after crossing proceed in a divergent state, fall upon the lens EY, as if they were proceeded from a real object situated at F. All that is effected by a telescope then is, to form such an image of a distant object, by means of the objective-lens, and then to give the eye such assistance as is necessary for viewing that image as near as possible; so that the angle it shall subtend at the eye shall be very large compared with the angle which the object itself would subtend in the same situation. This is effected by means of the eye-glass, which refracts the pencils of rays, so that they may be brought to their several foci by the humour's of the eye, as has been described.

To explain clearly, however, the reason why it appears magnified, we must again have recourse to the figure of a great distance, the length of the telescope is to be considered with respect to it. Supposing therefore, the eye viewed it from the centre of the object-glass C, it would see under the angle OCB, by OC and BC then produced to the focus of the glass, they will then limit the image IM formed in the focus. If then two parallel rays are supposed to proceed to the eye-glass EY, they will be converged to its focus H, and the eye will see the image under the angle EYI. The apparent magnitude of the object seen by the naked eye is, therefore, to that of the image which is seen through the telescope, as the magnitude of the angle OCB, or ICM, to that of EYI, or IGM. Now the angle IGM is to ICM as CF to FG; that is, as the focal length of the object-glass to that of the eye-glass.

The magnifying power of these glasses may be considered to a considerable extent, because the focal length of the object-glass, with respect to that of the eye-glass, may be greatly increased. This however would require a great length; because an eye-glass of a very short focus would cause such a dispersion of the rays of light, particularly towards the edges of the glass, that the view would be intercepted by the prismatic colours.

Another manifest defect in these telescopes is, that the image appears inverted; this, however, is of no consequence with respect to the heavenly bodies; and on this account it is still used as an astronomical telescope. The construction is also used on board of ships as a night-glass, to discover rocks in the sea, or an enemy's fleet. Notwithstanding the inconvenience of exhibiting the objects inverted, more glasses of this kind are produced from the principle of light; and habit soon makes the person who uses them to discern objects with tolerable distinctness.

Galileo, who had heard of the invention of telescopes, but had not seen one, constructed a telescope upon theoretical princi-
be altered; but fewer rays of every pencil that was being admitted, the object would appear obscure.

In few words, the apparent distinctness or confusion of any object, viewed through glasses, depends on the mutual inclination of the rays to each other, when they fall on the eye; the apparent magnitude depends upon the inclination of the rays of different pencils to each other; the apparent situation depends upon the relative brightness or obscurity of the object to each pencil; and the apparent brightness or obscurity depends on the quantity of rays in each pencil.

As the magnifying power of all dioptic telescopes depends on the proportion which the local length of the eye-glass bears to that of the object-glass; and as an eye-glass of very high magnifying powers could not be used on account of the aberration or dispersion of the rays, from the unequal thickness of the glass; various contrivances were invented for the sake of employing object-glasses of a very long focus. Wooden tubes of a very great length were found unserviceable. At length the famous Huygens invented a method of combining with the tube, an object-glass to a high pole, with a piece of mechanism which enabled him to raise or lower it at pleasure; and he made the eye-glass correspond to it by a silk cord, which he held tight in his hand. This method is, we believe, still in use on the continent for celestial objects, and distinguished by the name of the aerial telescope.

These inventions were however all rendered nugatory by the discovery of the reflecting telescope. For a dioptric or refracting telescope, even of one thousand feet focus, if it could be used, could not be made to magnify with distinctness above one thousand times; whereas a reflecting telescope of the length of eight or nine feet will magnify with distinctness 1200 times.

The well-known property in concave spectacles, of causing the pencils of rays to converge to their focus, and there forming an image of any object that may be opposed to them, is the reflecting telescope. In this the effect is precisely the same as that produced by the dioptic telescope; only that in the one case it is produced by reflector, and in the other by refracted, light. Reflected telescopes are made in various forms; and those principally in use in this country are distinguished by the names of their respective inventors, and are called the Newtonian, Gregorian, and Herschelian telescopes. The reflecting telescope of the Gregorian principle, which is the most common, as it is found to be the most convenient, is constructed in the following manner:

At the bottom of the great tube (Plate III, fig. 7) TUV, is placed a large concave mirror DUVF, whose principal focus is at m; and in the middle of this mirror is a round hole P, opposite to which is placed the small mirror L, concave toward the great one; and so fixed to a strong wire M, that it may be removed further from the great mirror, or nearer to it, by means of a long screw in the inside of the tube, keeping its axis still in the same line with that of the great mirror. If we remove the reflecting object, we can scarcely see a point of it but what is, at least, as broad as the great mirror, we may consider the rays of each pencil, which flow from every point of the object, to be parallel to each other, and to cover the whole reflecting surface DUVF. But to avoid confusion in the figure, we shall only show the intermediate points of the rays from each extremity of the object into the great tube; and trace their progress through all their reflections and refections to the eye f at the end of the small tube t, which is joined to the great one.

Let us then suppose the object AB to be at such a distance, that the rays C may flow from its upper extremity A, and the rays E from its lower extremity B; then the rays C falling parallel upon the great mirror at D, will be thence reflected converging in the reflecting spectacles in various forms; and the object A, which comes from the bottom of the object AB, and falls parallel upon the great mirror at f, are thence reflected, converging to its focus, where they form the lower extremity a of the inverted image IK, similar to the upper extremity A of the object AB; and passing on to the concave mirror, they will fall upon it at g, and be thence reflected, converging in the direction gN, because gN is longer than gK; and passing through the hole P in the large mirror, they would meet some object in the upper extremity a of the erect image ab, similar to the upper extremity A of the object AB. But by passing through the plano-convex glass R in their way, they form that extremity of the image at c; and the rays E, which come from the bottom of the object AB, and fall parallel upon the great mirror at f, are thence reflected, converging to its focus; and therefore the lower extremity I of the inverted image IK, similar to the lower extremity B of the object AB; and thence passing on to the small mirror L, and falling upon it at h, they are thence reflected in the same converging state HO; and going on through the hole P of the great mirror, they would meet somewhere about q, and form there the lower extremity b of the erect image ab, similar to the lower extremity B of the object AB. And through the plano-convex glass R in their way, they meet and cross sooner, at b, where that point of the erect image is formed. The like being understood of all those rays which flow from the intermediate points of the object between A and B, and enter the tube TT, all the intermediate points of the image between a and b will be formed; and the rays passing on from the image through the eye-glass S, and through a small hole e in the end of the lesser tube t, they enter the eye f, which sees the image ab (by means of the eye-glass) under the large angle ced, and magnified in length under that angle from c to d.

In the best reflecting telescopes, the focus of the small mirror is never coincident with the focus m of the great one, where the first image IK is formed, but a little beyond it (with respect to the eye) at aK; the consequence of which is, that the rays of the pencils will not be parallel after reflection from the small mirror, but converge so as to meet in points about q, e, r; where they would form a larger upright image than ab, if the glass R was not in their way, and this image might be viewed, and formed the image and the eye; but then the field of view would be less, and consequently not so pleasant; for
that reason the glass R is still retained, to enlarge the scope or area of the field.

To find the magnifying power of this telescope, multiply the focal distance of the great mirror by the distances as the small mirror from the image next the eye and multiply the focal distance of the small mirror by the focal distance of the eye-glass; then divide the product of the former multiplication by that of the latter, and the quotient will express the magnifying power. The difference between the Newtonian and Gregorian telescope is, that in the former the spectator looks in at the side through an aperture upon a plane mirror, by which the rays reflected from the concave mirror are reflected to the eye-glass; whereas in the latter the reader will see that he looks through the common eye-glass, which is in general more convenient.

The immensely powerful telescopes of Dr. Herschel are of a still different construction. This assiduous astronomer has made several specula, which are so perfect as to bear a magnifying power of more than six thousand times an object in a distant object. The object is reflected by a mirror as in the Gregorian telescope, and the rays are intercepted by a lens at a proper distance, so that the observer has his back to the object, and looks through the lens at the mirror. The magnifying power will in this case be the same as in the Newtonian telescope; but there not being a second reflector, the brightness of the object viewed in the Herschelian is greater than that in the Newtonian or Gregorian telescope. In conclusion, sir Isaac Newton's excellent maxim must not be omitted: "The art," says he, "of constructing good microscopes and telescopes may be said to depend on the circumstance of making the last image as large and distinct and luminous as possible."

There are some instruments of rather an amusing than a useful description, the effects of which depend on an optical illusion. Our limits will not admit the notice of more than two of this kind, namely, the magic lantern, and the camera obscura. The former is a microscope upon the reverse plan of the common microscope, and may be used with good effect for magnifying small transparent objects: but in general it is applied to the purpose of amusement, by casting the image of a small transparent painting on glass upon a white wall or screen, at a proper distance from the instrument.

Let a candle or lamp C (fig. 8) be placed in the inside of a box, so that the light may pass through the plano-convex lens NN, and strongly depend on the object QQ, which is a transparent painting on glass, inverted and moveable before NN, by means of a sliding piece in which the glass is set or fixed. This illumination is still more increased by the reflection of light from the concave mirror SS, placed at the other end of the box, which causes the light to fall upon the lens NN, as represented in the figure. Lastly, a lens LL, fixed in a sliding tube, is brought to the requisite distance from the object QQ, and a large erect image IM is formed upon the opposite wall.

The camera obscura has the same relation to the telescope as the solar microscope has to the common double microscope, and is thus constructed:

Let CD (fig. 12) represent a darkened chamber perforated at L, where a convex lens is fixed, the curvature of which is such, that the focus of parallel rays falls upon the opposite wall. Then if AB is an object at such a distance that the rays which proceed from any given point of its surface to the lens L may be esteemed parallel, an inverted picture will be formed upon the wall of the pencil which proceeds from A will converge to a, and the pencil which proceeds from B will converge to b, and the intermediate points of the object will be depicted between a and b.

For the use of painters these instruments are now constructed in a very convenient mode. The lens is made to slide in a small wooden box, so as to be easily adjusted to a proper focus; and the image falls upon a plane mirror, placed directly at the back part of the box, from which it is reflected on a piece of ground glass, or on a sheet of white paper extended over. The picture which is thus formed is very tender and beautiful. The moving object serves as the glass; and the outline formed is so perfect that it may be easily traced, even by a person who is little skilled in drawing or perspective.

Of the doctrine of colours, or chromatics. In some of the preceding sections we had occasion to use the word aberration; though we had not then an opportunity of explaining it; since in the optics of the mind, as well as in those of which we are treating, when too many images are present to one, a certain degree of confusion must necessarily manifest itself. As there is no "royal road to science," so philosophy gradually develops her secrets, and the possession of one fact prepares the mind for another.

We have hitherto assumed as a principle that a convex lens unites in one point, which we have called the focus, all the rays proceeding from any given point of an object. If this was exactly the case, the images formed by these glasses would be perfectly distinct and confused. The principle, however, holds strictly true only with respect to those rays which pass nearly through the centre of the lens; for those which pass near the extremities of the glass or edge of the glass, or are distant from the focus, are not so distinct and confused. From this multiplication of images great indistinctness results. To shew the reason of this it is necessary to have recourse to a figure. Let PP then (Plate III. fig. 10) be a convex lens; and let an object, the point E of which corresponds with the axis of the lens, and sends forth the rays EM, EN, EA, EM, and EN, all of which pass through the glass, but in different parts. Now it is manifest, from the principles already explained, that the rays EA, which pass through the middle of the glass, suffer no refraction; the rays EM, EM, also, which pass near to E, will be converged to a focus at F, which we have been accustomed to consider as the focus of the lens. But the rays EN, EN, which are nearer to the edge of the glass, will be differently refracted; and will meet about G, nearer to the lens, where they will form another image GG. Hence it is evident that the first image EF is formed only by the union of these rays which pass very near the centre of the lens; but, in truth, as the rays of light proceeding from every point of an object are very numerous, there is a succession of images formed according to the parts of the object, which produces great indistinctness and confusion; and this is what is meant by the word aberration.

This confusion or dispersion of the rays is increased in proportion as the arcs FAP, GPI, and larger segments of their respective circles: hence in very thick and convex lenses the aberration is such as to be intolerable. Even in the object-glasses of telescopes, though they are made thin, and are segments of large circles, and though from these results the dispersion of the rays may be insensible in itself, still the magnifying power multiplies it as often as the object itself. Hence the greater the magnifying power, the smaller should be the aperture of the object-glass; and when the dispersion of the rays is very great, the defect is in some degree remedied by covering the edge of the lens with an opaque ring; but in this case, while the brightness is retaincd, the transparency of the image is necessarily diminished. Opticians have therefore endeavoured to form such combinations of lenses, both concave and convex, varying in their respective forms, so as to unite all the rays in a single point, and thus present a distinct image. Calculations have been formed for these combinations, but the hand of the artist has never been wanting to bring the speculations of theoretists to the perfection.

The plan most generally adopted by practical opticians is, to combine two shallow lenses together in such a manner that they act as a single lens. They use often plano-convex, for that figure admits of less aberration than any other; but shallow lenses of a double-convex kind will answer. In this combination the lenses are set near together, so that the second lens acts only in bringing the rays which pass through the first to a common focus. Thus in Plate III. fig. 9, AB and CD are the two lenses of this description; and the focus of AB would be at F, but, by the second lens, the rays are made to converge at a common focus, thus forming one single lens of double their magnifying power, with this advantage; that as the curvatures of both are equal, they are less than the curvature of a single lens of equal power, the aberration is greatly lessened.

The aberration which we have been describing results from the spherical form of the glasses; but there is another kind of aberration, which depends immediately upon the nature and properties of light itself. Each ray or beam of light, indeed, which gives us the sensation of white, is found to be compounded of seven other rays; and these component rays are each of them differently refrangible. Hence objects viewed through very convex glasses are often found to have their edges tinged with various colours. This effect was long felt, but it remained for Newton to explain the cause.

In the short history contained in the first article, the theories on colours were briefly related; but it will be satisfactory to the reader to have the experiment described in the words of Newton himself, which will at the same time afford an ex-
ample of the style and manner of this first of philosophers.

"In a very dark chamber, at a round hole F (Plate III. fig. 14), about one-third of an inch broad (says he), made in the shutter of a window, I placed a glass prism ABC, whereby the beam of the sun's light, SF, which came in at that hole, might be refracted upon and toward the opposite wall of the chamber, and there form a coloured image of the sun, represented at P1. The axis of the prism (that is, the line passing through the middle of the prism and the middle of the other end, parallel to the edge of the refracting angle) was in this and the following experiments perpendicular to the incident rays. About this axis I turned the prism slowly; and saw the refracted light on the wall, or coloured image of the sun, first to descend, and then to ascend. Between the descent and ascent, when the image seemed stationary, I stopped the prism, and fixed it in that posture.

"Then I let the refracted light fall perpendicularly upon a sheet of white paper, MN, placed before all of the past chamber; and observed the figure and dimensions of the solar image PT, formed on the paper by that light. This image was oblong, and not oval, but terminated by two rectilinear and parallel sides, and two semicircular ends. On its sides it was bounded pretty distinctly; but on its ends very confusedly and indistinctly, the light there decaying and vanishing by degrees. At the distance of 18 feet from the prism, the breadth of the image was about 2½ inches, but its length was above 10½ inches, and the length of its rectilinear sides about 8 inches; and AGB, the refracting angle of the prism, whereby so great a length was made, was 62°. With a less angle the length of the image was less, the breadth remaining the same. It is farther to be observed, that the rays went on in straight lines from the prism to the image; and therefore at their going out of the prism, and all that is incident to one another from which the length of the image proceeded. This image PT was coloured, and the more eminent colours lay in this order from the bottom at T. The top at P was represented, green, blue, indigo, violet, together with all their intermediate degrees, in a continual succession, perpetually varying."

The philosopher continued his experiments, and by making the rays thus decomposed pass, as was formerly related, through a second prism, he found that they did not admit of farther decomposition; and that objects placed in the rays producing one colour always appeared to be of that colour. He then examined the circumstance of the same incidence at the refraction of these decomposed rays; and found that each of the seven primary colour-making rays, as they may be called, had certain limits within which they might pass. Thus, let the size of incidence in glass be divided into fifty equal parts, the size of refraction into air of the heat and most refrangible rays will contain respectively 77 and 78 such parts. If we take the least degree of red we will have the intermediate degree of magnitude, from 77 to 77½; orange from 77½ to 77¾; yellow from 77¾ to 77; green from 77 to 77½; indigo from 77½ to 77¾; and violet from 77¾ to 78.

According to the properties of bodies in reflecting or absorbing these rays, the colours which we see in them are formed. If every ray falling upon an object was reflected to our eyes it would appear white; if every ray was absorbed it would appear black; between these two appearances innumerable species of colours may be formed by reflection or transmission of the various combinations of the colour-making rays. If the rays also of light were not thus compounded, every object would appear of the same colour, and an homogeneous uniformity would prevail over the face of nature.

"To leave the present, however, for the present, the further prosecution of this subject, and to return to that of the errors arising in optical glasses from the dispersion of the rays of light, it must be evident that, in proportion as any part of a glass bears resemblance to the form of a prism, the component rays must be necessarily separated. The edges of every convex lens approach to this form; and it is on this account that the extremities of objects situated at the ends of the tube are found to be tinged with coloured rays. In reality, as all the different colour-making rays are different re- frangible, in such a glass these different rays will have different focii, and will form their images at different distances from the glass. Thus imagine PP (Plate III. fig. 11) to be a double-convex lens, and OO an object situated at some distance from it. If the object O0 was red, the rays proceeding from it would form an image at Rr; if it were violet, an image of that colour would be formed at Vv nearer the glass; and if the object was white, or any other combination of the colour-making rays, these rays would have their respective foci at different distances from the glass, and form a succession of images, in the order of the prismatic colours, between the space RR and Vv.

This dispersion depends on the focal length of the rays, on the number of colours, and the images occupy being about the 28th part. Thus, if the glass is of 28 feet focus, the space between RR and Vv will be about one foot, and so in proportion. Now when viewed through the eye, or through this same succession of images will seem to form but one image, but that very indistinct, and tinged with various colours; and as the red image RR in the figure is largest, or seen under the greatest angle, the extreme parts of this confused image will be red, and a succession of the prismatic colours will be formed with this red fringe, as is frequently found in telescopes upon the old construction.

"This defect in telescopes was long regarded as without a remedy; but who shall set bounds to the inventive powers of the human mind? It was in the different refractive powers of various media that a remedy was sought for this property in glasses, so adverse to the hopes and wishes of philosophers. Sir Isaac Newton had hinted the practicability of this plan; but he was too deeply engaged in the vast discoveries which the use of the prism had led to, to pursue the idea practically the idea. As water is known to have very different refractive powers from glass, the great Euler, proceeding upon the hint of Newton, projected an object-glass of two lenses, with water between them. The memoir of Euler excited powerfully the attention of Mr. Dollond, a practical optician in London; and after trying the refractive powers of water-glasses in the form of a prism, he conceived that the refractive powers of different glasses might serve to correct each other. He applied himself therefore to examine the qualities of many kinds of glass, and found that the two which differed most essentially in their refractive powers were the common crown or window glass, and the white flint glass. He then formed two prisms, one of the white flint of an angle of about 23 degrees, and another of flint of 29. They refracted very nearly alike, but their power of making the colours diverge was very different. He next ground several others of crown glass, till he procured one which was equal to the divergency of light with that of the flint glass. He placed them together, therefore, in opposite directions, so as to counteract each other; and he found that the rays which passed through was perfectly white. This discovery, it was obvious, was immediately applicable to the object-glasses of telescopes. To make the glasses act as the two prisms, to refract the light in the opposite directions, so that the one must be concave and the other convex, and as the rays are to converge to a real focus, the excess of refraction must be in the convex lens. As the convex lens is to refract most light, it was necessary that it must be of crown glass. He therefore employed two convex lenses of crown glass, with a concave lens of flint glass; and these are the telescopes most in use at present, and well known by the name of achromatic telescopes. Some opticians however, we believe, now construct them with two lenses, one convex and the other concave.

In fig. 13, a and c shew the two convex lenses, and bb the concave one, of this telescope. They are all ground to surfaces of different radii; the concave is to correct the refractive powers of the different kinds of glass, and the intended focal distance of the object-glass of the telescope. According to Boscovich, the focal distance of the parallel rays for the convex and concave, or the convex glass one-third, of the combined focus. When put together they refract the rays in the following manner: Let ab, ab (fig. 18), be two red rays of the sun's light parallel on the first convex lens e. Supposing there was no other lens present but that one, they would then be converged into the lines be, be, and at last meet in the focus q. Let the lines gh, gh, represent two violet rays falling on the surface of the lens. These are also refracted, and will meet in a focus; but as they have a greater degree of refrangibility than the red rays, they must of consequence converge more by the same power of refraction and meet sooner in a focus, suppose at r. Let now the concave lens of flint glass dd be placed in such a manner as to intercept all the rays before they come to their focus in q. In this case the surface of the same polished materials, and ground to the same radius with the convex one, it would have the same power to cause the rays to diverge that the former had to make them converge. In this case, the red rays would become paralle
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I. and move on in the line $a_2$, $o_2$: but the concave lens, being made of flint glass, and upon a shorter radius, has a greater refractive power, and thereby becomes, after they come out of it; and if no third lens was interposed, they would proceed diverging in the lines $a_3$, $o_3$: but, by the interposition of the third lens $c_0$, they are twice made to converge; and next in a focus somewhat more distant than the former, as at $x$. By the concave lens the violet rays are also refracted, and made to diverge; but, having a greater degree of refrangibility, the same power of refraction makes them diverge somewhat more than the red ones; and thus, if no third lens was interposed, they would proceed in such lines as $a_4$, $o_4$. As the differently-coloured rays then fall upon the third lens with different degrees of divergence, it is plain that the same power of refraction in that lens will operate upon them in such a manner as to bring them all together, to a focus, very nearly at the same point. The red rays, most of the blue light, and the yellow rays, though they require the least power of refraction, yet have that of divergence; and thus all meet together at the point $x$, or very nearly so. It was afterwards demonstrated by M. Zeilker of Petersburg, that it is the lead used in the composition of the crown glass, which gives this remarkable property of dispersing the extreme rays; and he found that this property was increased in proportion to the quantity of mica, or red lead, which was employed in the manufacture of the glass.

The more we investigate the works of nature, the greater reason have we to admire the wisdom of its author, and that wonderful adaptation of our organs, in the minute particulars, to the general laws which pervade the universe. The subject before us affords a striking instance to corroborate this remark. We have hitherto supposed the eye to be a lens capable only of enlarging and contracting, and consequently, from the description now given of the rays of light, it must be evident that it is impossible for us to arrive at the first motions which must arise from their different degrees of refrangibility. But here the use of that wonderful structure of parts, and the different fluids in the eye, is clearly seen. The eye is, in fact, a compound lens. Each fluid has its proper degree of refrangibility. The shape of the lenses is altered at will, according to the distance of the object; and the three substances having the proper powers of refrangibility, the effects of an achromatic glass are without difficulty produced by the eye, whose mechanical structure and exact arrangement of substances is it in vain for the art of man to imitate.

From what has been stated, the principal phenomena of colours may, without much difficulty, be explained.

If all the differently-coloured rays which the prism affords are remitted in the focus of a convex lens, the produce will be white; yet these same colours, when taken together, form white, give, after the point of their reunion, that is, beyond the point where they cross each other, the same colours as those which departed from the prism, but in a reversed order, by the crossing of the rays; the reason of which is clear; for the ray being white before it was divided by the prism, must retain the colour of its parts, which the difference of refrangibility had separated, and this reunion cannot in any manner tend to alter or destroy the nature of the colours; it follows then that they must appear unchanged at the point of crossing.

A similar effect will be produced, if the dispersed rays are received from the prism upon a concave reflector. In the focus of the reflector they will unite and form the white or reflected light.

In the same manner, if we mix a certain proportion of red colour with orange, yellow, blue, indigo, and violet, a colour will be produced which resembles that which we call the rainbow, and which, together with white, and which would be entirely white if some of the rays were not lost or absorbed by the grossness of the colouring matter.

A colour nearly approaching to white, is also formed by colouring a piece of round glass with the different prismatic colours, and causing it to be turned round so rapidly, that no particular colour can be perceived.

If to a single ray of the sun, divided by the prism, which will then form an oblong divided spectrum, we admit one of the primitive colours is applied, for example red, the light which passes through will appear red only, and will form a round image.

The component rays of light may be separated by other means than by the prism. It is a common amusement of children to blow round bubbles of soap, dissolved in water, from the bowl of a tobacco-pipe; and these bubbles will, in the sunshine, contain a vast number of the rays of the spectrum. Indeed the same thing may be at any time observed in the bubbles made by agitating soap and water. As these bubbles are thin vesicles of the matter dissolved in the fluid, they are commonly supposed to vary in their thickness, and to act in this way in separating the rays. If two pieces of glass, also of an unequal surface, are gently pressed together, round the point of contact circles of different colours will be formed. Sir Isaac Newton employed for this experiment the object-glasses of two telescopes of a long focus, which is well known are much less convex than the convex power, and produced in a glass convex for a telescope of 14 feet, and the other a double-convex for one of 50 feet. Upon pressing the glasses close together, at the point of contact circles of coloured light appeared, and they increased in number and variety as the pressure was increased. The order of the colours next to the point in contact, which was black, was blue, yellow, white, yellow, and red. Without this circle another appeared, consisting of violet, blue, green, yellow, and red. A third succeeded of purple, blue, green, yellow, and red; and a fourth of green and red. The outer circles were paler, and more obscure, than those within.

The appearance of these circles is delineated in Fig. 15, where $a$, $b$, $c$, $d$, $e$, $f$, $g$, $h$, $i$, $m$, $n$, $o$, $p$, $q$, $r$, $s$, $t$, $u$, $x$, $y$, $z$; denote the colours in order from the centre, namely, black, blue, green, yellow, red, purple, blue, green, yellow, red, green, red: greens blue, red; greens blue, red; dish-white.

Various theories have been offered to account for this separation of the rays, but none of them are quite satisfactory. Perhaps if Mr. Deleval's experiments on transmitted and reflected light were carefully pursued, they might afford some illustration of the phenomenon.

If two thick glasses, the one red and the other green, are placed one upon another, they will produce a perfect opacity, though each of them, taken separately, is transparent; because the one permits the red rays only to pass through it, and the other green ones; therefore with these two glasses united, neither of those kinds of rays can reach the eye; because the first permits only red rays to pass, and green ones are the only rays which the second can transmit.

If the rays of the sun are to fall very obliquely upon the interior surface of a prism, the violet-coloured rays will be reflected, and the red, $&c.$, will be transmitted; if the obliquity of incidence is augmented, the blue will also be reflected, and the red transmitted; the reason of which is, that the rays which have the most refrangibility are also those which are the easiest reflected.

In whatsoever manner we examine the colour of a single prismatic ray, we shall always find, that neither refraction, reflection, nor any other means, can make it forego its natural hue; but if we examine the artificial colouring of bodies by a microscope, it will be seen that there is an infinite variety of colours, unequally mixed. If we mix a blue and yellow to make a common green, it will appear moderate: beautiful to the naked eye; but when we regard it with microscopic attention, we shall observe that the outer rim of the yellow and blue parts, each particle reflecting but one separate colour.

Of the rainbows, and other remarkable phenomena of light.—Since the rays of light are found to be decomposed by refracting surfaces, we can no longer be surprised at the changes produced in any object by the intervention of another. The vivid colours which gild the rising or the setting sun, must be equally different from those which adorn its noon-day splendour. There must be the greatest variety which the brightest fancy can imagine. The clouds will assume the most various forms, or will pour with the darkest blues, according to the different rays which are reflected to our eyes, or the quantity absorbed by the vapours in the air. The ignatim promontory will necessarily be alarned by the sights in the heavens; by the clouds of smoke at one time of three, at another of five, some of circles of various magnitudes round the sun or moon, and those coexisting that congruity and changes, which, in such an event, must take place in the physical or the moral world, some fall of colour, or tremendous earthquake, while the optician...
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contemplates them merely as the natural and beautiful effects produced by clouds or vapours in various masses upon the rays of light.

One of the most beautiful and common of these appearances deserves particular investigation, as when this subject is well understood, there will be little difficulty in accounting for a similar nature, dependent on the different refrangibility of the rays of light. Frequently, when our backs are turned to the sun, and there is a shower either around us, or at some distance before us, a bow seen in the air, adorned with all or some of the seven primary colours. The appearance of this bow, in poetical language called the iris, and in common language the rainbow, was an inexplicable mystery to the ancients; and, though now well understood, continues to be the subject of admiration to the peasant and the philosopher.

We are indebted to Sir Isaac Newton for the explanation of this appearance; and by various easy experiments, we may convince any man that his theory is founded on truth.

If a glass globe is suspended in the strong light of the sun, it will be found to reflect the different primary colours exactly in proportion to the position in which it is placed; in other words, agreeably to the angle which it forms with the spectator's eye and the incidence of the rays of light. The fact is, that, suppose the rays of the sun to fall on the surface of the globe, and each of these is separated as by a prism. To make this matter still clearer, let us suppose the circle BAW (Plate III. fig. 10) to represent the globe; or a drop of rain in the air, considered as a small globe of water. The red rays, it is well known, are least refrangible; they will therefore be refracted, agreeably to their angle of incidence, to a certain point A in the more distant part of the globe; the yellow, the green, the blue, and the purple rays, will each be refracted to another point. A part of the light, as refracted, will be transmitted, but a part will also be reflected; the red rays will point A, and the others at certain other points, agreeably to their angle of reflection.

It is very evident that if the spectator's eye is placed in the direction of MW, or the course of the red-making rays, he will distinguish the red colour; if in another situation, he will see only by the yellow rays; in another by the blue, &c; but as in a shower of rain there are drops at all heights and all distances, all those that are in a certain position with respect to the spectator will reflect the red rays, all those in the next station the orange, those in the next the green, &c.

To avoid confusion let us, for the present, imagine only three drops of rain, and three degrees of colours in the section of a bow (Plate III. fig. 20). It is evident that the angle EAP is less than the angle AEP, and that the angle AEP is the greatest of the three. This largest angle then is formed by the red rays, the middle one consists of the green, and the smallest is the purple. All the drops of rain, therefore, that happen to be in a certain position to the eye of the spectator, will reflect the red rays, and form a band or semicircle of red; those again in a certain position will present a band of green, &c. If he alters his station, the spectator will still see a bow, though not the same bow as before; and if there are many spectators they will each see a different bow, though it appears the same.

There are sometimes seen two bows, one formed as has been described, the other appearing externally to embrace the primary bow, and which is sometimes called a secondary or false bow, because it is fainter than the other; and what most remarkably is, that in the false bow the order of the colours appears always reversed.

In the true or primary bow we have seen that the rays of light arrive at the spectator's eye after two refractions and one reflection; in the secondary bow the rays are sent to our eyes after two refractions and two reflections, and the order of the colours is reversed, because in this latter case the light enters at the inferior part of the drop, and is transmitted through the superior. Thus (fig. 19) the ray of light which enters at B is refracted to A, whence it is reflected to P, and again reflected to W, where it is refracted to M. The angles between the incident and emergent rays SLM is equal to SMW, and SMM, the height of the bow, is equal to the difference between the angle made by the incident and emergent rays and the height of the sun. In this case the angle SMN, for the red rays, is equal to 42° 30', because the violet rays it is equal to 53° 17'; consequently the upper part of the secondary bow will not be seen when the sun is above 54° 7' above the horizon, and the lower part of the bow will not be seen when the sun is 50° 7' above the horizon.

In the same manner innumerable bows might be formed by a greater number of reflections within the drops; but as the secondary is so much fainter than the primary, that all the colours in it are seldom seen, for the same reason a bow made with three reflections would be fainter still, and in general altogether imperceptible. Since the rays of light, by various refractions and refractions, are thus capable of forming, by means of drops of rain, the bows which we so frequently see in the heavens, it is evident that there will be not only solar and lunar bows, but all the striking appearances will be produced by drops of rain on the surface of the water. Thus a lunar bow will be formed by the moon affected by drops of rain; and as its angles and its colours are in comparison with that of the sun, such a bow will be very seldom be seen and the colours of it, when seen, will be faint and dim.

The marine or sea bow is a phenomenon sometimes observed in a much angulated sea; when the wind, sweeping part of the tops of the waves, carries them aloft, so that the sun's rays, falling upon them, are refracted, &c, as in a common shower, and paint the colours of the bow.

Rohault mentions coloured bows on the grass, formed by the refraction of the sun's rays in the morning dew.

Dr. Langwith, indeed, once saw a bow lying on the ground, the colours of which were almost as lively as those of the common rainbow. It was extended several hundred yards. It was not round, but oblong, being, as he conceived, the portion of an hperbola. The wind had swept up less space, and were much more lively, in the bow which were near him than in those which were at a distance.

The drops of rain descend in a globular form, and hence we can easily account for
the effects produced by them on the rays of light; but in different states of the air, instead of drops of rain, vapour falls to the earth in different forms of sheet, snow, and hail. In the two latter states there is a reflection of light; but in the former state, when a drop is partly in a condensed and partly in a fluid form, the rays of light will be differently affected, both from the form of the drop itself, and from its absorbing powers. Hence we may expect a variety of curious appearances in the heavens; and to these drops, in different states, we may attribute the formation of haloes, parhelia, and many other phenomena, detailed in the Philosophical Transactions, or in the histories of every country.

The halo, or corona, is a luminous circle surrounding the sun, the moon, a planet, or a fixed star. It is sometimes quite white, and sometimes coloured like the rainbow. Those which have been observed round the moon or stars are but of a very small diameter; those round the sun are of different magnitudes, and sometimes immensely great. When colours are formed it is generally less than those of the rainbow, and appear in a different order, according to their size. In those which Sir Isaac Newton observed in 1669, the order of the colours, from the inside next the sun, was in the innermost white, blue, red; in the middle purple, blue, green, yellow, pale red; in the outermost pale blue, and pale red. Huygens observed one red next the sun, and pale blue at the extremity. Mr. Wiedler has given an account of one yellow on the inside, and white on the outside. In France one was observed, in which the order of the colours was white, red, blue, green, and a bright red on the outside.

Artificial coronas may be made in cold weather, by placing a lighted candle in the midst of a cloud of steam; or if a glass window is breathed upon, and the flame of a candle placed at some distance from the window, while the operator is also at the distance of some feet from another part of the window, the flame will be surrounded with a coloured halo.

When M. Bouguer was on the top of mount Pichon, in order to observe the parhelion which accompanied him, observed a most remarkable phenomenon. When the sun was just rising behind them, and a white cloud was about thirty paces from them, each of them observed his own shadow (and no other) projected upon it. All the parts of the shadow were distinct; and the head was adorned with a kind of glory, consisting of three or four concentric crowns, of a lively colour, each exhibiting all the various tints of the primary rainbow, and having the circle red on the outside.

Similar to this appearance was one which occurred to Dr. M'Fart, in Scotland. This gentleman observed a rainbow round his shadow, in a mist, when he was situated on so eminence above it. In this situation the whole country appeared to be immersed in a vast deluge, and nothing but the tops of hills appeared here and there above the flood; at another time he observed a double range of colours round his shadow.

The parhelia, or mock suns, are the most splendid appearances of this kind. We find these appearances frequently adverted to by the ancients, who generally considered them as formidable omens. Four mock suns were seen at once by Scheiner at Rome, and by M. Newton in the same place; and were observed by Hevelius at Sedan, in 1691.

The parhelia generally appear about the size of the true sun, not quite so bright, though they are said sometimes to rival their parent luminaries in splendour. When there are a number of them the rays are not equal to each other in brightness. Externally they are tinged with colours like the rainbow. They are not always round, and have sometimes a long fiery tail opposite the sun, but paler towards the extremity. Dr. Halley observed one with tails extending both ways. Mr. Wiedler saw a parhelion with one tail pointing up and another downward, a little crooked; the limb which was farthest from the sun being of a purple colour, the other tinged with the colours of the rainbow.

Coronas generally accompany parhelia: some coloured, and others white. There is also, in general, a very large white circle, parallel to the horizon, which passes through the parhelia, and, if it was entire, would go through the centre of the sun: sometimes there are arches of smaller circles concentric to this, and touching the coloured circles at the extremity; the latter were tinged with colours, and contain other parhelia.

One of the most remarkable appearances of this kind was that which was observed at Rome by Scheiner, as intimated above; and they may serve as a sufficient instance of the parhelion.

This celebrated phenomenon is represented in Plate III. fig. 17, in which A is the place of the observer, B his zenith, C the true sun, and AB a plane passing through the observer's eye, the true sun, and the zenith. About the sun C there appeared two concentric rings, not complete, but diversified with colours. The lesser of these, D, was fuller, and more perfect; and though it was not large enough to contain the sun, nor could it be perfectly accounting to unite, and sometimes they did so. The outer of these rings was much fainter, so as scarcely to be discernible. It had, however, a variety of colours, and the third circle, KLMN, was very large, and entirely white, passing through the middle of the sun, and everywhere parallel to the horizon. At first this circle was entire; but towards the end of the phenomenon it was weak and ragged, so as hardly to be perceived from M towards N.

In the intersection of this circle and the outward iris GKI, there broke out two parhelia, or mock suns, N and K, not quite perfect, K being rather weak, but N quite bright, and stronger. The brightness of the middle of them was something like that of the sun; but towards the edges they were tinged with colours like those of the rainbow, and they were uneven and ragged. The parhelion N was a little wavering; and sent out a spiked tail NP, of a colour somewhat fiery, the length of which was continually changing.

The parhelia at L and M, in the horizontal ring, were not so bright as the former, but were rounded, and white, like the circle in which they were placed. The parhelion N disappeared before K; and while M grew fainter, K grew brighter, and vanished the last of all.

It is to be observed farther, that the order of the colours in the circles DEF, GKN, was the same as in the common halos, namely, red next the sun; and the diameter of the inner circle was about 43°, which is the usual size of a halo.

Parhelia have been seen for one, two, three, and four hours together; and in North America they are said to continue some days, and to be visible from sun-rise to sunset. When they disappear it sometimes rains, or snows; but in the latter part of this phenomenon, Mr. Wales says, that at Churchill, in Hudson's bay, the rising of the sun is always preceded by two long streams of red light. These rise as the sun rises; and, as they grow longer, begin to bend towards each other, till they meet directly over the sun, forming there a kind of parhelion, or mock sun.

These two streams of light, he says, seem to have their source in two other parhelia, which rise with the true sun; and in the winter season, when the sun never rises above the horizon, the screen of ice which is constantly found near the horizon, all these accompany him the whole day, and set with him in the same manner as they rise. Once or twice he saw a fourth parhelion under the true sun; but this, he adds, is not common.

The cause of this is apparently the reflection of the sun's light and image from the thick and frozen clouds in the northern atmosphere, accompanied also with some degree of refraction. To enter upon a mathematical analysis of these phenomena, it could be only tedious, and very foreign to our purpose. From what has been said upon this subject it is evident, that all the phenomena of colours depend upon two properties of light, the refrangibility and reflectibility of its rays.

Of the Inflection of Light.—The direction of the rays of light is changed, as we have seen, in their approach to certain bodies, by reflection and refraction; and, generally, we must admit that there is some power in these bodies by which such effects are universally produced. If reflection was produced by the impingement of particles of light on hard or elastic bodies, if the bodies were in themselves elastic, the same effects would follow as in the impulse of other elastic bodies; but the angle of incidence could not be equal to the angle of reflection, unless the particles of light were perfectly elastic, or the bodies on which they impinged were perfectly elastic. Now we know that the bodies on which these particles impinge are not perfectly elastic; and also that if the particles of light were perfectly elastic, the diffusion of light from the reflecting bodies would be very different from its present appearance: for as no body can be perfectly polished, the particles of light, which are so inconceivably small, would be reflected back in the fortuitous lines on the surface in every direction; consequently we are led to this conclusion, that the reflecting bodies have a power which acts at some little distance from their surfaces.

If this reasoning is allowed to be just, it necessarily follows, that if a ray of light, instead of impinging on a body, should pass so
near to it as to be within the sphere of that power which the body possesses, it must necessarily suffer a change in its direction. Actual experiments confirm the truth of this position; and to the change in the direction of a particle of light, owing to its nearness to a body, we give the name of inflection.

From this point the eyes and looking at a candle, there appear rays of light extending from it in various directions, like comets' tails; for the light, in passing through the eye-lashes, is inflected; and consequently the image formed by sir Isaac Newton, the whole of this subject will be easily understood. At the distance of two or three feet from the window of a darkened room, in which was a hole three-fourths of an inch broad, let a hole in the black board, a black sheet of pasteboard, having in the middle a hole about a quarter of an inch square, and behind the hole the blade of a sharp knife, to intercept a small part of the light which had otherwise have passed through the hole. The planes of the pasteboard and blade were parallel to each other; and when the pasteboard was removed at such a distance from the window, that all the light passing through the hole in the pasteboard, he received what came through this hole on a piece of paper two or three feet beyond the knife, and got a shadow arising out both ways from the beam of light into the shadow. As the brightness of the direct rays obscured the fainter light, by making a hole in his paper he let them pass through, one coming closely to the two streams, which were nearly equal in length, breadth, and quantity of light. That part which was nearest to the sun's direct light was pretty strong for the space of about a quarter of an inch, decreasing gradually till it became imperceptible; and at the edge of the knife it subtended an angle of about twelve, or, at most, fourteen degrees.

OFFSET. An object has then placed opposite to the former, and he observed, that when the distance of their edges was about the four-hundredth part of an inch, the stream divided in the middle, and left a shadow between the two, and then, as the edge was so dark, that all light passing between the knives seemed to be bent aside to one knife or the other; as the knives were brought nearer to each other, this shadow grew broader, till upon the contact of the knives the whole light disappeared.

Pursuing his observations upon this appearance, he perceived fringes, as they may be termed, of different-coloured light, three wide on one side by the edge of one knife, and three on the other side by the edge of the other; and thence concluded, that as in refraction the rays of light are differently acted upon, so are they at a distance from both the knives, of a quarter of an inch, in their other experiments of the same kind he supported his position, which is confirmed by all subsequent experiments.

We may naturally conclude, that from this property of inflection some curious changes will be produced in the appearances of external objects. If we take a piece of wire of a less diameter than the pupil of the eye, and place it between the eye and a distant object, the following experiment (Plate III. fig. 21). Let A be a church-steeple, B the eye, C the wire. The rays by which the steeple would have been otherwise seen are intercepted by the wire; and it is now seen by refracted rays, which make a greater angle than the direct rays, and consequently the steeple will be magnified.

In nearly cutting the eyes and looking at a candle, there appear rays of light extending from it in various directions, like comets' tails; for the light, in passing through the eye-lashes, is inflected; and consequently the image formed by sir Isaac Newton will appear in other objects which are seen by the means of inflected rays.

In this section of bodies upon light, we come to this general conclusion, for which we are indebted to our great philosopher; that light, as well as all other matter, is acted upon at a distance.

ORCHIS. A genus of the family Orchidaceae, of which the most remarkable species is the autumn crocus, or Colchicum autumnale, a perennial bulbous plant, with a long narrow oblong cup-shaped leaf, and a cluster of large oblong pointed flowers. The species of this genus show great variety, and are remarkable for the beauty of their flowers, and the great length of their leaves. The flowers are usually large, and the petals are generally of a rich color, and often of different colors in the same flower, as purple, red, brown, and dark-striped. The flowers of the orchis species are peculiarly adapted for their own propagation, and are often of different colors in the same flower, as ash-colour, red, brown, and dark-striped.

All the orchises are very hardly perennials, with bulblous fleshly roots. The flowers appear in May, June, and July, and principally in June: their mode of flowering is universally in spikes, many flowers in each spike; and each flower is composed of five petals in the form of a campanula. At the foot of the flower, as it is called, there is a large purple spot, which is called the nectar, and is often of different colors in the same flower, as ash-colour, red, brown, and dark-striped.
ORE

diet of the inhabitants of Turkey, Persia, and Syria. From it is made the alimentary powder called salep; which, prepared from foreign roots, is sold in the shawlings per pound, and might be furnished by ourselves at a sixth part of that price, if we chose to pay any attention to the culture of this plant. The orichs mascula is the most valued for this purpose, A dry, and not very fertile soil, is best adapted to its growth.

The proper time for gathering the roots is when the seed is formed, and the stalk is ready to fall; because the new bulb, of which the salep is made, is then near to its full maturity, and may be distinguished from the old one, by a white bud rising from the top of it, which is the germ of the orichs of the succeeding year.

ORDENAL, a form of trial, or of discovering innocence or guilt, formerly practised over almost all Europe, and which prevailed in England from the time of Edward the Confessor, till it was abolished by a declaration of Henry III. It was called purgation undergrows, in which an accused person was exposed to hell, or combat, the other form of purgation.

In England an attender, on being arraigned, and pleading Not guilty, had in his choice to put himself upon God and his country; he was then subject to the verdict of a jury; or upon God alone, on which account it was called the judgment of God, it being presumed that God would deliver the innocent. The more popular kinds of ordeal were those of red-hot iron and water; the first for freemen and people of fashion, and the last for peasants. Fire ordeal was performed either by taking up in the hand a piece of red-hot iron, of one, two, or three pounds weight, or else by walking barefoot and blindfold over nine red-hot ploughshares, laid at unequal distances; and if the party escaped unhurt he was adjudged innocent, if not he was condemned as guilty. Water ordeal was performed either by plunging the bare arm up to the elbow in boiling water, and escaping unhurt thereby; or by casting the person suspected into a river or pond of water; and if he fainted therein, without any action of the limbs, it was deemed an evidence of his guilt; but if he sunk he was acquitted. 4 Black, 340.

ORDER. See Architecture.

ORDERS, or ORDAINATION. No person shall be admitted to the holy order of deacon under 23 years of age; nor to the order of priest unless he be 24 complete; and none shall be ordained without a title, that is, a nomination to some cure or benefice, and he shall have a testimonial of his good behaviour, for three years past, from three clergymen; and the bishop shall examine him, and if he see cause may refuse him. And before he is ordained he shall take the oath of allegiance and supremacy before the ordinary, and subscribe the thirty-nine articles.

ORDINARY, in common and canon law, is one who has ordinary or immediate jurisdiction in ecclesiastical causes in such a place.

ORDINATIVES, or ORDINATE APPL.

ORE

Cates, in geometry, are parallel lines, MM, nn (Plate Miscell. fig. 178), terminating in a curve, and intersected by a diameter, as AD.

ORDINANCE, a general name for all sorts of great guns used in war. See GUN

ORDINANCE, boring of. Guns are thus bored: the piece A (Plate Observatory, fig. 7) is placed upon two standard BS, by means of two journeys, turned round by a water-wheel; the breech D being introduced into the central line of the wheel, with the muzzle towards the sliding carriage K, which is pressed forwards by a ratchet F and weights. Upon this sliding carriage is fixed, truly horizontal and central to the gun, the drill-bar G, to the end of which is fixed a carp's tongue drill or cutter H; which, being pressed forward upon the piece whilst it is turning round, perforates the bore, which is afterwards finished with bars and cutters.

The machinery for boring of ordnance is sometimes put in motion by a steam-engine: and in this way, from 18 to 24 great guns have been boring at the same time; the boring piece being brought up to its proper place in the gun, by a lever and weights. In this method of bringing up the bore the pressure may always be made equal, and the motion of the bore regular; but the disadvantage is, that without due attention the bore may work up too far towards the breach, and the piece be spoiled. In the royal arsenal at Woolwich, only one piece is bored at a time in the mill: the gun to be bored lies with its axis parallel to the horizon, and in that position is turned round its axis by means of wheel-work, moved by one or more horses. The bore is laid, as above described, in the direction of the axis of the gun, and is incapable of motion in any direction except that of its length; and in this direction it is constantly moved by means of a small rack-wheel, kept in proper motion by two men, who thus make the point of the bore so to bear against the part of the gun that is boring, as to pierce and cut it. The outside of the gun is smoothed at the same time by men with instruments fit for the purpose, whilst it turns round, so that the bore may be exactly in the centre of the metal. See Gregory's Mechanics.

ORDINANCE, office of; an office kept within the Tower of London, which superintends and disposes of all the arms, instruments, and ordnance of war, both by sea and land, in all the magazines, garrisons, and forts, in Great Britain.

ORES, METALLIC. This class comprehends all the mineral bodies, composed either entirely of metals, or of which metals constitute the most considerable and important part. It is from the minerals belonging to this class that all metals are extracted; for this reason they have obtained the name of ores.

As the metals at present known amount to 23, we shall divide this class into 23 orders, allotting a distinct order for the ores of every particular metal.

Metals exist in ores in one or other of the following states: 1. In a metallic state, and either solitary, or combined with each other. 2. Combined with sulphur. 3. In the state of oxides. 4. Combined with acids.

Each order therefore may be divided into the four following genera:

1. Alloys.
2. Sulphures.
3. Oxides.
4. Salts.

It must be observed, however, that every metal has not hitherto been found in all those four states, and that some of them are hardly susceptible of them all. Some of the orders, therefore, want one or more genera, as may be seen from the following table, taken from Dr. Thomson's incomparable work on chemistry; a work of which every student of that science, or of natural philosophy, ought to be possessed.

ORDER I. Gold.
1. Alloys.

ORDER II. Platinum.
1. Alloys.

ORDER III. Silver.
1. Alloys.
2. Sulphures.
3. Oxides.
4. Salts.

ORDER IV. Mercury.
1. Alloys.
2. Sulphures.
3. Oxides.
4. Salts.

ORDER V. Copper.
1. Alloys.
2. Sulphures.
3. Oxides.
4. Salts.

ORDER VI. Iron.
1. Alloys.
2. Sulphures.
3. Oxides.
4. Salts.

ORDER VII. Tin.
1. Sulphures.
2. Oxides.
3. Salts.

ORDER VIII. Lead.
1. Sulphures.
2. Oxides.
3. Salts.

ORDER IX. Nickel.
1. Sulphures.
2. Oxides.
3. Salts.

ORDER X. Zinc.
1. Sulphures.
2. Oxides.
3. Salts.

ORDER XI. Antimony.
1. Alloys.
2. Sulphures.
3. Oxides.
4. Salts.

ORDER XII. Bismuth.
1. Alloys.
2. Sulphures.
3. Oxides.
4. Salts.

ORDER XIII. Tellurium.
1. Alloys.

ORDER XIV. Arsenic.
1. Alloys.
2. Sulphures.
3. Oxides.
4. Salts.
Order XV. Cobalt.
1. Alloys.
2. Sulphures.
3. Oxides.
4. Salts.

Order XVI. Manganese.
1. Oxides.
2. Salts.

Order XVII. Tungsten.
1. Oxides.

Order XVIII. Molibdenum.
1. Sulphures.

Order XIX. Uranium.
1. Oxides.

Order XX. Titanium.
1. Oxides.

Order XXI. Chromium.
1. Oxides.

Order XXII. Columbium.
1. Alloys.

Order XXIII. Tantalium.
1. Oxides.

Ores, analysis of. The diversity of metallic ores is so great, that no general method of analysis can be given. We shall therefore follow the different orders, and point out the proper method of analysing each. In the rules we shall follow Bergmann, in whom we are indebted for the first precise treatise on the analysis of ores, except when his methods have been superseded by the improvements of succeeding chemists.

Gold ores. The presence of gold may easily be detected by treating the mineral supposed to contain it with nitro-muriatic acid, and dropping muriat of tin into the solution. If the solution contains any gold, a purple precipitate immediately appears.

Native gold ought to be dissolved in nitro-muriatic acid: the silver, if any is present, falls to the bottom in the state of muriat, and may be separated by filtration, and weighed. Pour the solution into a retort, and the gold is precipitated in the metallic state. The copper, if any is present, may be precipitated by means of a plate of iron. The presence of iron may be ascertained by dropping a little of iron filings into a portion of the solution.

The auriferous pyrites may be treated with diluted nitric acid, which dissolves the silver, leaving the greater part of the sulphur undissolved. The residue of the muriat to be dried, and then the sulphur burnt off. The loss of weight gives the sulphur. The residue, if any, is undissolved muriat, to be treated as at first. The silver is to be precipitated by common salt; and the other metals, if any are present, may be ascertained as above.

Part of the sulphur is always acidified. The acid thus formed may be precipitated by nitric acid, 100 parts of the dried precipitate indicating about 14.5 of sulphur.

4. Sulphuret of silver is to be treated with diluted nitric acid, which dissolves the silver, leaving the greater part of the sulphur undissolved. The residue of the muriat to be dried, and then the sulphur burnt off. The loss of weight gives the sulphur. The residue, if any, is undissolved muriat, to be treated as at first. The silver is to be precipitated by common salt; and the other metals, if any are present, may be ascertained as above.

Part of the sulphur is always acidified. The acid thus formed may be precipitated by nitric acid, 100 parts of the dried precipitate indicating about 14.5 of sulphur.

The nitric solution was green. Common salt occasioned a precipitate which weighed 67.75, equivalent to 63.81 of pure silver. After dissolving this muriat of silver, sulphate of soda occasionally precipitate. Therefore the solution contained no lead. When supersaturated with soda, a grey precipitate fell, weighing five parts. On burning, this precipitate gave out an arsenical smell. It was reduced in nitric acid; sulphated alkali occasioned a smutty brown precipitate; and prussic alkali a Prussian blue, which after torrefaction was magnetic. Hence he concluded, that these five parts were a combination of iron and arsenic acid.

The nitric solution which had been supersaturated with amonia was blue; he therefore suspected that it contained copper. To discover this, he saturated it with sulphuric acid, and put it into a polished plate of iron. The quantity of copper was so small, that none could be collected on the iron.

5. Sulphuret of silver may be analysed as No. 3, precipitating the copper by means of a plate of iron.

6. Black silver ore may be analysed as No. 2, separating the copper, it any is present, by the methods of an iron plate, and estimating the carboxylic acid that escapes when the ore is heated or dissolved in nitric acid.

7. Red silver was analysed by Vaucouleurs in the following manner: one hundred parts of it were digested in 300 parts of nitric acid previously diluted with undersaturated residuum, being washed and dried, weighed 42.66. Being treated with muriatic acid, it was all dissolved except 14.60 parts, which were sulphur. The muriatic solution, which, when dissolved with a great quantity of water, deposited a white powder, which weighed 21.25, and was oxide of antimony. The nitric acid solution remained still to be examined. Muriatic acid occasioned a heavy precipitate, which weighed 72.60 parts, and which was muriat of silver. Reagents showed that the acid retained no other substance of solution.

8. Muriat of silver was analysed by Klaproth: one hundred parts of it were mixed with 200 parts of the residuum of potas, and melted together in a glass retort. The mass was dissolved in water, and the solution filtered. A residuum remained, which was dissolved in nitric acid, with the exception of a red precipitate, which, when redissolved in nitric acid, was dissolved, except a little muriat of silver, which, when reduced, yielded .5 of pure silver. Ammonia precipitated from the nitro-muriatic solution 2.5 parts of oxide of iron. The nitric solution was precipitated by common salt; the muriat of silver, thus obtained, yielded, when reduced, 67.25 of pure silver.

The original aqueous solution of the alkaline mass was saturated with acetic acid, on which it deposited 1.75 parts of alumina. The solution was evaporated to dryness, and the dry mass treated with alcohol, which dissolved the acetate of potas. The residuum, 1.75 parts, was dissolved in water, and being treated with muriat of barytes, 15 parts of sulphate of barytes precipitated, indicating the presence of about .5 of sulphuric acid, or .75 sulphat of potas. Evaporating 30 parts were muriat of potas, indicating about 21 parts of muriatic acid.
Ores of mercury. We have very few exact analyses of the ores of mercury, owing, perhaps, to the facility with which the mercury is extracted from them by distillation.

Native mercury and amalgam may be dissolved in nitric acid. The gold, if any is present, remains in the state of powder, and may be estimated by its weight. The addition of water precipitates the bismuth, if the solution happens to contain any. Common salt precipitates the silver, and also part of the mercury; but the latter may be redissolved by a sufficient quantity of water, or which is far better, of oxyacids from, while the muriatic acid and calcium magnesia, while the muriol of silver remains insoluble. Lastly, the mercury may be precipitated by sulphate of iron, and estimated.

2. Native cinnabar may be treated with a mixture of nitric and muriatic acid, one part nitric acid, which dissolves the mercury, and leaves the sulphur. The mercury may be estimated as in the last paragraph.

3. Hepatic mercurial ore has not been analysed. Its analysis may be attempted as in No. 2, by dissolving it in nitric acid.

4. Muriol of mercury may be digested in muriatic acid till the whole is dissolved. Muriol of barytes precipitates the sulphuric acid, 100 parts of which are equivalent to 150 of sulphate of mercury; and the proportion of this salt being known, we have that of the muriol.

Ores of copper. Native copper sometimes contains gold, silver, or iron. It may be dissolved in nitric acid; the gold remains in the state of a blackish or rather violet-coloured powder; the silver may be separated by a polished plate of copper (or it may be precipitated from a separate portion of the solution by common salt); the iron may be separated by boiling the solution to dryness, and treating the residuum with water. By this process, the nitrate of iron is decomposed; the oxide of iron remains, while the water dissolves the nitrate of copper. This last salt may be decomposed by boiling it with potash; the precipitate being reduced, and the solution in water, the iron is separated; and the copper may be estimated as in the last paragraph; or muriatic acid may be used instead of nitric; but in that case it is more difficult to obtain a complete solution.

2. Sulphur of copper may be dissolved in dilute nitric acid. Part of the sulphur remains by estimating its weight, killing it, and burning off part. Part is acidified, and may be precipitated by nitrate of barytes; 100 parts of the dry precipitate indicating 1.45 of sulphur. By evaporation to dryness, and solution in water, the copper is separated; and the copper may be estimated as in the last paragraph; or muriatic acid may be used instead of nitric; but in that case it is more difficult to obtain a complete solution.

3. Grey copper ore was analysed by Klaproth in the following manner: three hundred parts of it were digested with four times their weight of nitric acid. This operation was repeated, and the two acid liquids mixed. The unconsidered residue was 188 parts. The nitric solution was green, and when common salt was added to it, muriate of silver precipitated. The solution being now supersaturated, by the mixture of 9.5 parts of the mercuric red precipitate were obtained, which was found to be composed of silica, alumina, and iron, by dissolving it in muriatic acid, and proceeding by the rules laid down in the first section. A polished iron plate precipitated from the nitric solution 89 parts of copper.

Ores of iron. Notwithstanding the great variety of iron ores, they may be all, as far as analysis is concerned, arranged under three heads; namely, 1. Sulphurets; 2. Oxides; and 3. Salts.

1. Pyrites, or sulphuret of iron, may be treated repeatedly with boiling nitric acid till the sulphur is acidified. Muriatic acid is then to be added, and the digestion continued till the whole is dissolved. Muriol of barytes is then to be added to precipitate the sulphuric acid; 100 of the dried precipitate indicates 1.45 of sulphur. If the solution contains only iron, it may be yielded by carbonat of soda, calcined to redness, and weighed. But if earths or manganese are present, we must proceed by the rules laid down in the first section.

2. If the oxides of iron are pure, that is, contain nothing but iron, we have only to dissolve them in muriatic acid, and precipitate them as above. It is very seldom that ores possess this perfect degree of purity. The iron is usually combined with manganese, alumina, silica, or with all of these together. The analysis is to be conducted exactly according to the rules already laid down.

3. The sparry iron ore may be analysed in the same manner, excepting only that the carbonic acid gas must be separated by distillation or solution in close vessels.

4. Arseniate of iron was analysed by Mr. Chenevix in the following manner: one hundred parts of it were boiled with potash till the arsenic acid was separated. Nitrate of lead was mixed with the solution; 100 parts of the precipitate indicated 35 of arsenic acid. That part of the arsenic acid which is not precipitated by the action of the potash was treated with muriatic acid; the undisolved resinum was silica. The muriatic acid was supersaturated with ammonia. The iron precipitated; but the copper was dissolved by the ammonia.
of soda, yielded 25 parts of sulphat of lead, ≈ 20.2 parts of lead. The liquor thus freed from lead was treated with ammonium. The precipitate obtained weighed 39 parts. It consisted of oxide of iron mixed with oxide of ammonia, and a portion of the solution of the acid precipitated it and induced Vauquelin to consider the lead as in the state of peroxide.

3. Carbonat of lead was thus analysed: One hundred grains were thrown into 200 grains of nitric acid, and heated with 300 grains of water. It dissolved completely with effervescence. The loss of weight was 10 grains. It was equivalent to the carbonic acid. The solution, which was colourless, was diluted with water, and a cylinder of zinc put into it. In 24 hours the lead was precipitated in the metallic state. It weighed 77 grains, ≈ 82 grains oxide. If muriatic acid is suspected, it may be easily detected, and its weight ascertained, by means of nitrat of silver.

4. Sulphat of lead was thus analysed by Klaproth: One hundred grains of the ore, heated to redness, lost two grains, which were considered as water. It was then mixed with 400 grains of carbonat of potash, and heated to redness in a platinum crucible. The redish yellow mass thus obtained was digested in water, and the whole thrown on a filter. The oxide of lead thus obtained weighed 73 grains. It was dissolved in diluted nitric acid. One grain of oxide of iron remained behind. Into the solution a cylinder of zinc was put. The lead thrown down weighed 63½ grains. The alkaline solution was supersaturated with nitric acid, and then treated with acetyl of barytes. The sulphat of barytes obtained weighed 73 grains, which Klaproth considers as indicating 23 grains of sulphur.

5. Phosphat of lead was thus analysed: One hundred grains were dissolved in diluted nitric acid. Nitrat of silver dropped into the solution formed a precipitate weighing 11 grains, ≈ 1.7 grains muriatic acid. The solution was mixed with sulphuric acid. The sulphat of lead precipitated weighed 106 grains, ≈ 7.84 oxide of lead. The solution was freed from sulphuric acid by means of nitrat of silver, and then almost Quantitatively with ammonia. Acetat of lead was then dropped in. The phosphat of lead which precipitated weighed 82 grains, ≈ 18.37 phosphoric acid. The solution was now mixed with muriatic acid, evaporated to dryness, and the dry mass washed in alcohol. The alcohol, when evaporated, left a small residue, which dissolved in water, and formed Prussian blue with prussat of potash. It contained about 25 grains of oxide of iron.

6. Molybdat of lead was thus analysed by Mr. Hatchet. The ore was boiled repeatedly with sulphuric acid till the acid refused to dissolve any more. The solution contained the molybdic acid. The unsoluble powder (sulphat of lead) was boiled for an hour with carbonat of soda, and then washed. Nitric acid now dissolved it, except a little silica. The lead was precipitated from this solution by nitric acid; after treatment, and saturation with ammonia, a little oxide of iron. The sulphuric acid solution was diluted with 10 parts of water, and saturated with ammonia; a little oxide of iron gradually precipitated. The solution was now evaporated to dryness, and the mass strongly heated to separate the sulphat of ammonia. The residuum repeatedly treated with nitric acid was converted into yellow molybdic acid.

Ores of nickel. Copper nickel may be dissolved in nitric acid, by which the greatest part of the sulphur will be separated. The arsenic may be afterwards precipitated by the affinity of silver, or by mixing iron will precipitate the copper, if any should be present. Precipitate by potass added in excess, and boil the precipitate, which will separate the arsenic and sulphur completely. Dissolve the precipitate in water (keep moist for some time to the air) in acetic acid, and add an excess of ammonia. The iron is precipitated; but the cobalt and nickel remain in solution. Evaporate, and the cobalt is deposited; then by continuing the evaporation to dryness the nickel is obtained.

Ores of zinc. 1. Blende may be treated with diluted nitric acid, which will separate the sulphur, the silicious gange, &c. The purity of the blende is to be ascertained by combustion, the ashes being reduced in the manner formerly described. Precipitate the nitrie solution by sods, redissolve in muriatic acid, precipitate the copper (if any should be present) by a plate of iron; separate the iron and sulphur excess of ammonia. The zinc now only remains in the solution, which may be obtained by evaporating to dryness, redissolving in muriatic acid, and precipitating by soda.

2. Calamine; one hundred grains digested in nitric acid, noting the loss of weight for carbonic acid, and the insoluble residues boiled with muriatic acid repeatedly; what remains after dilution with boiling water is silica. The nitric solution contains zinc, and probably also iron and alumina; evaporate to dryness, redissolve, and add an excess of ammonia. The iron and alumina either remain undissolved or are precipitated, and they may be separated by potash. The zinc may be precipitated by an acid, or by evaporation to dryness. The muriatic solution probably contains iron and alumina, which may be precipitated by the rules already laid down.

Ores of antimony. Native antimony was thus analysed: One hundred grains were digested in nitric acid till the whole was converted into a white powder. When the acid emitted no longer any nitrous gas, the mixture was diluted with water and thrown upon a filter. The solution was then treated with nitrat of silver. The precipitate yielded by reduction one grain of silver. The precipitate of potash threw down from the residue solution a precipitate which contained 1/4 grain of iron. The white oxide formed by the nitric acid was digested in muriatic acid; the whole dissolved and formed a transparent solution. It was diluted with six times its weight of water, and the precipitate redissolved in muriatic acid, and a cylinder of zinc put into it. The antimony obtained weighed 98 grains.

2. Sulphuret of antimony is to be treated with nitro-muriatic acid. The sulphur and the muriatic acid (if any silver is present) will remain. Water precipitates the antimony; sulphuric acid, the lead; and amonnia the iron.

3. Klaproth analysed the red ore of antimony as follows: One hundred grains were digested in muriatic acid till the whole dissolved, except 1/4 grains of sulphur. A little sulphure of antimony rose with the sulphurated hydrogen gas, and heated, was deposited in the beak of the retort. The solution was diluted with water. The whole precipitated in the state of a white powder; for the arsenic was thrown down from the liquid. The powder was redissolved in muriatic acid, an excess added, and the solution diluted. A plate of iron threw down 67½ grains of antimony. The ore then contained 78.3 grains of oxide of antimony. One hundred grains of the ore yielded by boiling with muriatic acid 37 cubic inches of sulphurated hydrogen gas. From this, Klaproth concluded that it contained 20 grains of sulphur.

Ores of bismuth. Native bismuth may be treated with nitric acid. Repeated concentrations and evaporation of water precipitate the bismuth, and perhaps the arsenic; but this last may be redissolved in boiling water. The cobalt remains, and may be examined in the same manner. The ore is treated with nitric acid. The whole was dissolved except 5.3 grains of sulphur. The solution being diluted with water, a white powder precipitated. The nitrate solution was treated with common salt; at first no change produced no change, but by and by the whole became milky. The precipitate consisted, like the last, of oxide of bismuth. The solution continuing clear for some time, indicated that no silver was present. The white precipitate was not altered by exposure to the light; an additional proof that no silver was present.

Ores of tellurium. Klaproth dissolved the white gold ore of Fatzsky in nitro-muriatic acid, and added potass in excess to the solution. A brown precipitate remained undissolved, which was a mixture of gold and iron. It was redissolved in nitro-muriatic acid, the gold first precipitated by nitrat of mercury, and then the iron by potash. The precipitate of the first solution being saturated with muriatic acid, the oxide of tellurium precipitated. The other ores may be analysed in the same manner; only the precipitate occasioned by the potash must be treated according to the metals of which it consists. The rule have been already laid down.

Ores of arsenic. Native arsenic may be treated with nitro-muriatic acid. The silver and gold remain; the first in the state of a nitrate, the second may be dissolved by means of nitro-muriatic acid, and precipitated by sulphat of iron. The arsenic may be precipitated by concentrating the nitric solution, and then diluting with water. The iron may then be separated, and was deposited with ammonia.

2. The sulphurated ores of arsenic may likewise be treated with diluted nitro-muriatic acid. The sulphur remains undissolved; the arsenic may be precipitated by concentration and the addition of water; the iron by ammonia.

3. Oxide of arsenic may be dissolved in sixteen parts of water. The solution displays acid properties, and nitrat of silver and of mercury occasion precipitates in it.
Ores of cobalt. White cobalt ore was thus analysed by Tassé. To ascertain the proportion of arsenic he treated the ore with diluted nitric acid, and obtained a complete solution. Crystals of white arsenic were deposited. On evaporated evaporation he separated the whole of the arsenic, and ascertained its weight. He then boiled a new portion of the ore with four times its weight of nitric acid, and in the solution he precipitated cobalt. This solution was treated with potash, which retained the arsenic, and separated the cobalt. A precipitate of arsenat of cobalt, which had fallen when the nitric solution was diluted with water, was treated with potash for the same reason. The residuum, together with the precipitate occasioned by the potash, was dissolved in nitric acid, and ammonia added in excess. Part was retained in solution by the ammonia; but part was precipitated. The precipitate was dissolved in acetic acid, and the solution repeatedly evaporated to dryness. By this process the oxide of iron gradually separated in the form of a red precipitate, and the whole of the cobalt was dissolved except a little charcoal and silica. The solution when evaporated yielded crystals of muriat of barytes. These were separated; and the liquid, evaporated to dryness, yielded a yellow mass soluble in alcohol, and when this solution was mixed with yellow brilliant barytes. The proportion of barytes was ascertained by precipitating it in the state of a sulphat; the muriatic acid, by precipitating it by carbonat of potash.

2. The grey ore of manganese was treated by the same chemist with muriatic acid; some silica remained undissolved. Carbonat of potash was added to the solution. The precipitate was at first white, but became black when exposed to the air. It was treated with nitric acid, which dissolved every thing but the manganese and iron (if any had been present). The nitric solution, when mixed with carbonat of potash, deposited only carbonat of lime. The black residuum was mixed with sugar, and treated with nitric acid. It was continued a long time; the mixture became a jelly-like mass, and evaporated to dryness two or three times repeatedly. The oxide of iron is left behind, while the acetate of manganese continues soluble in water.

Ores of tungsten. Wolfram was boiled with nitric acid, and then digested with ammoniacal solutions of tungstate of potash, and dissolved in ammonia. It was precipitated by adding a weak solution of ammonium nitrate, and dissolved in ammonia again. When this solution was evaporated, dried, and dissolved in nitric acid, the precipitate obtained was separated, and treated with boiling nitric acid repeatedly, till the iron which it contained was oxidized to a maximum. It was then digested in acetic acid, which dissolved the manganese, and left the ore. Finally, the manganese was precipitated by an alkali.

Tung-tine of lime was thus analysed by Klaproth: One hundred grains of it were digested in nitric acid. The yellow-coloured residue was washed and digested in ammonia. The precipitate was dissolved in nitric acid and ammoniacal solutions of tungstate of potash, and from it was obtained a precipitate which, when dissolved in nitric acid, it left one-17.6 grains of oxide of tungsten.

Ores of molybdenum. Molybdena may be treated with nitric acid; successively boiled upon it till it is converted into a white powder. This powder, washed and dried, is molybdenic acid. The liquid obtained by washing the acid on the addition of potash, deposits some more molybdenic acid. This being separated, muriat of barytes is to be dropped into it as long as any precipitate appears.

One hundred parts of this precipitate indicate 1.45 of molybdenum. The precipitate dried weighed 33 grains. It was carbonised; but when redissolved in nitric acid, it left one-0.7 grains of oxide of molybdenum.

Ores of uranium. 1. Pechblende, or the black ore of uranium, was dissolved by Klaproth in nitric acid. The undissolved part was a mixture of silver and sulphur. By evaporating the solution, nitrat of lead was precipitated; then nitrat of uranium in crystals. The solution being now evaporated to dryness, and treated again with nitric acid, left the iron in the state of a red oxide.

2. Uranic ochre may be treated with nitric acid, which dissolves the uranium, and leaves the iron. The purity of the iron may be tried by the rules already laid down.

3. Green mica was dissolved by Klaproth in nitric acid, and ammonia added in excess to the solution. The oxide of uranium was precipitated; that of copper retained.

Ores of titanium. The oxide of titanium, reduced as usual to a fine powder, are to be mixed with potash or its carbonat. The melted mass is then to be dissolved in hot water. A white precipitate gradually separates, which is the white oxide of titanium. This is all that is necessary to separate the ore. But when either of the silica are present, the following method of Chevenix may be adopted: Saturate the alkaline solution with muriatic acid. White oxide of titanium precipitates. Separate the precipitate, and evaporate the solution to dryness. Redissolve the residuum in water. The silica remains behind. Precipitate the solution by an alkali; add the precipitate to the oxalate obtained at first, and dissolve the whole in sulphuric acid. From this solution phosphoric acid precipitates the titanium, but leaves the iron.

The third species, which contains lime and iron, is to be fused with potash, dissolved in nitric acid, and the carbonat of lead is forced, and remains unsolved. It may be dissolved in nitric acid, and its quantity ascertained by precipitation with sulphuric acid. Or the whole may be treated with nitro-sulphuric acid; and chronic acid remains in solution. This process must be repeated till the whole of the ore is decomposed. There remains in solution chronic acid, mixed with a little muriatic acid, which may be identified by means of oxides of silver.

ORGAN, in general, is an instrument or machine designed for the production of some certain action or operation; in which sense the mechanic powers, machines, and even the veins, arteries, nerves, muscles, and bones of the human body, may be called organs. The organs of sense are those parts of the body by which we receive the impressions or ideas of external objects, being commonly reckoned five, viz. the eye, ear, nose, palate, and cutis.

ORGAN, a wind-instrument blown by bellows, and containing numerous pipes of various kinds and dimensions, and multiform tones and powers. Of all musical instruments this is the most proper for the sacred purpose to which it is most generally applied in all countries wherever it has been introduced. Its structure is lofty, elegant, and majestic; and in its solemnity, grandeur, and rich variety of tone, have justly obtained it an acknowledged pre-eminence over every other instrument.

An organ, when complete, is of threefold construction, and furnished with three sets of keys; one for what is called the great organ, and which is the midst set; a second (or lower set) for the choir organ; and a third (or upper set) for the swell. In the great organ, the principal stops are the two diapasons, the principal, the swell, the fifth, the sixteenth, the mixture or furniture of the instrument, the trumpet, the clarion, and the cornet. The choir organ usually contains the stopt diapason, the dulcian, the principal, the flute, the twelfth, the organ, and the vox humana. The swell comprises the two diapasons, the principal, the hautboy, trumpet, and cornet. Besides the complete organ, there are other organs of lesser sizes, and more limited powers, adapted to the wind of church, chapel, and chamber use. There is also the
barrel or hand organ, consisting of a moveable turning cylinder called a barrel, on which, by means of wires, pins, and staples, are set the tunes it is intended to perform. These pins and staples, by the revolution of the barrel, strike upon the keys within, and give admission to the wind from the bellows to the pipes. The barrel organ is generally portable; and so contrived that the same action of the hand which turns the barrel, supplies the wind by giving motion to the bellows.

The invention of the organ, which is attributed to the Greeks, is very ancient, though it is generally allowed to have been little used before the eighteenth century. It has been a subject of debate at what time the use of organs was first introduced into the church. Some writers say, that they were first applied to sacred use in the time of pope Vitalian, about the year 669; others that they were not employed in that way till the ninth century. A learned author has, however, shown that neither of these dates can be just; and Thomas Aquinas expressly says, that at this time (about the year 1290) the church did not use any musical instruments; and Bingham says, that Marvianus Sanvitius, who lived about the year 1290, first introduced the use of them into churches. But if we give credit to the testimony of Gerbas, the bishop of Canterbury, who flourished at the beginning of the fourteenth century, organs were introduced more than one hundred years before his time. Bede, who died in 735, says nothing of the use of organs, or other musical instruments, in our churches or convents, though he minutely describes the manner in which the psalms and hymns were sung; yet Mabillon and Muratori inform us, that organs, during the 16th century, became common in Italy and Germany, as well as in England; and that about the same time they had admission into the convents throughout Europe.

The church-organ consists of two parts: the main body, called the great organ, and the positive or little organ, which forms a small case or buffet, commonly placed before the great organ. The size of an organ is generally expressed by the length of its largest pipe; thus, an organ of 16, 32, 64 feet, &c. The organ in the cathedral church at Ulm in Germany is 93 feet high and 28 broad; its largest pipe is 13 inches diameter, and has 16 pair of bellows.

Plate Organ, represents barrel-organ made by Mr. Lincoln, Holborn, A, figs. 2 and 6, is the handle by which it is played; on its spindle is a crank a, that works the bellows which supply the organ with air: these bellows are in two distinct parts BD; and as the lower boards move round, as acute, one of the sides is always filling with air by a valve in its under side, while the other is forcing its way through a valve in the board E into the regulator F, the movable or upper board of which is pressed down by two wire springs bb. When the handle A is turned, the crank a by the rod d, moves the lower boards BD of the bellows up and down, so that the pipe b,b in this case, are alternately through their respective valves into the regulator; when a great quantity of air is forced into the regulator, it overcomes the springs, and raises the upper board; and during the time that the bellows supply no air, which is when

the valves in the boards BD are shutting, the springs bb force down the board of the regulator, and drive the air out of it for the supply of the pipes to the bellows, and begin to act. The board E has a hole cut through it, which communicates with a passage ce, fig. 2; which conveys the air from the regulator to a trunk g, called the wind-chest, and which extends the whole length of the organ under the pipes G and H: the board which forms the top of this has a hole through it under every pipe, and is covered by a valve as k. k is a small wire, the end of which rests upon the valve, so as to open it when the wire is pushed down the passage; for the air is conveyed through the upper board of the wind-chest, under two sliders kl, called stops, which have handles (shown in fig. 6.) coming through the frame, by which they can be moved in or out: these stops slide in tubes, lined with leather, which they fit very exactly, so as to prevent any air getting through by the sides of them; and the stops have as many holes cut through them as there are valves and pipes, and at the same distance from one another; so that when the stops are pushed in, the holes in them coincide with the passages from the valves to the pipes G, H, so as to give the air the proper note; and when they are drawn out, the spaces between the holes in the stops are brought over the passages, so as to close them, and prevent any air getting through. From the stop k the air is conveyed from the passage to the wooden pipes H, and the slider l, is to intercept the air for the metal pipes G. A section of each kind of pipe is shown in figs. 3 and 4: a. a fig. 3 is a cylindrical pipe, usually of lead; to one end of this is soldered a conical pipe bb of the same metal, at the end of which the air is admitted. Near the junction of the two pipes a piece of metal e is soldered, which fills up all the pipe, except a small cavity on one side, which is cut straight; and the edge of the conical pipe bb is bent straight, so as to leave a small crack, through which the air issues. The edge n of the cylindrical pipe is cut to a sharp edge, and bent down to the line with the opening through which the air comes; when the air is blown through the end d, d, it rushes through the opening between the piece e and the edge of the pipe bb, the sound is formed by the edge n dividing the current of air, and the air in the remainder of the tube aa: in large pipes a small piece of metal o, called the ear, is soldered on, which adds much to the sound. The wooden pipes, fig. 4, is composed of a square trunk of wood in: in one end a block of wood b is glued; a small wooden pipe of is inserted into the lower end of this block to bring the air to the pipe, the end of which is partly closed by a plug of wood to adjust the quantity of air; in the wooden pipes this is done by pinching them up at the end. On one side of the block b a piece of oak is glued, between the edge of which and the block b the air issues, and is divided, as in the metal pipes, by the edge of one of the boards of the trunk, which is cut sharp for the purpose: the ends of the wooden pipes are closed by a plug of wood ad, which is slid farther in or out, to adjust the pipe to the proper note. The spindle of the handle A, fig. 6, has a screw m upon it, which works into a wheel I, the barrel K (shown separately in fig. 1.) This barrel is made of wood, and has pins drove into it, which pins, as it is turned round, lift up the keys a, fig. 6, shewn in fig. 5, where A is the barrel, the pins of which, as it turns, take hold of the end of the keys n, and lift them up; these keys are supported by a bar f called the key-frame, of which a side of a brass plate bb is screwed, which passes through the cut in it to guide each key: a wire d is put through each key, round which it moves as a centre; the end of the key has a piece of mahogany hardened to it, which is joined to the rod k, by a piece of leather. The lower end of this rod is jointed to the wire f, fig. 2, by which the valve h is opened as before described: the spring under this valve throws the rod I upwards; and to prevent the end of the key from touching the barrel, a screw p is put through the key-frame, the bottom of which is covered with leather, to catch the key without making any noise. The operation of the machine is as follows: When the handle A, fig. 6, is turned, it works the bellows by the crank a, and forces the air to the wind-chest, e, fig. 2; at the same time the screw m turns the barrel K, fig. 6, slowly round; the pins in its end (the end e l, fig. 5.) of the key, which depresses the key, and by the rods I and wire i, fig. 2, opens the stop l, and allows the air (if the stops l or k are open) to enter into the pipe of the proper note, and sound it. In the barrel turns, that key is dropped, and the spring shut up the other pipe, corresponding to the next note of the tune, is then opened and so on till the tune is completed. If the tune is wanted to be played slowly, the key l is drawn out, and the metal pipes G are rather low key the wooden pipes, which are an octave lower, are played, by pulling out the stop K, and pushing in the other; if the tune is to be played very loud, both are drawn out; and when both are pushed in, no sound is produced. As a different quantity of air is wanted for playing the metal and wooden pipes, the bellows are made large enough to supply both at once; and when only one is used, the air escapes through the key-frame, the upper board of the regulator F: this board has a handle to g, and is kept shut by a wire spring; when the board of the regulator is raised to open the valve cells, the handle of the valve m meets a part of the board of the key-frame, the valve is opened, and the air escapes. The frame, on which the barrel is mounted, fig. 1, is slid into a groove M, figs. 2 and 6, and one of the uprights of the frame; a piece of brass N, fig. 1, is screwed; this projects through the outside board of the organ, as shown in fig. 7, and has as many notches cut in it as the barrel plays different tunes; a bolt O slides into any of these notches, so as to keep the piece N in any place where the end of the bolt of this bolt; another bolt P slides so that P must be withdrawn before O can be moved. The bolt P has a wire w, figs. 5, 6, and 5, projecting from the back e at through the board; this wire acts upon one end of the lever r, so as to push it down when the bolt is drawn back. The key-frame E, fig. 5, is not fastened down to the frame of the organ, but has two pieces r, r, fastened to the ends of it; the other end of this piece r must be fastened by a high screw, as a centre, so that the frame and key-frame be turned up clear of the barrel; it has a wire spring S, to keep it down, and a screw r regulated the distance from the barrel when down. One end of the lever r is put under
the key-frame, so that when the outer end is pushed down by drawing back the bolt \( P \), fig. 7, the other will raise the key-frame: the bolt \( O \) is then driven into the key, and the piece \( N \) can be set, and fixed at another notch, which causes the organ to play another tune, by moving the barrel along a small distance, which brings a fresh set of pins under the keys, which are differently disposed. By the arrangement of the bolts as above, the barrel can never be moved without first fitting up the keys, so that there is no danger of breaking the keys of pins in the barrel.

The paws of the organ are slid into grooves cut in the four uprights of the frame.

ORNITHOS, a genus of the monogynia order, in the pentadìa class of plants, and in the natural method ranking under the forty-seventh order, stellate.

Orchis, a small, tuberous, and monopetalous plant. Orchis is a globular-berried, growed longitudinally; is quinquenucular, and contains one seed. Of this there are six species, all natives of the warmer parts of America, viz. 1. O. californica, natives of Guiana, make influence of the leaves, and given in cases of spasmodic asthma. 2. Racemosum. 3. Violacea. 4. Lutea. 5. Paniculata. 6. Longiflora.

ORNITHALUM. See Zinc.

ORGANUM, organ, marjoram, a genus of the gymnospermae class of plants, and in the natural method ranking under the forty-second order, verticillate.

There is a strubulous or cone-collecting the calyces together. The principal species are, two hardy perennials and an annual for the open ground, and five perennials for the greenhouse: viz. 1. The vulgare, or wild pot-marjoram. 2. The heracleum, or winter sweet-marjoram. These are finely-scented aromatics, excellent for culinary purposes, particularly for broths, soups, &c. they have likewise merit for medical uses, and for giving fragrance to ointments; so that the plants are proper both for kitchen gardens, and also be employed in the pleasure-ground, 3. The marjoram, or an an sweet-marjoram, is an aromatic: the highest fragrance, is admirable for kitchen use, and makes a great novelty. It is often called knotted marjoram, from the flowers growing in close, knotted-like heads. The following mostly assume an undershrub-like growth; frequently with ailing stalks, if they shelter here in winter: 4. The dicatamenus or dittany of Crete. 5. The sylvestre, or organum of miltis Pylites. 6. The cretacum, or Cretan organy. 7. The snyrmia, or Snyryna organy. 8. The egypticum, or Egytian organy. There are four other species.

ORIGENISTS, in church-history, a Christian sect in the fourth century, so called from their drawing their opinions from the writings of Origen. The origenists maintained, that the initial men of had a pre-existent state, that they were holy intelligences, and had sinned in heaven before the body was created: that Christ is only the son of God by adoption.

ORIGINAL, in the court of king's bench, such a complaint as is made in the action as for action of trespass upon the case. And this court does not issue originals in actions of debt, covenant, or account, &c. whereas the court of common pleas proceeds by original in all kinds of actions; but to arrest there and suit. The reason of using it is used in both cases. See JAPPY's B. R. and C. B.

ORIOLES, oriole, in ornithology, a genus belonging to the order of Picce. The bill in this genus is straight, conic, very sharp-pointed, edge calcinated, inclining towards; mandibles of equal length. Nostrils small, placed at the base of the bill, and partly covered. Tongue divided at the end. Toes, three forward, one backward; the middle joint conical in shape, the utmost one. These birds are inhabitants of America, except in a few instances; they are a noisy, gregarious, frugivorous, granivorous, and voracious race, very numerous, and often have penile nests.

The several species, which are very numerous, since Mr. Latham describes no less than forty-five, seem to be principally distinguished by their colour.

1. The first species, is called the oriole Baltimore, by Linnaeus, and the Baltimore oriole inhabitant of North America, which country it quits before winter, and probably retires to Mexico; the schizocitl of Fernandez seeming to be of the same species. The head, throat, neck, and breast of the male, are described to be black; the lesser coverts of the wings orange; the greater black, tip with white; the breast, belly, lower part of the back, and coverts of the tail, of a bright yellow. The female is putrid; the male and female are described to be black; the tail dusky, edged with yellow. The length both of the male and female is seven inches.

This bird suspends its nest to the horizontal forks of the tulip and poplar trees, formed of the filaments of some tough plants, curiously woven, mixed with wool, and lined with hair. It is of a pear-shape, open at top, with a hole on the side through which the young are fed. In some parts of North America, this species, from its brilliant colour, is called the fiery hung-nest. It is named the Baltimore bird, from its colours resembling those in the arms of the late lord Baltimore, whose family were proprietors of Maryland.

2. The sharp-tailed oriole is about the size of a lark; the bill is dusky; the crown is brown and crimson; the cheeks are brown, bowed above and below with deep dull yellow. The throat is white; the breast, sides, thighs, and vent, are a dull pale yellow, spotted with brown; the belly is white; the back is varied with ash-colour, black, and white; the wing-coverts are dusky, with ferruginous edges.

The other species of the oriole, (see Plate Nat. Hist. figs. 301 and 302) according to Mr. Pennant's enumeration, are the white-headed, the bastard, the black, the brown-headed, the rusty, the white-headed, the Hudsonian white-headed, the olive, the yellow-throated, the unalascia, the sharp-tailed, and the red-winged. This last species is found generally distributed in America, both in the red-winged starling and the swamp blackbird. Although they appear at New York only from April to October, they probably continue through the whole year in the southern states. They are very difficult to be discovered, by seeking the maize before they sit down to a decoction of white heliohore. The birds that eat this prepared corn, are seized with a vertigo, and fall down, which sometimes drives the rest away. This potion is particularly aimed at the purple grackles or purple jackdaw, which conmits in myriads with this species, as, if in conspiracy against the 1 baths of the husbandman. The fowler seldom fires among the clocks without killing some of each. They appear in the greatest numbers in autumn, when they receive additions from the returned parts of the country, to prey on the ripened maize. Some of the colonies established a reward of a three-pound piece of tea, for the discovery and destruction of the jackdaws; and in New England, the intent was almost effected at the cost of the inhabitants; who discovered, at length, that Providence had not formed these destructive birds in vain. Notwithstanding they caused such havoc among the grain, they made ample recompence, by clearing the ground of the noxious worms, the caterpillar of the brussels pisi, or peas-beetle. Many crops have been saved by it. As soon as the birds were destroyed, the reptiles had full leave to multiply; and the consequence was the total loss of the grass in 1749, when the New Engladis, rep.testing too late, were obliged to get their hay from Pennsylvania, and even from Great Britain.

ORION, in astronomy, a constellation of the southern hemisphere. See Astronomy.

Orion's ring, in astronomy, a constellation more usually called Eridanus. See Eridanus.

ORNITHOGALUM, star of Bethlehem, a genus of the angiospermae class of plants, the corolla whereof consists of six petals, of a bancedate figure from the base to the middle, cect from the points, plan-oatent; they are permanent, but lose their colour; the fruit is a 3angulated capsule, formed of three valves, and containing three cells; the seeds are numerous and roundish, the receptacle cumbom.

There are thirty-five species, all of them herbaceous and perennial, rising from three to six feet high, having stalks terminated with long spikes of hexapetalous, star-shaped, white and yellow flowers. Six of the species are very hardy, and will prosper in any situation; but one, namely the capucens, a native of the Cape of Good Hope, requires the assistance of artificial warmth to preserve it in this country.

ORNITHOLOGY, that branch of zoology, which treats of birds. See Bird. Linnaeus, whose ornithology we have followed, arranges the whole tribe of birds by the six orders, according to the different figures of their beaks, viz.

1. Accipitres, upper mandible with an
cular projection. 2. Pleo, bill compressed convex; with feet formed for perching or climbing. 3. Aniætes, bill covered with skin, broad at the base, some with and some without teeth. 4. Grillæ, bill ramish, tongue fleshy; some with three or some with four toes. 5. Gallinæ, bill convex, upper mandible arched. 6. Passeræ, bill come, sharp-pointed. 7. Brr, bill foot, strip of the delphinæ decandra class of plants, with a papilionaceous flower: its fruit is an oblong pointed pod, of a cylindrical figure, and containing in each joint a single roundish seed; and this, the several of these pods usually grow together. There are five species.

The leaves of this plant are said to be good for a hernia, and for breaking and expelling the stone of the kidneys or bladder.

ORNITHORHYNCHUS PARADOXUS, from New South Wales, a singular quadruped, which has not yet been properly classed in the Linnean system. The most remarkable circumstance in this curious animal is, the great similarity of its head with that of a duck, which, however, is still more strikingly similar to an internal structure. From the external form of the skull of this animal, one might be more easily led to conclude that it belonged to such an aquatic bird, than to a creature of the mammalia tribe. Both the jaws are as broad and low as in a duck, and the calvaria has no traces of a suture, as is generally the case in full-grown birds. There is likewise a singularity in the cavity of the skull, of which nothing like it is known in any quadruped of the mammalia tribe, though there exists something analogous in the class of birds, namely, a considerable bony flap, which is situated along the middle of the os frontis, and the osseous brain-case. This process is in general scarcely to be seen in the mammalia, even in those that have a bony tentorial cerebelli. The mandible of this animal is very singular, consisting of a beak, under the part of which its margin is indented as in ducks, and of the proper instrument for chewing that is situated behind, within the cheeks. This has no teeth, nor even the traces of alveoli, but only two broad processes of a peculiar form on each side, whose unadulterated superciliæ fit one another. Dr. Shaw says of the specimen he examined, that it had no teeth, "denti nulla sunt vestigia." But sir Joseph Banks informs us, that Mr. Home has found, in a specimen that belongs to the Society of Natural History at Newcastle, on each side of the jaws, two small and flat molars teeth. The fore part of this anomalous mandible, or beak, is covered with a strong coriaceous skin, in which three parts are to be distinguished: 1. The proper integument of the beak (integumentum rostri). 2. The labiated margins of it (margines labii). 3. A coriaceous edge of the skin of the beak (limbus transversarius). Into these three parts of that membrane numerous nerves are distributed, of which those in the upper part of the beak arise from the second branch of the fifth, the limbus transversarius, that which penetrates through the forehead in the tabula infraorbitalis, in the margo labii; that which comes forth behind the os maxillaria, and to the integumentum rostri, three branches, which run out between the ossa intermaxillaria. From this quantity of nerves, with which the integument of the beak is profusely supplied, it is being intended as the organ of feeling, a sense, which, besides men and the quadrupedans, very few mammalia enjoy, that is to say, few animals possess the faculty of distinguishing the form of external objects and their qualities by organs destined for that purpose; a property that is different from the common feeling, by which every animal is able to perceive the temperature and movements of the air; but, those being informed by the touch of their peculiar qualities. Thus, for instance, the skin in the wings of a bat, and its ear, serve probably as organs of common feeling, by means of which they are enabled to fly, after being blinded, without flying against any thing. The whiskers (vibrissæ) of many animals seem likewise to serve for the purpose of informing them of the presence of several objects. Dr. Darwin compares them with the antennæ of insects; but they are not able to inform themselves of the properties of those objects. It is true that the snout of a mole has been considered as a sort of tactile organ, and the consideration of the tongue of many other animals likewise by bullet, as organs of touching; but this seems only to be their secondary use. The same may be said of the elephant's trunk, which Bullett also attributes to an organ of touching, although from its manner of living, the necessity of such an organ of touching does not appear. The ornithorhynchus, however, is an animal which, from the similarity of its abdomen, and the manner of searching for food, agrees much with the duck, on which account it has been equally provided by nature with an organ for touching, viz., with the integument of the beak, richly endowed with nerves. This instance of analogy in the structure of a singular organ of sense in two species of animals from classes quite different, is highly instructive for comparative physiology, and on this account the integumentary beak belongs to one of the most remarkable phenomena of zoology, and may in general be looked upon as one of the most interesting discoveries with which that part of natural history has been enriched during the last century. See Plate Nat. Hist. fig. 303.

OROBOURGHE, hrown-rope, a genus of the didynamia angiosperma class of plants ranking under the 40th order, personate. The corolla is monopetalous and ringent; and its fruit an oblong capsule formed of two valves, and containing a great many minute seeds; the calyx is bident. There is a glandule under the base of the germen. There are fourteen species.

OROBUS, bitter vetch, a genus of the decandria order, in the dielaphida class of plants; and in the natural method ranking under the 32d order, papilionaceæ. The style is linear; the calyx obtuse at the base, with the upper segments deeper and shorter than the rest. There are 16 species. All of them have bifurcate roots, which are perennial, bearing an annual, but branching in spring and decaying in autumn. They are very hardy plants, and proper in any common soil of a garden. Most of the sorts are very floridious, and the flowers conspicuous and ornamental for adorning the flower-compartments. The Scotch Highlanders have a great affection for the flowers of the roots of the tuberous, or species sometimes called wood-pea. They dry and chew them in general to give a better relish to their liquor; they also affirm that they are good against most disorders of the breast, and that by the use of them they are enabled to resist hunger and thirst for a long time. In Bread- abane and Ross-show, they sometimes bruise and steep them in water, and make an agreeable fermented liquor with them. They have a sweet taste, something like the roots of liquorice; and, when boiled, we are told, they are nutritious and well flavoured; and in times of scarcity have served as a substitute for bread.

ORONTIUM, a genus of the monogonym order, in the harkenia class of plants; and in the natural method ranking under the 2nd order, piperineæ. The spadix is cylindrical, covered with bristles; the corolla hexapetalous and naked; there is no style; the follicles are monosporous. There are two species, marsh plants of Canada and Japan.

OROPHAN: in the city of London there is a court of record established for the care and government of orphans.

ORPIMENT. See ARSENIC.

ORREY, a curious machine for representing the motions and appearances of the heavenly bodies. We shall in this place merely shew the theory of the wheels, leaving a more particular description for the article PLANETARIUM. We must first consider and find out the proportion which the periodical times, or revolutions, of the primary planets, bear to that of the earth; and they are such as are expressed in the table below: where the first column is the time of the earth's period in days and decimal parts; the second, that of the planets; the third and fourth numbers are in the same proportion to each other as:

<table>
<thead>
<tr>
<th>Earth</th>
<th>Mars</th>
<th>Jupiter</th>
</tr>
</thead>
<tbody>
<tr>
<td>360.25</td>
<td>58.4</td>
<td>75.1</td>
</tr>
<tr>
<td>360.25</td>
<td>686.9</td>
<td>365.245</td>
</tr>
<tr>
<td>365.245</td>
<td>433.5</td>
<td>73.</td>
</tr>
<tr>
<td>365.25</td>
<td>107.93</td>
<td>148.</td>
</tr>
</tbody>
</table>

If we now suppose a spindle or Arbor with 80 spokes, perpendicular to the horizontal position, having the number of teeth in each corresponding to the numbers in the third column, viz. the wheel AM (see Plate Observatory, fig. 6) of 83 teeth, BL of 32, CH of 50 (for the earth), DI of 40, EH of 7, and FG of 5; and another set of wheels moving freely about an Arbor, having the number of teeth in the fourth column, viz. AN of 28, BO of 32, CP of 50 (for the earth), DQ of 75, ER of 32, FS of 148; then, if those two Arbor of fixed and moveable wheels are made of the size, and fixed at the distance from each other, as here represented in the scheme, the teeth of the former will take those of the latter, and turn them very freely, when the machine is in motion.

These arbors, with their wheels, are to be placed in a box of an adequate size, in a perpendicular direction, with fixed wheels to move in pivots at the top and bottom of the box; and the Arbor of moveable wheels to move in pivots at the top and
bottom of the box; and the abor of move-\-

able wheels to go through the top of the box, or a proper height, on the top of which is to be placed a rolling ball gilt with gold, to represent the sun. On each of the movable wheels is to be fixed a socket, or tube, ascending above the top of the box, and having on the top a wire fixed, and bent at a proper distance from the tube, and bearing on the top a small round ball, representing its proper planet.

If then on the lower part of the abor of fixed wheels is placed a plunon of sixteen-\-

tudes, a windlass with an endless screw, playing in the teeth of the abor, will turn it with all its wheels; and these wheels will move the others about with their planets, in their proper and re-

spective periods of time, very exactly. For, while the fixed wheel CK makes its equal CP once round, the wheel A:M will move AN a little more than four times round, and so will nicely exhibit the motion of Mercury; and the wheel FG will turn the wheel FS about 17 3/5 round, and so will truly re-\n
present the motion of Saturn, and the same is to be observed of all the rest.

ORTHIGA, a genus of the class and order Triandria monogyna, which teaches the nature and affections of letters, and the just method of spelling or writing.

ORTHIGRAFI, that part of grammar which teaches the nature and affections of letters, and the just method of spelling or writing.

ORTHOGRAFI, in geometry, the art of drawing or delineating the fore-edge plan of any object, and of expressing the heights or elevations of each part. It is called ortho-
graphy, from its determining things by per-

pendicular lines falling on the geometrical plane.

ORTHOGRAFI, in architecture, the elevation of a building.

ORTHOGRAFI. See Perspective.

ORTOLAN. See Emberiza.

ORYRA, rice, a genus of the digynia order, in the hexadactyl class of plants; and in the natural method ranking under the 4th order, gramineae, of the 4th class, angiosperma. The calyx is five-\-

feathered; corolla none; capsule one-celled; seeds many; there are two species, trailing plants of Spain and Italy.

ORTHOGRAPHY, that part of grammar which teaches the nature and affections of letters, and the just method of spelling or writing.

ORVZA, rice, a genus of the digynia order, in the hexadactyl class of plants; and in the natural method ranking under the 4th order, gramineae, of the 4th class, angiosperma. The calyx is five-\-

feathered; corolla none; capsule one-celled; seeds many; there are two species, trailing plants of Spain and Italy.

OSIEKIA, a genus of the ocdotria monogyna class and order. The cal is four-\-

cleft; cor. four and five-petalled; stam. eight or ten; anthers beaked; caps. inferior, four-celled. There is one species, a trailing plant of China.

OSCILLATION, in mechanics, the vi-

bration, or reciprocal ascent and descent, of a pendulum. See Pendulum.

It is demonstrated, that the time of a com-\n
plete oscillation in a cycloid, is to the time in which a body would fall through the axis of the cycloid, or of a great circle or cycloid to its diameter; whence it follows, 1. That the oscillations in the cycloid are all performed in equal times, as being all in the same ratio to the time in which a body falls through the diameter of the generating circle. 2. As the middle part of the cycloid may be conceived to coincide with the gener-\n
ating circle, the time in a small arc of that circle will be nearly equal to the time in the cycloid; and hence the reason is evi-\n
dent, why the times in very little arcs are equal. 3. The time of a complete oscillation in any little arch of a circle, is to the time in which a body would fall through half the radius, as the circumference of a circle, to its diameter; and since the latter time is half the time in which a body would fall through the whole diameter, or any chord, it follows that the time of an oscillation in any little arc, is to the time in which a body would fall through its chord, as the semicircle to the diameter. 4. The times of the oscillations in cycloids, or in small arches of circles, are in a sub-duplicate ratio of the lengths of the pendulums. 5. But if the bodies that oscillate are acted on by unequal accelerating forces, then the oscillation will be performed in times that are to one another in the ratio compounded of the di-\nrect subduplicate ratio of the lengths of the pendulums, and inverse subduplicate ratio of the accelerating forces. Hence it appears that if oscillations of unequal pendulums are performed in the same time, the accelerating gravities of these pendulums must be as their lengths; and thus we conclude, that the a-\n
vail of gravity decreases as you go to-\n
towards the equator, since we find that the lengths of pendulums that vibrate seconds are always less at a less distance from the equator; 6. The space described by a falling body in any given time, may be exactly known; for finding, by experiment, what pendulum oscillates in that time, the half of the pendulum will be to the space required, in the duplicate ratio of the di-\n
meter of a circle to the circumference.

**Centre of Oscillation. See CENTRE.**

OSMINTES, a genus of the class and order Syngenesia polygyna, family Campanulaceae. The cal is imbricate, scarios; cor. of the ray luci-\n
late; down obsolete; recept. chalyx. There are four species, shrubs of the Cape.

OSMUNDA, moonwort; a genus of the order Filices, in the cryptogramma class of plants. There are two species, one of which is the most remarkable of which the regalis, osmund-royal, or flowering fern. This is a native of Britain, growing in patrid marshes. Its leaf is doubly winged, bearing bunches of flowers at the ends. This root boiled in water is very di\n
ly; and is used in the north to stiffen linen instead of starch. Some of the leaves only bear flowers.

**OSSIFICATION, the formation of bones.**

**OSTEOLOGY.** See Anatomy.

OSTEOSPERMUM, a genus of the class and order Syngenesia polygyna, family Campanulaceae. The cal is simple, in two rows, many-\n
leaved, almost equal; seeds globose, coloured, bony; down none; recept. naked. There are 17 species, shrubs of the Cape.

OSTRACION, in ichthyology, a genus of the branchiostegous order of fishes, of a rounded form, with rhomboidal figure; the skin is always very firm and naked, and in some species smooth, in others entirely covered with spines; and, finally, in some of the spines entirely occupy only particular places; there are three species, and the others are five in number, viz. two pectoral or lat-\n
teral fins, one on the back, the pinnia ani, and the tail. There are 12 species of this genus: the triquetor has a triangular body unmarred; inhabits India; the back appearing as if covered with rhomboidal marks, cut transversely. The quadricornis, with frontal and subcaudal spines, inhabits India and Guinea.

OSTRACION, trunck-fish, a genus of fishes, of the order Nanto: the generic charac-\n
ter is, teeth pointing forwards, cylindrical, rather blunt; body nerved by a series of os-\n
a. 1. Ostracion triquetor, triquetral trunk-\n
fish; the ostracions or truck-fishes are so strikingly distinguished by their bony crust or covering, that no difficulty can arise to the ichthyological student in referring them to their proper family. 2. Investigation of the species however demands a greater degree of attention, and such is the similarity between some of these, that it remains de-
full whether they should be considered as truly distinct, or as constituting mere sexual differences.

The general trunk-fish measures about twelve inches in length, and is, as its name imports, of a trigonous shape, the sides sloping obliquely from the ridge of the back, and the abdomen being flat; the whole animal, except to within a small distance from the tail, is completely enveloped in a bony covering, divided into well-defined hexagonal spaces, and covered (as in the whole genus) with a transparent epidermis like that of the armadillo. Among quadrupeds, the usual colour is a subkurrigruous brown, with a white spot in the centre of each hexagon, which is also marked by fine rays diverging from the centre to the edges; the fins are yellowish, and the tail rounded; the naked part of the extremity of the body or base of the tail being marked with white specks, similar to those on the crustaceous part of the animal: the pectoral fins are rather small than large, and of a rounded shape; the dorsal and anal are also rather small, and are situated opposite each other towards the extremity of the body, and, like the rest of the genus, this fish is destitute of ventral fins. It is abundant in the Indian and American seas, and is supposed to feed on the smaller crustacea, shell-fish, and sea-worms. It is said to be considered as an excellent fish for the table, and is held in high estimation among the East Indians. There are ten species.

2. Ostracus quadriconcis, four-horned trunk-fish; length twelve inches; shape sub-trigonal; the back, when viewed in profile, strongly arched, and having a smooth outline; tail divided into large hexagons marked with numerous and very small tubercles; on the top of the head two very strong spines pointing forwards; and from the hind part of the abdomen, immediately before the anal fin, two more spines pointing backwards; colour of the mailed part sub-violaceous brown, with darker streaks irregularly dispersed over the whole; naked part of the tail, yellowish-brown, marked with deep-brown spots; fins and tail yellowish-brown. Native of the Indian and American seas. See Plate Nat. Hist. fig. 504.

OSTREA, the oyster, in zoology, a genus belonging to the order of vermes testacea. The shell has two unequal valves; the carot has no teeth, but a small hollowed one with transverse lateral streaks. There are thirty-one species, principally distinguished by peculiarities in their shells. The common oyster is reckoned an excellent food; and is eaten both raw and variously prepared. The character of the genus, in the words of Bartholomew, is its animalial tethys; the shell bivalve, univalve, with something like ears; the hinge void of teeth, with a deep oval hole, and transverse streaks on the sides. There is no worm nor ann. The genus is divided into four families, of which one is the last.

The oyster differs from the muscle in being utterly unable to change its situation. It is entirely without a tongue which answers the function of an arm in the other animal, but nevertheless is often attached very firmly to any object it happens to approach. Nothing is so common in the rivers of the tropical climates, as to see oysters growing amidst the branches of the forest. Many trees, which grow along the banks of the stream, often bend their branches into the water, and particularly the mangrove, which chiefly delights in a moist situation. To these the oysters hang in clusters, like apples upon the most fertile trees; and in proportion as the weight of the fish sinks the plant into the water, where it still continues growing, the number of oysters increase, and hang upon the branches. This is effected by means of a glue proper to themselves which when it cemented, the joining is as hard as the shell, and as difficultly broken.

Oysters usually cast their spawn in May, which at first appears like drops of candle-grease, and sticks to any hard substance it falls upon. These are covered with a shell in two or three days; and in three years the animal is large enough to be brought to market. As they invariably remain in the same places where they are laid, and as they grow without any other seeming food than the afflux of sea-water, it is the custom at Colchester, and other parts of England, where the tide settles in marshes on land, to pick up great quantities of small oysters along the shore, which, when first gathered, seldom exceed the size of sixpence. These are deposited in beds where the tide comes in, and in two or three years grow to a tolerable size, to be better sheltered from the agitations of the deep; and a mixture of fresh water entering into these repositories, is said to improve their flavour, and increase their growth and fatness.

The oysters, however, which are prepared in this manner, are by no means so large as those found sticking to rocks at the bottom of the sea, usually called rock-oysters. These are sometimes found as broad as a plate, and are admired by some as excellent food. But what is the size of these compared to the oysters of the East Indies, some of whose shells have been seen two feet over! The oysters found along the coast of Corsica are replete of furnaces of flame; a noble meat, and refreshment for forty or ten men; but it seems universally agreed that they are no way comparable to ours for delicacy of flavour.

OSTRICH. See Struthio.

OSYRIS, poet's rosemary, a genus of the dicotyledonous class of plants, without any flower-petals; the fruit is a globe unilocular berry, containing a single ossaceous seed. There are two species. This whole shrub is aromatic, and consequently good in fluxes.

OTIHERA, a genus of the tetrapod monogynia class and order. The cal is four-parted; pet. four; stigma sessile; caps. There is one species, a shrub of Japan.

OTHONIA, a genus of the polygynia necessaria class of plants; and in the natural method ranking under the 49th order, composite. The receptacle is naked; there is almost no pappus; the calyx is monophyllous, multifid, and nearly cylindrical. There are 27 species.

OTIS, the bustard, in ornithology, a distinct genus of birds, of the order of the gallo-linis, the characters of which are these: there are three toes on each foot, all turned forwards; and the head has no comb. There are four species, principally distinguished by their colour. One of the species, the tundra, or bustard (see Plate Nat. Hist. fig. 502.), is the largest of the British order, the male weighing 25 pounds; there are instances of some very old ones weighing 27: the breadth nine feet; the length near four. Besides the size and difference of colour, the male is distinguished from the female by a tuft of feathers about five inches long on each side of the lower mandible. Its neck and head are ash-coloured; the back is barred transversely with black, and bright rust-colour; the greater part of the underparts and belly white; the tail is marked with broad red and black bars, and consists of twenty feathers; the legs dusky.

The female is about half the size of the male: the crown of the head is of a deep orange, traversed with black lines; the rest is brown; and the brown spot on the fore-side of the neck is ash-coloured; in other respects it resembles the male, only the colours of the back and wings are more dull.

The birds inhabit most of the open countries of the south and east parts of this island, from Dorsetshire as far as the Wolds in Yorkshire. They are exceedingly shy, and difficult to be shot; run very fast; and when on the wing can fly, though slowly; and it is said, that they take flight with difficulty, and are sometimes run down with greyhounds. They keep near their old haunts, seldom wandering above twenty or thirty miles. Their food is corn and other vegetables, and the earthworms that appear in great quantities on the downs before sun-rising in the summer. These are replete with moisture, and enable them to live long without drinking on those extensive and dry tracts. Besides this, nature has given the male an admirable magazine for their security against drought, being a pouch whose entrance lies immediately under the tongue, and is closed by a lock of holding near seven quarts; and this they probably fill with water, to supply the hen when sitting, or the young before they can fly. Bustards lay only two eggs of the size of those of a goose, of a pale olive-brown, marked with spots of a dark colour; they make no nest, only scrape a hole in the ground. In autumn they are (in Wiltshire) generally found in large turnip-fields near the downs, and in flocks of 40 or more.

OTTER. See Mustela.

OVAL, an oblong curvilinear figure, wider than called ellipse. The proper oval, however, or egg-shaped, differs considerably from that of the ellipse, being an irregular figure, narrower at one end than at the other; whereas the ellipse, or mathematical oval, is equally broad at each end; though they are sometimes called when the curve is very obtuse. These are commonly confounded together, even geometricals calling the oval a false ellipse.

OVARIUS. See Anatome, and Comparative Anatome.

OVIEDA, a genus of the corydalis angio-
OVI

OVI

OVI

OVI 323

2. Ovis aries, the common sheep. This animal is so generally known, that a particular description of its form and manners becomes unnecessary. The domestic sheep, in its most valuable or woolly state, exists hardly anywhere in perfection; being of various kinds, peculiar to different countries, and some of the temperate parts of Asia. When transported into very warm climates, it loses its peculiar covering, and appears coated with hair, having only a short wool next the skin. In very cold climates also, the exterior part of the wool is observed to be hard and coarse, though the interior is more soft and fine. In England, and some other European regions, the wool acquires a peculiar length and hardness, and is best adapted to the various purposes of commerce.

That of Spain is still finer, but less proper for using alone; and is mixed with the English for the superior kinds of cloth.

Of all the domestic animals, none is so subject to various disorders as the sheep. Of these, one of the most extraordinary, as well as the most fatal, is the rot, owing to vast numbers of worms, of the genus fasciola, in the liver and gall-bladder. They are of a flat form, of an atrophical, with slightly pointed extremities, and bear a general resemblance to the seeds of a gourd.

3. Ovis steccheirosc, Cretan sheep; this variety is principally found in the island of Crete, and is kept in several parts of Europe for the singularity of its appearance; the horns being very large, long, and twisted in the manner of a corkscrew; those of the male are upright, those of the female at right angles to the head. This animal is ranked as a distinct species in the Systema Naturae. See Plate Nat. Hist. fig. 306.

4. Ovis Guineensis, African sheep. This, which is sometimes termed the Cape sheep, and which is erroneously mentioned in Buffon's Natural History as of Indian extraction, is supposed to be most frequent in Guinea, and is distinguished from others by its remarkably meagre appearance, length of neck and limbs, pendant ears, and long arched or curved visage. It is covered rather with hair than wool, and has a pair of grey, hairy wattles beneath the neck, as in goats. The horns are small, and the tail long and thick. This variety is also considered as a distinct species in the twelfth edition of the Systema Naturae. See Plate Nat. Hist. figs. 307, 308.

5. Ovis laticaudata, broad-tailed sheep; this extraordinary and awkward variety occurs in Syria, Barhar, and Ethiopia. It is also found in Tartary, Tibet, &c. Its general appearance, as to other parts of the body, scarcely differs from that of the European sheep, and in Tibet it is remarkable for the exquisite fineness of its wool. The tails of this sheep sometimes grow so large, long, and heavy, as to weigh, according to some reports, from fifteen to fifty pounds; and in order to enable the animal to graze with convenience, the shepherds are often obliged to carry boards, furnished with small wheels, under the tail. This part of the sheep is of a substance resembling marrow, and is considered as a great delicacy.

6. Ovis pudu. This is a newly discovered species, having been first described by Molina, in his Natural History of Chili. He informs us that it is a native of the Andes;
OUTWORKS, in fortification, all those works made without the ditch of a fortified place, to cover and defend it. See FORTIFICATION.

OXALATE. Salts formed by the oxalic acid. This genus of salts was first made known by Bergman, who described the greater number of them in his Dissertation on Oxalic Acid, published in 1776. These salts may be distinguished by the following properties: 1. When exposed to a red heat, their acid is decomposed and driven off, and the base only remains behind. 2. Lime-water precipitates a white powder from their solutions. 3. There is no excess of acid present. This powder is soluble in acetic acid, after being exposed to a red heat. 3. The earthy oxalates are in general nearly insoluble in water; the alkaline oxalates are capable of forming superoxalates much less soluble than the oxalates. 4. The insoluble oxalates are rendered easily soluble by an excess of the more powerful acids.

OXALIC ACID. When nitric acid is poured upon sugar, and a moderate heat applied, the sugar soon melts, an effervescence ensues, a great quantity of nitrous gas and carbonic acid gas is emitted; and when the effervescence ceases, and the liquid in the retort is allowed to cool, a number of small transparent chrysalis appear in it. These chrysalis constitute a peculiar acid, which has received the name of oxalic acid, because it exists readily, as Schelieh has proved, in the oxalis acustella, or wood sorrel. At first, however, it was called the acid of sugar, or the carboxylic acid.

Oxalic acid is in the form of four-sided prisms, whose sides are alternately larger, and they are terminated at the extremities by two-sided summits. They are transparent, and of a fine white colour, with considerable lustre. They lose very acid taste, and redden vegetable blues.

When this chrysalized acid is exposed to heat in an open vessel, there arises a smoke from it, which affects disagreeably the nose and head, and a powder of it is a powdery white much whiter than the acid had been. By this process it loses three-tenths of its weight, but soon recovers them again on exposure to the air. When distilled, it first loses its water of crystallization, then liquefies and becomes brown; a little phlegm passes over, a white saline crust sublimes, some of which passes into the receiver; but the greatest part of the acid is destroyed, leaving in the retort mass one-fifth of the whole, which has an empyreumatic smell, blackens sulphuric acid, renders nitric acid yellow, and dissolves in muriatic acid without alteration. That part of the acid which sublimes is unaltered. When this acid is distilled a second time, it gives out a white smoke, which, condensing in the receiver, produces a colourless unchrysalizable acid, and a dark-coloured matter remains behind. During all this distillation, a vast quantity of elastic gases makes its escape. From 279 grains of oxalic acid, Bergman obtained 109 cubic inches of gas, half of which was carbonic acid, and half carbureted hydrogen. From 104 grains of oxalic acid, Fontana, from an oven, obtained 43 cubic inches of gas, one-third of which was carbonic acid, the rest carbureted hydrogen.

From these facts, it is evident, that oxalic acid is composed of oxygen, hydroxon, and carbon.

The chrysalis of oxalic acid are soluble in their own weight of boiling water. Water at the temperature of 62.7° dissolves half its weight. The specific gravity of the solution is 1.093. One hundred parts of boiling alcohol dissolve 30 parts of these chrysalis; but at a mean temperature only 45 parts. Liquid oxalic acid has a very acid taste, when it is concentrated, but a very agreeable acid taste when sufficiently diluted with water.

It changes all vegetable blues, except indigo, to a red. One grain of chrysalized acid, dissolved in 1920 grains of water, reduces the blue paper in which sugar-loaves are wrapped: one grain of it, dissolved in 3000 grains of water, redens paper stained with tannin. According to Moreau, one part of the chrysalis acid is sufficient to decolourize a sensibly acid liquid to 2933 parts of water.

Its action is such, that none of it is sublimed when water containing it in solution is raised to the boiling temperature.

Oxalic acid is not acted upon by the air, or to the action of oxygen gas. The effect of the simple combustibles on it has not been tried.

It is capable of oxidizing lead, copper, iron, tin, bismuth, nickel, cobalt, zinc, and manganes.

It does not act upon gold, silver, platina, or mercury.

Oxalic acid combines with alkalies, earths, and metallic oxides, and forms salts known by the name of oxalates.

Muriatic and acetic acids dissolve oxalic acid, but without altering it. Sulphuric acid decomposes it partly by the assistance of heat, and a quantity of charcoal is formed. Nitric acid decomposes it at a boiling heat, and converts it into water and carbolic acid. From this result, and from the products obtained by distilling pure oxalic acid, it follows, that this acid is composed of oxygen, hydrogen, and carbon. Fourcroy informs us, that Vauquelin had he ascertained that it is composed of:

<table>
<thead>
<tr>
<th>Element</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Oxxygen</td>
<td>77%</td>
</tr>
<tr>
<td>Carbon</td>
<td>13%</td>
</tr>
<tr>
<td>Hydrogen</td>
<td>10%</td>
</tr>
</tbody>
</table>

But the experiments upon which this result is founded, have not been published; so that it is impossible to judge of their accuracy.

The affinities of oxalic acid, according to Bergman, are as follows:

<table>
<thead>
<tr>
<th>Element</th>
<th>Affinity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lime</td>
<td>Basic</td>
</tr>
<tr>
<td>Barium</td>
<td>Basic</td>
</tr>
<tr>
<td>Strontia</td>
<td>Basic</td>
</tr>
<tr>
<td>Magnesia</td>
<td>Basic</td>
</tr>
<tr>
<td>Potass</td>
<td>Basic</td>
</tr>
<tr>
<td>Soda</td>
<td>Basic</td>
</tr>
<tr>
<td>Alumina</td>
<td>Basic</td>
</tr>
<tr>
<td>Oxalic</td>
<td>Acid</td>
</tr>
</tbody>
</table>

This acid is too expensive to be employed for the purposes of domestic economy; but it is extremely useful in chemistry to detect the presence of lime held in solution. For this purpose it is neutralized by the pure acid, or of the solution of oxalate of ammonium, is dropped into the liquid supposed to contain
lime. If any is present, a white powder immediately precipitates. The reason of this is, that the other oxides, the insoluble and oxalic acid in consequence is capable of taking lime from every other acid.

Oxals, zoodacor, a genus of the pen-tacynia order, in the decandria class of plants, and in the natural method ranking under the 14th order, gruniales. The calyx is pentahyous, the perianth is at the capsule pedunculose, and opening at the angles. There are 96 species; of which the common wood sorrel grows naturally in moist shady woods, and at the sides of hedges, in many parts of Britain, and the second is seldom admitted into gardens. The roots are composed of many scaly joints, which propagate in great plenty. The leaves arise immediately from the roots upon single long footstalks, and are composed of three heartshaped leaves. They are gracefully acid, and of use in the scurvy and other patrid disorders. The bulbous kinds from the Cape are elegant ornaments of the greenhouse.

OXIDE, any substance combined with oxygen, in a proportion not sufficient to produce acidity.

Oxygen is capable of combining with bodies usually in various proportions, constituting a variety of compounds with almost every substance with which it is capable of uniting. Now the whole of the compounds into which oxygen enter, may be divided into two sets: 1. Those which possess the properties of acids; and, 2. Those which are desitute of these properties. The first set of compounds are distinguished by the term oxides; but the second is but seldom admitted into highest. By oxide, then, is meant a substance composed of oxygen and some other body, and destitute of the properties which belong to acids. It is by no means improbable that the same base and oxygen belonging to both of these sets, according to the proportion of oxygen which enters into the compound. In all these cases, the smaller proportion of oxygen constitutes the larger the acid. Hence it follows, that oxides always contain less oxygen than acids with the same base.

Oxygen combines with three distinct set of bodies, the simple combustibles, the incom bustibles, and the metals, and forms oxides with every individual belonging to these sets. These oxides vary as the substance which constitutes the base; but all the oxides of the simple combustibles are combustible, except the oxide of hydrogen, which is a product of combustion; all the oxides of the simple in combustibles are supporters of combustion; and all the oxides of the metals are either products of combustion or supporters. Of course, the first set of oxides (except that of hydrogen) cannot be formed by combustion; neither can the second set; but part of the third set are formed by combustion, a part by the union of the oxygen of supporters without combustion. Besides these oxides, which may be considered as simple, because they contain but one ingredient combined with oxygen, there is another set much more numerous than they, consisting of oxygen united at once with two or more simple substances. These bodies may be distinguished from the others by giving them the name of compound oxides.

Oxides are often distinguished according to the degree of oxygen they contain. Thus the protoxide or first oxide denotes a metal combined with the least portion of oxygen; the simple oxide, a metal combined with one dose of oxygen; and when a metal has combined with as much oxygen as possible, the compound oxide is called a peroxide.

Oxide, carbonate. When a mixture of pured charcoal and oxide of iron or zinc is exposed to a strong prernpor, the metallic oxide is gradually reduced, and during the reduction a large quantity of gas is evolved. This gas is a mixture of carboxic acid gas, and another which burns with a blue flame. This last is carboxic oxide.

Oxyraphus, a genus of plants as yet unclassified, nearly allied to the mirabilis, a native of Peru.

Oxygen, in chemistry, a simple substance that enters into the composition of water and air. The term oxygen signifies a double principle, which generates on itself. The one of the most characteristic properties of this body, was discovered by Dr. Priestley in 1774. It was at first called depilolated air, and afterwards successively known by the names of eminently respirable air, pure air, vital air, as long as it was not known that this aerial form is merely one of its states of combination; which, notwithstanding its frequency, and its being less impure in this than in any other condition, does not prevent its being concealed in other states; and more particularly as, by combining with many bodies, it loses this elastic state or appearance of air. As soon as this truth was well proved, and clearly explained by Lavoisier, the necessity was admitted of giving it a different name, which might be applicable to all the states in which it could exist, as well that of gas as of the liquid or solid form. Lavoisier first called it this oxygen principle; and the French school having decided for the word oxygen, by admitting a simple change of termination in the first word proposed by Lavoisier, this name became generally adopted.

The effect of oxygen is of such importance, that its presence must be stated as the most indispensable condition of combustion; which would not otherwise take place. It truly constitutes the essential part of that process, because its most decisive and extensive character is its indispensability in that process.

Oxygen, like many other natural bodies, is found in three states, but in neither of them is it alone or insulated. In the gaseous form it is dissolved in caloric; in the liquid and solid form it is combined with different substances, and can never exist concrete and pure without combination, like many other substances no less decomposable than itself. And though we can, in imagination, conceive it alone, insulated, pure, and in a solid state, experiment has never yet exhibited this fact. It is a discovery which still remains concealed from us. It is certain, indeed, is understood, under the name of some substance yet unknown in our collections of minerals.

As oxygen is frequently contained in a mere or less solid form in several natural fossils which have undergone combustion, and as it has much attraction for the cold color. It appears one of those fossilis should be heated more or less, or generated with a great quantity of caloric, in order to disregage this principle, and obtain it in the form of air or gas. This is the way chemists to procure oxygen gas. They expose certain substances, particularly metals burned by nature or by art, to a fire of considerable activity in closed vessels, so disposed as to conduct and receive, under inverted jugs, the elastic fluid intended to be collected. The burned matter passes again to a combustible state; and the oxygen which gave it the burned state, being separated and fused by calorice, for which it has a great attraction, becomes developed in the form of gas. It is the product of a true combustion.

Of the two bodies which form oxygen gas, the caloric, which is the solvent, and gives it the state of invisibility and elastic fluid, not being ponderable; the solid, which is dissolved, or oxygen, being the only ponderable and fixable body in all the substances with which this gas can combine; and chemists having no other means of obtaining oxygen in a smaller state than that of gas, which they use for a great number of operations or combinations; many of them are habituated to denote this gas by the simple name of oxygen. This is, nevertheless, an error of nature and of the living principle, to the pernicious of chemical doctrine; because the word oxygen ought only to be used to denote the base of this gas considered alone, or in all the possible states, but particularly in the numerous combinations wherein it possesses the liquid or solid state.

Oxygen gas. See Air.

Oxymel, in pharmacy, a composition of vinegar and honey.

Oxymuriatic acid. This acid was discovered by Schiede in 1774, during his experiments on manganese. He gave it the name of oxymuriatic acid, and the supposition that it is muriatic acid deprived of plicatogen. The French chemists, after its composition had been ascertained, called it oxymuriatic acid; which uncommon and unappellation Kirwan has simply contracted into oxymuriatic acid.

It may be procured by the following process: Put into a tubulated retort a mixture of three parts of common salt, and one part of the black oxide of manganese in powder. Place the retort in the sand-bath of a furnace, plunge its beak into a small water-trough, and lute a bent funnel into its mouth. When the mixture has acquired a moderate heat, pour into it at intervals through the last funnel two parts of sulphuric acid, which ought to be somewhat dilute with water. An effervescence ensues; a yellow-bodied gas issues from the retort, which may be received in large phials fitted with ground stoppers.

Oxymuriatic acid gas is of a yellowish-green colour. Its odour is intolerably acrid and suffocating. It cannot be breathed without provoking fatal effects. The most solemn and industrious Pelletier, whose chemical labours have been so useful to the world, was occasioned by a enthusiast attempting to respire it. A consumption was the consequence of this attempt, which, in a short time, proved
When phosphorus is plunged into this gas, it immediately takes fire, burns with consider- able splendour, and is converted into phlogistic acid.

Oxymuriatic acid oxidizes all the metals without the assistance of heat. Several of them take fire as soon as they come into contact with the gas. All that is necessary is, to throw a quantity of the metal reduced to a fine powder into a vessel filled with the gas. The inflammation takes place immediately; the metal is oxidized; while the acid, decomposed and reduced to common muriatic acid, combines with the oxide, and forms a muriatic. Arsenic burns in oxymuriatic acid gas with a blue and green flame; bismuth, with a lively bluish flame; nickel, with a white flame, bordering on yellow; cobalt, with a white flame, approaching to blue; zinc, with a lively white flame; tin, with a feebly bluish flame; lead, with a sparkling white flame; copper and iron, with a red flame.

Several of the metallic sulphurates, as chalcan, realgar, sulphur of antimony, take fire when thrown in powder into this gas.

When oxymuriatic acid and ammoniacal gas are mixed together, a rapid combustion, attended with a white oxide, instantly takes place; both the gases are decomposed, water is formed, while azotic gas and muriatic acid are evolved. The same phenomena are apparent, though in a smaller degree, when a liquid ammonia is poured into the acid gas. The same decomposition takes place, though both the acid and alkali are in a liquid state. If four-fifths of a glass tube are filled with oxymuriatic acid, and the remaining fifth with ammonia, and the tube is then inverted over water, an effervescence ensues, and azotic gas is extracted. It was by a similar experiment that Berthollet demonstrated the composition of azotic acid.

Oxymuriatic acid is composed of
84 muriatic acid
16 oxygen
—- 100.

P
PACE, passus, a measure taken from the space between the two feet of a man in walking; usually reckoned two feet and a half, and in some islands, a yard or three feet.

The geometrical pace is five feet; and 60,000 such paces make one degree of the equator.

PACK, in commerce, denotes a quantity of goods loaded on loads or bales for carriage. A pack of wool is 47 stone and two pounds, or a horse's load.

PACKERS, persons whose employment it is to pack up all goods intended for exportation; which they do for the great trading companies and merchants of London, and are answerable if the goods receive any damage through bad package.

PACOS. See CAMELUS.

PÆDEMA, a genus of the pentandria monogynia class and order. It is contorted; berry void, brittle, two-seeded; style biff. There are two species, climbers of the East Indies.

PÆDEROTA, a genus of the monogynia order, in the pentandria class of plants, and in the natural method ranking under the 30th order, contorta. The berry is empty, brittle, and dispermous; the style biff. There are three species.

PÆXONIA, pecyn, a genus of the digynia order, in the polyandra class of plants, and in the natural method ranking under the 26th order, multiflicate. The calyx is pentaphyllous; the petals five; there are no styles; the capsules are polyporous. There are five species, most of them hardy. They are large herbaceous flowery perennials, with tuberous roots, sending up strong annual
PAI The and about the red chamber, & of It not the display ing particularly the light and shade of objects, as far as by the diminution or increase of these the harmony of tints before-mentioned can be eff ected; but that mixed effect of colour and of light and shade which is denominated chip-scuro, is more justly regarded as a branch of composition.

Art of painting. The art of painting is justly ranked among the highest of that class of arts which are denominated liberal. Its tendency and powers are congenial with those of poetry, and it has of course been considered as an employment worthy of the most elevated ranks of life. The honours with which it has been distinguished in various countries, will be found in the history of painting.

We shall proceed, in consistence with a general plan, to describe, first, the means by which the student may hope to forward his progress in this admirable but difficult art. We shall divide the different branches of painting, and the methods of practice; and shall lastly add a summary of its history in all ages and countries.

Course and methods of study requisite to attain the art of painting.

The process of study requisite for the attainment of the art of painting, has been in various ages already described, under the article Design; the knowledge of design being, as was there said, the basis of painting, and its various attainments the necessary steps by which the painter must commence his progress in the art. The student having completed the various studies which lead to excellence in drawing, must proceed to transfer the principles he has learned to his canvas; and, before he can arrive at eminent perfection, must acquire a complete mastery of the new materials in which he travels, and know every part of the mind and the skill of his hand. For this purpose, he must add to the knowledge he already possesses, the study of colours, and colouring in all their branches. It is the knowledge of this department of art which particularly characterizes the profession he is about to undertake. The various branches of design have formed the commencement of his studies, and he may be supposed a perfect master of them; but these alone cannot constitute him a painter; neither can he acquire that title by the knowledge of every rule of invention or composition. If we consider a painter in regard of these last powers of skill, we rank him with the poet or the draughtsman; if in regard of anatonic knowledge or perspective, we confound him with the anatomist or the mathematician; if in regard of symmetry, grace, and proportions of forms, we cannot distinguish him from the geometer or the sculptor. The painter, who is supposed the perfect imitator of nature, necessarily makes colouring his chief object, since he only considers nature as he is enabled to imitate it only by his hand; and he can only see it as he is visible; and she is only visible as she is coloured.

Although the perfect idea, therefore, of a painter depends on invention, composition, design, and colouring, conjointly, yet it is by their union of these only that he can establish a special branch of art; and the first and ultimate accomplishment of all his studies in the art of painting.

We shall, therefore, first treat of colouring, and proceed to consider more minutely the component parts which form the art of colouring.

Colouring. Colouring is that mode of art by which the artist imitates the appearance of colours in all natural objects, and gives to artificial objects those which are calculated to please or to deceive the sight.

It is the duty of the colourist to consider, that as there are two sorts of objects, the natural or real, and the artificial or painted, so there are two sorts of powers in the mind, the natural, or that which makes all the objects in nature visible to us, and the artificial, or that which, by a judicious mixture of simple colours, imitates those natural ones in all their various situations and circumstances.

The painter must first endeavour to acquire a perfect knowledge of these two sorts of colours; of the natural, in order to distinguish with precision which of them he ought to imitate; and of the artificial, in order to compose the tint most proper for representing the natural colour. These acquisitions include the study of dioptries, or that part of optics which has for its object the nature of light and colours, and an acquaintance at least with the general principles of chemistry. (See Optics.) He will learn also that the natural colour is of three sorts: 1st, the true colour of the object; 2d, the reflected colour; 3d, the colour of the light. In the artificial colours, he will distinguish their force and softness separately and by comparison, in order that he may use a proper judgment in heightening or attenuating them, according as that which he is to imitate.

To this end he will also consider, that a picture is, for the most part, a flat superficies, that, some time after the colours are laid on, they necessarily lose their freshness; and that the distance at which a picture is viewed takes from it much of its brightness and vigour; and it is therefore impossible to guard against these drawbacks on the effect of his pencil, without a complete mastery of that art, which is the chief object of the art of colouring.

Although imitation is the principal aim of colouring, the painter must by no means be the slave of natural objects, but the judge and judicious imitator of them: he must not imitate all the colours in proportion, but these objects as they are, only imitating them as they are, in their proper situation, and in their proper situation, and sometimes striving to heighten it by superior force and brightness of colours, in order to convey...
to the eye with precision and truth the spirit
and real character of the object. There are
few, and those only among the greatest
painters, who have arrived at the perfect
management of this difficult part of art.

On the apposition of colours, and on the
knowledge of chiaro-scuro, depends all the
harmony of colours. In what that happy
arrangement of colours consists, which
produces effects delightful to the eye, no rules
are given to ascertain. If the source of
information in this point is not in the mind of
the artist, it remains for him to find it.

Improvement, however, may, and must,
be superadded to natural discrimination:
to acquire the necessary improvement,
he will find the best school of the works
of those great masters who have possessed
the power of colouring the object in an eminent
degree. Such are Titian and Rubens. But he
must be careful that, in studying even these
great examples of the art, he does not forget
that he is the pupil of the road to
the nature, the final source of his imitation.

The few maxims which can be offered
on the subject of colouring, the following are
the least questionable:

We must learn to view nature to
advantage, and not to repeat her well.
There are two manners of colouring: the one
depending on habit, the other on the true-know-
ledge of colours. The first is confined, the
second unlimited.

The harmony of nature in her colours
arises from objects participating of one
another by reflection; there is no light which
does not strike some body; nor is there any
enlightened body which does not reflect its
light and colour at the same time, in propor-
tion to the force of the light, and according
to the nature of the colour. This participa-
tion of reflection in light and colour, consti-
tutes that union of colouring which is the
business of the painter to imitate.

This desirable union of colour is sometimes
considerably altered in pictures by the process
of glazing; that is, by the use of colours which,
having little body, are diaphanous; and are,
by means of a light brush or pencil, passed over
(or, as painters express it, scumbled over) such
parts of the picture as were intended to be
opaque or otherwise discordant. This use of
transparent colour is by some called toning,
or tunng; and probably affords the justest ex-
planation of the well-known passage in Pliny,
where he speaks of the Atramentum used by
one of the ancient painters to give harmony
and sweetness to his picture.

Variety of tints, very nearly of the same
tone, employed in the same figure, and often
upon the same part, with the moderation, con-
tribute much to harmony.

The turn of the parts, and the outlines
which insensibly melt into their grounds and
artfully disappear, bind the objects to-
together, and preserve them in perfection
as they seem to conduct the eye whatever it sees,
and persuade it that it sees what it really does
not see, or at least that it conceives that
continuity which the extremities of the objects
cannot supply.

Any loading or overcharging of colouring,
for whatever purpose it is used, must be so
discretely managed, as not to destroy the
character of the object.

The repetition of the same colour in a
picture is to be avoided, unless where it
serves to connect the various masses of a
composition. The eye becomes tireful with
viewing the same object; it loves variety art-
fully presented to it.

The apparent value of colours in a picture
(as in all things) arises from comparison.

Saturated and variegated by one another, have a kind of aerial brightness,
when mixed together, produce a disagree-
earthly colour: for instance, ultramarine
with fine yellow, or blue vermilion.

Colours which by insensible strength and
become harmonious, are called broken
colours, and contribute, as greatly to the
sweetness and softness of tones in pictures
as they subtract from their brightness.

Chiaro-scuro, the knowledge of lights
and shades evidently forms a part of that
essential distinction of painting, which we
have just described under the head of colouring,
and is requisite to that part of colouring
which is called chiaro-scuro.

The art of chiaro-scuro is that which,
of all others comprehended under the general
head of painting, is the greatest power of
attracting the eye of the spectator,
and of exciting the admiration of the artist
in particular.

In the same manner that we have here
endeavoured to define the general principles
of that distinctive branch of the painter's art
called colouring, and as we have before fully
described the requisite progress of study in
drawing or design, we shall now proceed to
the chiaroscuro branch; composition; and
afterwards add a few words respecting its
use in painting.

Composition. Composition may be di-
vided into the general distribution of objects,
the grouping, the choice of attitudes, the
contrast, the cast of draperies, and the man-
agement of the back-ground or the connec-
tion of the whole effect.

In composition, as far as regards the gene-
ral arrangement of objects, the painter ought
to contrive that the spectator may, at the
first sight, be struck with the general charac-
ter of the subject, or at least may compre-
prehend its principal scope. This effect is most
obtained by grouping the most essential
figures in the most conspicuous places,
provided it can be done without violence or
impropriety. Besides this distinctness in the
general expression of the subject, the beauty
of the composition will depend on the variety
of connection, and contrast, displayed in the dis-
tribution of objects; provided, in like manner,
that these are conformable to the nature of the
subject, whether gay, familiar, full of
motion and hurry, or still, solemn, and melanc-
holical.

The grouping regards both design and
chiaro-scuro. In the former, it respects the
figures principally concerned in the expression
of the subject, which must necessarily lie
to, or distant from, one another, as their
actions, conversations, or other mutual rela-
tions, require. In the latter, it regards those
masses which are formed from objects which
are free from any proper outline or of any
effects of light and shade which are formed
in consequence of such assemblage or union.
These are the points to which the attention
must be principally and diligently directed
in forming the groups of a composition.
The choice of attitudes is the principal subordinate division of grouping. A whatever attitude is given, the ordinary arrangement of the figures and the general expression of the action, and the interest of the spectator towards it, will substantially contribute its due portion to the completion of the group, but the greatest care must be taken by the painter, that it does not appear to be introduced for that purpose merely. So important is the appropriate to the character of the individual figure, and expressive of its requisite action; and it must, at the same time, combine whatever beauty of form can be shown by such a selection of turns or views of the body, as the natural expression of that character admits. The knowledge of general characters, under the various modifications of sex, age, and condition; of the various operations of the passions in the human mind; and a thorough acquaintance with the circumstances of the history or other subjects to be represented; are the best guides to a good choice of attitudes.

To the effect produced by well-chosen attitudes, contrast gives the most powerful aid. Contrast has many kinds of expression (see Contrast); and it is only to be observed here that in composition it extends not to human figures only, but to objects of every kind, animate or inanimate, and also to the effects of light or shadow, by which character is exhibited.

Of draperies, and the proper modes of casting or disposing them, notice has been taken under the article Drawing.

The management of the back-ground, or connection of the general effect, is, of all other parts of composition, at once the most difficult to be defined or performed. It consists in the general accordance and subordination of objects with and to one another, so that they shall all concur to constitute but one single object. It is to the whole what the grouping of lines, forms, and chasos-quo, is to a part. It is effected by a due combination of lights and shades, by an union of colours, and by such oppositions or contrasts as are sufficient to relieve the distinct groups, and to give repose to the eye. Amidst several groups (if the picture consists of such), it requires that one should be justly predominant in force and colour, and that all detached objects should be so contrasted with their respective groups as to form together one general mass of repose for the support of the principal object.

The satisfaction of the eye is the ultimate purpose of this difficult part of composition.

Invention. It now remains to enlarge on the most arduous attainment of the painter, and which we have placed at the last in the order of his studies, because it is that which gives the highest character to the artist, as it affords the greatest opportunities of displaying the powers of his mind.

Invention comprehends every kind of subject which can be represented to sight; but it is generally divided into historical, allegorical, and mystic.

Invention simply historical, is the collection of such objects as plainly relate to or represent a subject. Its degrees are more or less valuable according to its matter or subject, and its requisite properties are fidelity and perspicuity. It extends also to the introduction of all subsequent embellishments, as the most consistent and congenial with the history represented, in the same manner as in poetry.

The same illustration by collateral erudition, the same enhancing by incidental ornament, the same blending of poetic imagery (not purely illustrative), is admired in the painter as in the poet.

The cartoons of Raphael are among the works which present the finest examples of this species of invention. The battles of Constantine, St. Michael, others by the same master, in the Vatican, are equally excellent.

Allegorical invention is a choice of objects which serve to represent either wholly or partly what they are not; and of which the expression arises from illusion. Calumny dragged in, at the foot of Truth, as described by Lucian, and sketched by Raphael, is wholly of this class. Such also is Hercules placed between Virtue and Pleasure (generally called the Choice of Hercules); and such also is the picture of the School of Athens, by Raphael, in which many persons of various times, countries, and conditions, are brought together, to represent the various states of philosophy.

Other works are partly allegorical and partly historical; in which the spectator easily distinguishes the figures purely historical from others mixed with them in the same picture, and entirely allegorical. Such are the well-known pictures of Mary de Medici, painted by Rubens.

The first great requisite of allegorical painting, is that it be intelligible. An allegory not understood, is a loss. To the painter and spectator. For this purpose, it must, in general, consist of such symbols as are established on good authority, or, if new, are obvious to the mind.

In addition to this first requisite, the proper choice of allegorical demijets, either that the subject could in no other way be represented, or that it could not be represented by historical invention in an equal degree of force and beauty.

Mystical invention respects the expression of such ideas as are incalculable in our minds by the precepts of religion. The paintings in the Capella Sistina at Rome, by Michael Angelo, exhibit an illustrous instance of this kind of composition; and much advantage can be obtained from certain modifications) can enter no better school of this part of art. The Transfiguration of our Saviour, by Raphael, the Annunciation, Holy Families, &c. of numerous painters, are of the same kind.

The style of mystical painting is sometimes familiar and tender, as in subjects of the Holy Family, but chieftly majestic and elevated.

We have thus accompanied the painter, and slightly, but it is hoped justly, traced his path, through the long course of his studies; in the prosecution of which he must himself contribute the fullest share of unwished diligence and attention. Nor are his pursuits to be considered as bounded by the rules which have been given. Enough remains behind to exercise both his industry and genius.

Beyond the complete possession of the various component parts of art which have been enumerated, expression, in all its distinct powers of vivacity, justness, and delicacy, calls for every exertion of talent. See Expansion. The purity, in all this, in order to attain perfection, must be superadded the rare and transcendent charm of grace, that indestructible excellence which no painters are allowed to have reached, except Apelles, Raphael, and Coreggio.

Of the different classes of painting.

Painting is chiefly divided into historical (comprehending allegorical and mystical), grotesque, and portrait painting. The modes of flowers, battles, landscape, sea-sights, architecture, still life. The subordinate divisions of all these are endless.

The first has been sufficiently spoken of under the head of invention, in the present article.

Grotesque painting being also already explained under its proper article, it is only necessary here to add, that the finest examples of this species of art are to be found in the celebrated Loggia of the Vatican palace at Rome, painted from the designs of Raphael, and in the ceiling of the portico of the Capitol, carved from those of Michael Angelo.

Of portrait, as being a branch of painting to which our country is peculiarly addicted, it is requisite to give a more detailed account.

Portraiture. If the accurate imitation of nature is, on any occasion, capable of forming the principal merit of that art, it must certainly be in portraiture, which not only represents a man in general, but such an one as may be distinguished from all other men. The greatest perfection of a portrait, however, and the greatest fault is the resemblance of a person for whom it was not designed, unless we are inclined to except a still more grievous defect, viz. the want of resemblance to any person whatever. The resemblance of no painter, however, is indeed frequently found in living nature, but it is seldom or never so complete and entire, but that some particular turn or view of the face will betray the difference; and it is the business of the artist ever to discover and to appropriate to his pencil, those peculiar features, lines, and turns of the face, the representation of which will effectually convey to the spectator the distinct especial idea of the person whose portrait is set before him.

Various difficulties attend, and not seldom impede, the execution of this task. It is true, that there is not one single person in the world, of whatever age, sex, or condition, who has not a particular figure of his body and face; but it is also the essential duty of portraiture, that it not only imitate what we see in nature, but that it exhibit such views of nature as are confessedly the most advantageous to the person represented. The moment that the idea raised by the sight of the portrait is inferior to that raised by the sight of the person, the labour of the artist sinks into the degrading region of caricature.

Likeness, however, being the essence of portrait, it is unquestionably the part of the painter to imitate defects as well as beauties, since, by this means, the resemblance will be more complete. He is only to be aware that he strictly preserves that balance which constitutes the character of the object. It has been sometimes suggested by those who are more willing to court favour than fame, that all appearances of deformity, when the air, temper, and general expression of the face, can be without them, ought to be omitted or corrected in portrait; but this must be done at least with considerable discretion; for, by too strenuous endeavours to correct,
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The different modes of painting new in use are:

Oil painting: preferable to all other methods, as it admits of a perfect gradation of this in the most durable of all materials, except porcelain.

Mosaic painting: in which an imitation of objects is produced by the junction of a great number of small pieces of natural marble of different colours fixed in stucco, a mortar, so that if the mortar is well prepared, the monuments of this art may descend to the most remote ages. Some of the works of the great Italian masters have been exceedintly copied in mosaic, and are to be seen in St. Peter's church at Rome.

Fresco painting: which is performed with colours diluted in water, and laid on a wall newly plastered, with which they incorporate, and are sometimes as durable as the walls themselves.

Crayon painting: in which colours, either simple or compound, are ground in water mixed with gum, and made into small rolls or hard paste, which are then used on paper or parchment.

Miniature painting: which consists of colours prepared with water or gum, and laid on vellum or ivory. It is of course confined to works of a very small size.

Enamel painting: which is performed on copper or gold, with mineral colours, dried by fire. This method is also very durable.

Wax, or encaustic painting: performed by the mixture of wax with the varnish and colours.

Painting on glass, too well known to need description, and performed by various methods.

Painting in distemper: which is with colours mixed with size, whites of eggs, or any thing glutinous, varnished, and used on paper, linen, silk, board, or wall.

Painting in water-colours, more properly called liming: it is performed with colours mixed with water, gum, size, paste, &c. on paper, silk, and other materials.

To these is to be added elydidoric painting, consisting of a mixed use of oil-colours and water.

For a full account of some of these methods, see their respective articles in this work.

Those of which a further explanation remains to be given are distemper, fresco, oil-painting, miniature, mosaic, and the elydidoric method.

The former shall be treated of according to their order in point of time.

Fresco. Fresco is the most ancient of all kinds of paints, the most speedily executed, and sometimes the most remarkable for its durability. Norden speaks of some ruins of Egyptian palaces, on the walls of which are colossal paintings, which have been preserved by Winckelmann to have been executed in fresco. The fragments of ancient paintings handed down to us by the Romans are likewise in fresco. Could this stability of colour be continued, this art would be preferable to all others, particularly in the decoration of palaces, temples, or other large
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As it has a freshness, splendour, and vigour, unknown either to oil or water-colours. It is at the same time the most difficult of accomplishment, requiring, in the opinion of Vasari, "the greatest force of genius, boldness of execution, and readiness of pen in the work." The reason for such an opinion will be seen in the following account of the mechanical process of this beautiful mode of art.

Method of painting in fresco. Before you begin to paint, it is necessary to apply two layers of stucco on the place where your work is to be executed. If you are to paint on a wall of brick, the first layer is easily applied; if of freestone closely joined, it is necessary to make excavations in the stone, and to drive in nails or pegs of wood, in order to hold the layer together.

The first layer is made of good lime and a cement of pounded brick, or, which is better, river-sand, which latter forms a layer more uneven, and better fitted to attach the second smooth to the surface. Patients appear to have possessed the art of making such species of mortar superior to any now in use.

Before applying the second layer, which you are to paint, it is necessary that the first is perfectly dry, as the lime while moist contains a pernicious effluvium. When the first layer is perfectly dry, wet it again with water, in proportion to its dryness, that the second layer may more easily incorporate with it.

The second layer is composed of lime, slaked in the air, and exposed for a whole week, and of river-sand of an equal grain, and moderately fine. The surface of this second layer must be uniformly even. It is laid on with a trowel; and the workman is provided with a small piece of wood, to remove the large grains of sand, which, if they remained, might render the surface uneven.

To give a fine polish to this surface, a sheet of paper should be applied on it, and the trowel passed and repassed over the paper; this caution will prevent any little inequalities which might injure the effect of the painting at a distance.

The workman must not extend the layer over a greater space than the painter is able to finish in a day, as it is necessary that the ground should always be fresh and moist under his pencil; and it is on this account that the readiness of the artist's hand becomes so requisite a quality in the execution of works in fresco.

In the ground being thus prepared, the painter begins his work; but as painting in fresco must be executed rapidly, and as there is not time to retouch any of the strokes of the brush with good effect, he will first have taken care to provide himself with large finished drawings in chalk, or paintings in distemper, of the same size as the work which he has to paint, so that he shall have only to copy these drawings on the wall.

These drawings are generally made on large sheets of paper pasted together, and have thence been generally termed cartoons (cartoni).

The painter traces the outlines of the figures on the plaster, by passing a steel point over them, or prickling them closely and passing very finely powdered charcoal through the prickled holes. He then proceeds to the completion of his work; having his chalk tints ready prepared in asperges, and pots, and generally first trying their effect on a dry smooth tile, which quickly imbibing their moisture discovers the line which they will have with water on the wall.

All natural earths are good for painting in fresco. The colours are ground and tempered with water. It is to be remarked, that all the colours used in this method of painting are somewhat dry, excepting the hyacinth red, ultramarine-red, the brownish red, ochre, ruth-ochre, and the blacks, particularly those that are passed through the fire. The best colours are white, made of old lime, and white marble-dust (the proportion of the latter depends on the quality of the lime, and must be found by trial, as too great a quantity of marble-dust will turn the colour black); ultramarine-blue, the black of charcoal, yellow ochre, burnt sienna, old umber, red ochre of Verona, Venetian black, and burnt ochre.

Other colours, which require to be used with greater precaution, are amel, or enamel-blue, and cinnabar. Enamel-blue must be applied instantly; while the lime is very moist; otherwise it will not incorporate; and if you retouch with it, you must do it an hour or more after the first application of it, in order to increase its lustre.

Cinnabar behaves like them all beyond all other colours, but it loses it when mixed with lime. It may, however, be employed in places not exposed to the air, if proper care is used in preparing it for this purpose, reduce the quantity of the pure cinnabar to powder, put it in a earthen vessel, and pour fine-water on it two or three times. By this process the cinnabar receives some impression from the lime-water, and you may then use it with greater safety.

The white of lime is formed by mixing lime, slaked a long time before, with good water. The lime deposits a sediment at the bottom of the vessel; when the water is poured off the remainder is the white of lime.

Another kind of white of lime is made from egg-shells, pounded, in great quantities, and boiled in water, together with quicklime, and afterwards put into a strainer and washed repeatedly with spring water.

The shells must be again pounded until the water employed for that purpose becomes pure and limpid; and when the shells are completely reduced to powder, they are ground in water, made up in small pieces, and dried in the sun.

The effect of this colour must be ascertained by experiment.

Oxides of all kinds make good colours for fresco, being previously burnt in iron boxes.

Naples yellow is dangerous to be used, when the painting is much exposed to the air.

Blacks, from charcoal, peach-stones, and vine-twine, are good; that extracted from bones is of no value.

There is a black used by the Italians, which they call fesca da botta. It is made of the lees of burnt wine.

Roman vitriol gathered at the furnaces, and called burnt vitriol, being afterwards pounded, retains the secret of painting in oil, which is only the grinding the usual green, in several kinds of oil, as poppy-oil, nut-oil, and linseed-oil. This method was likewise unknown to the layers where cinnabar is afterwards to be used; draperies painted with these two colours are so bright as to be fit to serve as backgrounds.

Ultramarine never changes, and seems to communicate its permanent quality to the colours with which it is mixed.

Oil paper. In addition to what has been said of this method of painting under its proper article, the following particulars are worthy of notice.

Until the discovery of oil-painting, the methods most generally adopted by all Italian painters were those of distemper and fresco.

In distemper, when they painted on boards, they often pasted over the boards a piece of fine cloth, to prevent them from paining; they then laid on a layer of white, after which, having tempered their colours with water and paste (or rather with water and yolks of eggs, together with little fig-tree branches, the milk of which mixed with the eggs), they painted their pictures with this mixture.

All colours are proper for distemper, except the white of lime, which is used in fresco only.

Azure and ultramarine must be used with a paste made of glove-skin, or parchment, as they will turn green when mixed with yolks of eggs.

If the work is on walls, care must be taken that they are quite dry. The painter must lay on two layers of hot paste before he applies the colours, which, if dry may also temper with paste, the composition of eggs and fig-tree branches being only retouching, and the paste rendering the colours more durable. When used, it must be kept hot by fire. This paste, as has been said, is made of glove-skin or parchment.

All their designs for tapestry were made on paper, in the same manner as has been mentioned in the account of the cartoons used for fresco-painting.

When a painter in distemper would work on cloth, he must choose that which is very old and smooth; then press pounded plaster with glove-skin paste, and lay it over the cloth; when dry, add another layer of the same paste.

All the colours are pounded with water, and as the painter wants them for his work, he tempers each paste with water; or if he will only make use of yolks of eggs, he takes of water one glass, to which he adds an equal quantity of vinegar, the yolk, white, and shell of an egg, and some ends of fig-tree branches cut into small pieces, and beats them all well together in an earthen pan.

If he wishes to varnish his picture when finished, he must rub it with the white of an egg well beaten, and then put on a single coat of varnish.

Oil painting. The principal advantage of oil-painting over other methods consists in the colours drying less speedily, so that it allows the painter to finish, smooth, and retouch his works, with greater care and precision. There is a mixture of pure oils, which, when it becomes more blended together, produce more agreeable gradations, and a more delicate effect.

The antients are said (see the historical part of this article) to have been ignorant of the art of painting in oil, which is only the grinding the usual green, in several kinds of oil, as poppy-oil, nut-oil, and linseed-oil. This method was likewise unknown to...
the first masters of the modern Italian schools, and is generally thought to have been discovered in the 15th century. It was first used on board or panel, afterwards on plates of copper, and on linen cloth. Whichever of these materials is used for the purpose of painting on it, it is requisite that a ground of colour is previously laid, which is called the priming; or else that they are covered with a layer of size, or other glutinous substance, to prevent the oil from penetrating, and being wholly absorbed during the painting of the picture. These preparations are familiarly known to all connoisseurs.

In some of the pictures of Titian and Paolo Veronese, there is reason to believe that they laid their ground with water-colours, and painted over it with oil, which contributed much to the vivacity and freshness of their works by the ground gradually inhaling so much of the oil as may be requisite to preserve the brightness of the natural colours.

As the superior beauty of oil-painting depends on the vivacity and delicacy of durable tints, we shall present the student with the best rules drawn from a careful study of the works of Vandyck and Rembrandt, two of the most remarkable colourists in different styles, whose works are arranged so as to be a method, that the student may be led, step by step, through all the difficulties of this nice and pleasing progress.

We shall first treat of the painting of flesh, next of drapery, then of the background, and lastly of landscapes.

OF PAINTING FLESH.

Principal colours from which all the tints of the flesh are made, and their qualities in painting.

Flake-white is the best white known to us. This colour should be ground with the finest poppy-oil that can be procured. It is often found to turn yellow, on account of the oil, generally sold by that name, not being really drawn from poppies.

White comes forward to the eye with yellow and reds, but retires with blues and greens. It is the nature of all whites to sink into whatever ground they are laid on, therefore they should be laid on white grounds.

Ivory-black is the best black: it is a colour which mixes kindly with all the others. It is the true shade for blue; and when mixed with a little Indian red, it is the best general shadow-colour that can be used. It is generally ground with linseed-oil, and used with drying oil.

Black is a cold, retiring colour.

Ultramarine is the finest blue in the world: it is a tender retiring colour, and never glares, and is a beautiful glazing colour. It is used with poppy-oil.

Prussian-blue is a very fine blue, and a kind-working colour: it is ground with linseed-oil, though not oil as is more proper. It should never be used in the flesh, but in green tints and in all the blues and greens.

Light-ochre is a good mixing colour, and of great use in the flesh: it is usually ground with linseed-oil, but nut-oil is better. All yellows are strengthened with red, and weakened with blues and greens.

Light-red is nothing but fine light ochre burnt. This and white, in mixing, produce a most perfect flesh-colour. It is a beautiful clean colour; but for mixing for the white, and therefore to grow darker. It should be ground and used with nut-oil.

No vermillion but what is made of the true native cinnabar should be used. It will not glaze; but is a fine colour when it is glazed, and therefore to grow darker. It should be ground and used with nut-oil. It will always be laid before the oil tints in use.

Carmine is the most beautiful crimson: it is a middle colour, between lake and vermillion; it is a fine-working colour, and glazes well. It should be ground with nut-oil, and used with drying oil.

Lake is a tender deep red, but of no strong body; therefore it should be strengthened with Indian red. It is the best glazing colour that can be used. It is ground with linseed-oil, and used with drying oil. Lake is a strong pleasant-working colour, but will not glaze well; and when mixed with white, falls a little into lead: it is ground and used as the lake.

Brown pink is a fine glazing colour, but of no strong body. In the flesh it should never join or mix with the lights, because this colour and white antipathize, and mix of a warm and dirty hue for which reason their junctions should be blended with a cold middle tint. In glazing of shadows it should be laid before the other colours that are to enrich it: it is one of the finishing colours, and therefore should never be used in the first painting. It is strengthened with burnt umber, and weakened with terracotta; ground with linseed-oil, and used with drying oil.

Burnt umber is a fine warm brown, and a good working colour: it is used in the hair, and mixes finely with the warm shade.

Principal tints, composed from the foregoing principal colours, and necessary for painting flesh.

Light red tint is made of light red and white: it is the best-conditioned of all colours, for the general ground of the flesh. With this cold tint, you should make out all the flesh, like clara-obscura, or mezzotinto. Remember, that this colour will grow darker, because it is in its nature too strong for the white; therefore you should improve it by vermillion and white, in proportion to the fairness of the complexion.

Vermillion tint is only vermillion and white mixed to a middle tint: it is the most brilliant red tint that can be. It agrees best with the white, light red, and yellow tints.

Carmine tint is carmine and white only, mixed to a middle tint; it is, of all colours, the most beautiful red for the cheeks and lips: it is one of the finishing colours, and should never be used in the first painting, but kid upon the finishing colours without mixing.

Rose tint is made of the red shade and white, mixed to a middle degree, or lighter: it is one of the cleanest and most delicate tints that can be used in the flesh, for clearing up the heavy dirty colours, and in changing will sympathize and mix kindly.

Yellow ochre is made of Naples yellow and white; but it is as well to use light ochre and white, which is a good working colour. The ochre is too strong for the white; therefore you should make a little allowance in using it. It follows, the light red tints and yellow should always be laid before the blues. If you lay too much of it, you may recover the ground it was laid on with the light red tints.

Blue tint in shades of ultramarine and white, mixed to a lightish azure: it is a pleasantworking colour; with it you should blend the gradations. It follows the yellows, and with them it makes the greens; and with the reds it produces the purples. No colour is so proper for blending down, or softening the tints into keeping.

Lead tint is made of ivory-black and fine white, mixed to a middle degree: it is a retiring colour, and therefore is of great use in the gradations, and in the eyes.

Green tint is made of Prussian blue, light ochre, and white. This colour will dirty the lights, and should be laid sparingly in the middle tints. It is of most use in the red shadows, where they are strong.

Shade tint is made of lake, Indian red, black, and white, mixed to a beautiful morr colour, of a middle tint. This is the best mixture for the general ground of shadows. It mixes well, and produces a pleasant clean colour, a little inclined to the reddish pearl. As all the four colours of its composition are of a friendly sympathizing nature, so consequently this will be the case, and therefore may be easily changed by the addition of any other colours.

Red shade is nothing but lake and a very little Indian red. It is an excellent working colour, and a good glazer: it strengthens the red shadows on the face and neck, and gives, when it is wet, the green and blue tints agreeable. It is a good ground for all dark shadows.

Warm shade is made of lake and brown pink, mixed to a middle degree. It is a fine colour for strengthening the shadows on the shade tint, when they are wet or dry. Take care that it does not touch the lights, because they mix of a dirty colour, and therefore should be softened off with a tender cold tint.

Dark shade is made of ivory-black and a little Indian red only. This colour mixes very kindly with the red shade, and blends agreeably with the middle tints in the dead of the face. It is a very good colour for mixing the eyebrows and the darkest shadows.

Process. The process of oil-painting, particularly in the colouring of flesh and in landscape, is to be divided into three stages, or paintings.


First stage, or dead-colouring of flesh.

The first lay of colours consists of two parts; the one is the work of the shadows only, and the other that of the lights.

The work of the shadows is, to make out all the drawing very correctly with the shade.
tender, and which should rid they their cause of the lesser tints, and in the other half to the work into character, and leave the colouring more delicate: then go over the darker shadows with the red or warm shade, which will finish the rest of the picture.

The warm shade being laid on the shaded tint, improves it to a warmer hue; but if laid instead of the shade tint, it will dirty and spoil the colour it mixes with it; and if the red shade is laid first, instead of the shade tint, the shadows would then look too red too; therefore, notwithstanding these two colours are the best that can be for the shadows; yet they are too strong to be laid alone, which is a proof of the great use and merit of the shade tint. Here we may observe, that shade is not the so friendly in their nature, that even in continually altering and changing, they always produce a clean colour of a pearly hue.

Next. In order to finish the first painting, improve the reds and yellows to the complexion, and after them the blues; observing, that the blues on the reds make the purple, and on the yellows produce the green. The same method is to be understood of the grounds, but be more careful in them and clean, and not too dark; therefore allowance should be made in the grounds with the light red, because glazing them will make them darker. When the cloth is of a dark, or bad colour, there must be a strong body of colour laid all over the shadows, such as will not sink into the ground, but appear warm, and a little lighter than the life, so that it may be of the same forwardness to finish as if it had been a bright ground. This business of dead-colouring is, that you leave it always in the same order for finishing, though the colour of the cloth is quite the reverse.

The grounds of shadows, in what we call the demi-colours, are such as will support the character of the finishing colours: which ground must be clean, and a little lighter than the finishing colours, because the finishing of the shadows is glazing; and no other method than glazing can leave such brilliancy and beauty as they ought to have. If you begin the first painting with glazing, it will stare, and be of no use; and the cold colours which are laid on it, will look heavy and dull; therefore, all shadows and colours that are to be glazed, should be done with colours of a clean solid body, because the glazing is more lasting, and has the best effect, on such colours. Remember to leave no roughness, that is, none such as will appear rough, and interrupt or hurt the character of the finishing colours; which, by examining the work, whilst it is wet, with a soft tool, or when it is dry with a knife, may be avoided, as you will easily take off the knots and roughest parts.

The light red and white improved is superior to all other colours for the first lay or ground; which should be always done with a full pencil of a stiff colour, made brighter than the light, because it will sink a little in drying. The greater the body and quantity of colour, and the stiffer it laid, the less it will sink. Every colour in drying will sink, and part of it, if the work be not skilful, of the colour will be left out; therefore, all the lights of the flesh, if not laid on a light ground, must consequently change a little from the life, if there is not allowance made. The shade tint for the shadows should fall into the nose, as the complexion grows delicate; all which should be lightly united, with a soft long pointed hog-tool, to the lights, making out the whole like mezzotinto. The great masters very seldom softened the colours; but in uring the first lay, they were very careful in preserving the brightness of their colours, and therefore did not work them below the complexion: for to force or keep up a brilliancy in the grounds, can only be done with the whites, reds, and yellows, which method will make for the deficiency of the white grounds; therefore, the first painting should be left bright and bold, and the less the colours are broken. You should be surprised at seeing any colours that will produce them, and be contented to add what is wanting in the next painting; where, if you fail, a clean rag will restore the first ground.

Second painting, or second stage.

The second painting begins with laying on the least quantity, that can be, of poppy-oil; then wipe it almost all off, with a dry piece of a silk handkerchief.

The second painting is also divided into two parts: one, the first lay of the second painting; which is scumbling the lights, and glazing the shadows; the other, finishing the complexion with the virgin tints, and improving, as far as you can, without daubing.

First. Scumbling is going over the lights, where they are to be changed, with the light red tints, or some other of the shade colours, such as will always clear and improve the complexion, with short stiff pencils; but such parts only as require it, otherwise the beauty of the first painting will be spoiled.

The light red tint improves all the best colours for scumbling, and improving the complexion in general. Where the shadows and drawing are to be corrected, you should do it with the shade tint, by driving the colour very stiff and bare, that you may use the least mix with the shades, the more meaty; those shades will appear. Thus far the complexion is prepared and improved, in order to receive the virgin tints.

Second. Go over the complexion with the virgin tints as the colours which improve the colouring to the greatest perfection, both in the lights and shadows.

This should be done in the same manner as you laid them in the second part of the first painting; that is, red, yellows, and blue, blending them with delicate light touches of the tender middle tints, without softening. Leave the tints and their grounds clean and distinct, and be content to leave off whilst the colours are fresh, leaving what is further required for the next sitting; for in attempting the finishing touches before the oil is dry, you will lose the spirit and drawing, and your colours will become a dirty mess.

The painting, or finishing.

It is to be supposed, the complexion now wants very little more than a few light touches; therefore there will be no occasion for oiling.

Begin with correcting all the glazing; first, where the glazing serves as a ground or under tint; then determine what should be done next, before you do it, so that you may be able to make the alteration on the part with one stroke of the pencil. By this method you preserve both the glazing and the tints; but if it happens that you cannot lay such a variety of tints and finishing colours as you intended, it is much better to leave off whilst the work is safe and in good order; because those few touches, which would be easier easily be done, if you have patience to stay till the colours are dry; and then, without oiling, add those finishing with free light strokes of the pencil.

This part of the work a painter touched up his best pictures a great many times, letting them dry between. It was this method which gave them their surprising force and spirit. It is much easier to soften the over-strong tints when they are dry, than when they are wet; because you may add the very colours that are wanting, without endangering the dry work. If any of the colours of the pallet want to be a little changed to the life, when you are painting, it is much better to do it with the knife on the pallet than with the pencil, because the knife will mix and leave it in good order for the pencil.

Of painting draperies.

In order to shew the nature and different degrees of colours of tints used in painting draperies, it must be observed, that these divisions are absolutely necessary to make the first lay of colours, and after that the reflections and finishing tints.

The right method of painting draperies in general is to make out the whole, or the first lay, with three colours only, viz., the lights, middle tint, and shade tint.

Observe that the lights should rather incline to a warmish hue, and the middle tint should be made of friendly-working colours, such as will always mix of a clean, tender, coldish hue. The shade tint should be made of the same colours as the middle tint, only with less light; therefore this tint will also mix of a tender clean colour. The beauty and character of the folds, the shape, attitude, and principal lights and shades, are all to be considered, and made with these three colours only; which should be done to your satisfaction before you add any of the reflections, or finishing tints.

The reflections of draperies and satins are generally productions of their own, and are always lighter than the shadows on which they are found; and being produced by light, will consequently have a light warm colour mixed with the local colour that receives them. Here it will be necessary to notice...
the general method of arranging the colours of the first lay, and those of the reflections and finishing tints.

In the first lay, the high lights should be laid with plenty of still colours, and then shaped and softened into character with the middle tint first. Where the gradations of the light or shade are in the large parts, it will be proper to lay the middle tint first at their extremities, with a tool that will drive the colour, and leave it sparingly; because the lights will mix and lie the better upon it. Next make out all the parts of the shadows with the tint driven bare. After this comes the middle tint, for the several lights and gradations, which should be very nicely wrought upon, to character without touching any of the high lights which finish the first lay.

The reflections and finishing tints are in general the antitheses of the first lay: they will, without great care, dirty the colours on which they are laid, and therefore should be laid with a delicate light touch, without softening. If it is overdone, endeavour to recover it with the colour of the part on which it was laid: this may be done directly, or with a tool. Where the reflections proceed from the same colour, or any other, the method of using them is the same.

Before we proceed to the particular colours, it will be proper to make some observations on their grounds.

It often happens, that the colour of the cloth is very improper for the ground of the drapery; and when it is so, you should change it with those colours which are most proper to improve and support the finishing colours. This method of dead-colouring must consequently preserve them in the greatest lustre. In dead-colouring, you should lay the lights and shades in a manner so as only to show a faint idea of them, with regard to the shape and roundings of the figure. If you have a design to work from, then it will be proper to make all the large and principal parts in their places; which should always be done with a colour that is clean, and lighter than the heaviest drapery, though in general of the same hue; and let the shadows be no darker than a middle tint. These should be mixed and broken in a tender manner, and then softened with a large tool, so that nothing rough at all is left to interrupt or hurt the character of the finishing colours.

White satin. All whites should be painted on white grounds, laid with a good body of colour, because this colour sinks more into the ground than any other.

There are four degrees of colours in the first lay, to white satin. The first is the true white for the lights; the second is the first tint, which is made of fine white and a little ivory-black, mixed to an exact middle degree between the white and the middle tint. This colour follows the white; and it is with this you should shape the lights into character before you lay on any other; and take care that this first tint appears distinctly between the white and the middle tint, otherwise the beauty and the character of the satin will be spoiled.

A second tint should be made of white, black, and a little Indian red. These three colours are very friendly, and mix to a beautiful clear colour of a pearly hue, which has the true brightness and warmth of the general hue of the satin. Remember to allow for the red hue changing a little to the lead.

If there is no intention to make any part in the middle tint lighter, do it with the first tint only. This colour should also be laid sparingly before the white, in all the little lights that happen in the middle tints and shadows; on which you should lay the white with one light touch, and be sure not to cover all the parts that were made with the first tint; if you do, it will spoil the character, and look like a spot, for want of the softening edge or border, which must be between the white and the middle tint. The shade that should be made of the same colour as the middle tint, but with less white, so that it is dark enough for the shadows in general; with which mix out all the parts of the shadows nicely to character, which is the work of the first lay.

Next follow the reflections and finishing tints.

Brown ochre, mixed with the colour of the light, is of the most useful colour in general for all reflections in drapery, that are produced either from their own colours. All accidental reflections are made with the colour of the parts from which they are produced, and the local colours that receive them. There are but two reflections specified for drapery in general: one should be lighter than the middle tint, the other darker. These colours may be a little changed on the pallet with the first and middle tints, as occasion requires, or lightly broken on the part that receives them; but this last method is not so safe as the other. The tint sufficient for blending the dark shadows to the mellow tints under the fine, is made with the shade tint and a little brown ochre, which should be laid on very sparingly, with soft light touches, for fear of making them dull and heavy; if it is overdone, recover it with the colour it was laid upon.

We often see a little blue used in the first tint of white satin. Van Haecken, who was the best drapery-painter in England, did so; and sometimes, instead of the blue, he used burnt-ochre, till he found it to be a pernicious colour, and therefore obliged to use blue; because his middle tint, which was only of black and white, was so very cold, that no other colour but blue would make a colder tint; yet he managed these cold colours in all the lights and middle tints, so agreeably, and so light and easy was his touch, that we may learn something from him.

Blue satin. Blue satin is made of Prussian blue and fine white.

The best ground for blue is, white for the lights, and black and white for the shadows.

The first lay of colours for blue is divided into three degrees or tints. First make the middle tint of a beautiful azure; then mix the colour for the light about a middle degree, between that and white. Make the shade tint dark enough for the shadows in general. All the broad lights should be laid with plenty of colour, and shaped to character before you lay on any other colours. Remember, the brighter the colours are mixed, the better they will appear and stand; for the lights of blue should be managed as much care as those of white. Lay one part of the middle tint, and then make out all the shades of the shadows. The more you drive the shade tint, the better it will receive the reflections and finishing tints. The shadows should be strengthened and blended with ivory-black, and more, when dry, may be a little improved, if there is occasion to alter them, with the colours they were made with. The Russian proper to be used, is that which looks of the most beautiful azure before it is ground; and the sooner it is used after it is ground, the better it will work and appear.

Velvet may be painted at once. The method is, to make out the first lay with the middle tint and shade tint, on which lay the high lights, with light touches, and finish the shadows in the same manner as those of satin; but the nearest imitation of velvet is done by glazing; the method of which is, to prepare a ground, or dead-colouring, with a body of dry colour; then to make the middle tint lighter in proportion to the glazing, because that will make it darker. It is often necessary to cover all but the high lights, with a thin glazing, laid in less quantity than if it was to be done once only. If any of it touches the lights, wipe it off with a clean rag.

The very high lights should be improved, and made of a fine white, and left to dry. The glazing colour is Prussian, ground very fine with nut oil; and should be laid with a large stiffish tool. It is in this kind of glazing we should strengthen and finish the shadows.

The greatest fault in the colouring of draperies is the painting the shadows with strong colours, which destroy the beauty of the lights. This is the reverse of the art, but of nature, whose beauty always diminishes in proportion with the lights. For this reason, take care to blends and soften the shadows with such friendly colours as will agree with their local character and obscurity. Here observe, that glazing the middle tint, which is made of black and white, will not produce a colour so blue as if it had been prepared with Prussian and white; yet this colour will preserve the beauty of the lights, in the highest perfection, by reason of its tender or blue, when the blueness of the other would only diminish them. This method of glazing the blue is the general rule for all glazing.

When glazing blue, the lights may be glazed with ultramarine, though all the other parts are done with Prussian. This method saves a great quantity of that valuable colour, and may be a little improved, as if it had been done with ultramarine.

Though this general method of painting satins is to make the first lay of colours with three degrees, or tints, yet you should understand, that they produce two more; for the mixing of two different
colours together on the cloth will make another of a middle tint between them; so it is with the lights and middle tints, and with the middle tint and shade tint: the first answers to the first tint in white satin, and the last will consequently be a sort of grading, or half shade.

It the lights and middle tint mix to a beautiful clean colour, of a middle hue between both, there will be no occasion for a colour to go between them, as in blue satin: but if in mixing they produce a tint inclined to a dirty warm hue, then another of a sympathizing nature should be laid between them, in order to preserve the beauty of the lights, as the first tint in the white satin; for if it were not so, the red in the middle tint would certainly dirty and spoil the white.

It is highly necessary to understand these principles of the first lay of colours, in order to have a perfect knowledge of the general rule of colouring.

Scarlet and crimson. A light yellow red, made of light ochre, light red, and white, is the proper ground for scarlet; the shadows are Indian red, and in the darkest parts mixed with a very deep black.

The second painting should be a little lighter than you intend the finising colour, that is, in proportion to the glazing, which will make it darker.

The high lights are vermillion and white for satin and velvet, and vermillion for cloth.

The middle tint is vermillion, with a very little lake or Indian red; the shade tint is made with Indian red and lake, with the addition of a little black, in the darkest shadows. The difference between scarlet and crimson is, that the high lights of crimson are whiter, and the middle tint is made darker. Their reflections are made with light red and vermillion. The high light should be bluish and mingled in the same manner as those of the blue, for fear of dirtning them; and sometimes they require to be touched over the second time before we glaze them. The more the colours of the second painting are dried, the better they may be managd to character; but the high lights should have a good body of colour, and be let with a delicate light touch. After it is well dry, finish with glazing the whole with fine lake, which reflects a little of the shade.

Remember that the scarlet requires but a very thin glazing; and it is better to glaze the crimson twice over, than lay too much at once painting.

Pink colour. There are two different methods of painting a pink colour; one is by glazing, the other is done with a body of colours at one painting. The same grounds do for both; which should be a whitish colour, inclining to a yellow, for the lights; and Indian red, lake, and white, for the shadows.

The second painting, for the glazing method, is done with the same colours, and a little vermilion and white for the high lights. When it is dry, glaze it with fine lake, and then weak and soften the colours into harmony directly.

The other method is to make the high lights with carmine and white; the middle tint with lake, white, and a tint from tinting with lake and Indian red, with a little vermillion for the reflections. But remember, the shadows will require to be broken with some tender obscure tint.

Yellow. The ground for yellow should be a yellowish white for the lights, and a mixture of the ochres for the shadows.

There are the same number of tints in the yellow, as there are in the white satin, and the method of colouring is the very same.

The lights are made with king's yellow, ground with clean good drying oil. The first tint is light ochre, changed with a little of the pearl tint, made with the dark shade and white, which should be laid and managed as the first tint in white satin. The middle tint is a mixture of the light and brown ochre, soffened with the pearl tint. The shade tint is made with brown pink, and brown ochre; these belong to the first lay.

The reflections are light ochre, and sometimes in the warmest parts mixed with a little light red. The shadows are strengthened with brown pink and burnt umber.

Green. The proper ground for green is a light yellow green, which is made of light green, with some brown, a little white, and Prussian blue, for the lights, and the ochre, brown pink, and Prussian, for the shadows.

The finest green for draperies is made of king's yellow, Prussinian blue, and brown pink. The high lights are king's yellow, and a very little Prussian; the middle tint should have more Prussian, and the shadow tint is made with some of the middle tint, brown pink, and more Prussian; but the darkest shadows are brown pink and a little Prussian. The lights and middle tint should be managed in the same manner as those of the blues. The shadow tint should be kept entirely from the lights, because the brown pink that is in it will, in mixing, dirty them, as the black does those of the blues. Remember to allow for their drying a little darker; and that the king's yellow must be ground with good drying oil; for the longer it is drying, the more it will change and grow darker; and the sooner it is used, the better it will stand. It is proper to have two sorts of king's yellow, one to be very light, for the high lights of velvet.

Changeable colours. Changeable colours are made with four principal tints, viz. the high lights, middle tint, shade tint, and reflecting tint.

The greatest art lies in finding the exact colour of the middle tint, because it has more of the general hue of the silk than any of the others. The shade tint is of the same hue with the middle tint, though it is dark enough for the shadows. The high lights, though very often different from the middle tint, should be of friendly-working colour, that will, in mixing with it, produce a tint of a clearer hue.

The method of painting silks is to make out the folds with the shade tint, and then fill them up in the lights with the middle tint. This first lay should be done to your satisfaction before you add any other colours; and the other the middle tint is used, the better the high lights may be laid upon it. The reflecting tint falls generally upon the graduating half-shades, and should be laid with tender touches sparingly, for fear of spoiling the first lay.

This method of painting answers for all coloured silks, as well as changeable, with this difference only; that the plain colours require not so much art in matching the tints, as the changeable do. The last part of the work is the shining and strengthening the shadows with an obdurate tint, a little glazing to a mellowish hue; such as will not catch the eye, and interrupt the beauty of the lights.

Black. The best ground for black is light red for the lights, and Indian red and a little black for the shadows.

The finishing colours are, for the lights, black, white, and a little lake. The middle tint has less white, and more lake and black; the shade tint is made of an equal quantity of lake and brown pink, with a very little black.

The method of painting this back is very different from that of other colours; for as in these the principal thing is to leave their lights clear and brilliant; so in black, it is to keep the shadows clear and transparent.

Therefore begin with the shade tint, and glaze over all the shadows with it. Next lay in the darkest shadows with black, and a little of the shade tint, very correctly. After that, fill up the whole breadth of lights with the middle tint only. All which should be done exactly to the character of the colours; or the lake in the lights takes off the cold hue, and gives it a more beautiful colour. If the shade tint was of any other colour than a transparent warm hue, the shadows would consequently be black, and this because no other colours can preserve the warm brilliancy which is wanting in the shadows of the black, like lake and brown pink. Black is of a cold heavy nature, and always too strong for any other colour; therefore you should make an allowance in using it. There will be a few reflects in satin, which should be added as those of other colours; but they should be made of strong colours, such as burnt umber, or brown ochre, mixed with a little shade tint.

Though the grounds mentioned for the draperies are absolutely necessary for the principal and nearest figures in a picture, such as a single portrait, or the like; yet for figures which are placed behind the principal or front figures, their grounds should always be fainter in proportion to their local finishing colours.

Linon. The colours used in linens are the same as those in white satin, except that the tint, which is made of white and ultramarine ashes, instead of the black, and mixed to a very light bluish tint.

In the dead-colouring, take particular care that the grounds are laid very white and broad in the lights. The shadows are made with black, white, and a little Indian red, like the middle tint of white satin. These should be left very light and clean, in order to support the finishing colours.

The second painting begins with glazing all the lights, with a still pencil and fine white only, driven bare, without using any oil. The shadows may be scumbled with poppy-oil, and some of the cobour they were made of. This is the first lay, to which you set to follow with the finishing colours directly. The middle tint of white satin is the best colour for the general hue of the shadows. With this and white, in different degrees, make out all the parts to character, with free.
light touches, without softening; then, with a large long-pointed pencil and fine white, lay the high lights very nicely with one stroke. After this comes the fine light bluish tint, which should be mixed light, and laid in the lightest gradations, very sparingly and lightly, without filling them up.

Remember, the first lay should be left clear and distinct; the more it appears, the better. It is the overmixing and joining all the colours together, which spoils the beauty of the character; therefore it is better to let it dry before we add the reflections and finishing tints.

The method of getting the beautiful clear colour dry, before you add the warm reflections, and harmonizing tints, prevents them from mixing and dirt ing each other.

The principal blending colours used in the reflections are the yellow tint, green tint, and rose tint; which last is made of lake, Indian red, and white. Glazing the pear and lead colour with white, though it seems to answer our purpose at the time when it is done, will certainly sink and be lost in the grounds on which it is laid; therefore you should make the mixtures, as white as possible, and then paint the finishing colours, by reason they will sink a little in proportion to the colour of the cloth, which the glazing with pure white only will recover.

Of painting back grounds.

The principal colours that are necessary for painting of back-grounds, as walls, buildings, or the like, are white, black, Indian red, light ochre, Prussian blue, rose, ultramarine, andumber; from which the eight principal tints are made, as follows:

1. Pearl is made of black, white, and a little Indian red.
2. Lead, of black and white, mixed to a dark lead-colour.
3. Yellow, of a brown ochre and white.
4. Olive, of light ochre, Prussian, and white.
5. Flesh, of Indian red and white, mixed to a middle tint.
6. Murrey, of Indian red, white, and a little black, mixed to a kind of purple, of a middle tint.
7. Burner, of white, umber, black, and Indian red.
8. Dark shade, of black and Indian red only.

Here the lead tint serves for the blues, the flesh tint mixes agreeably with the lead, and the murrey is a very good heathing colour, and of great use where the olive is too strong; the umber, white, and dark shade, will produce a fine variety of stone colours; the dark shade and umber, used plentifully with drying oil, make an excellent warm shadow-colour. All the colours should be laid with drying oil only, because they mix and set the better with the solvent.

Where the marks of the towel are so strong in the priming of the cloth, that one body of colour will not be sufficient to conceal it, lay a colour to prevent it, which should be dry before you begin with those parts you expect to Whilst are the true painting.

Process. The process of painting background is divided into two parts in stages: the first is the work of the first lay, the second that of the finishing tints.

Begin the first lay from the shadowed side of the head, and paint the lights first; from them go into the gradations and shadows, which should be done with a stiffish tool, very sparingly, with the dark shade and white, a little changed with the colours that will give it more variety; and keep very near in regard to tone and strength, leaving them like mezzotinto.

The dark and warm shadows should be laid before the colours that join them. This do with the dark shade and umber, driven with drying oil. If those colours were laid on first, they would spoil the transparency, which is their greatest beauty. The more the first lay is driven, the easier and better you may change it with the finishing tints, therefore you may lay them with the greater body.

The second part is to follow directly, whilst the first lay is wet, with those tints that are the most proper to harmonize and finish with.

Begin with the lights first, and remember, as you heighten and finish them, to do it with warmer colours; and let those be accompanied with fine tender cold tints. The lightest parts of the picture should be painted with a variety of light warm clear colours, which vanish and lose their strength imperceptibly in their gradations. Take care that you do not cover too much of the first lay, but consider it as the principal colour.

From the lights, go to the gradations and shadows; when the lights are well adapted to produce and support the figure, it is easy to fall from them into whatever kind of shadow you find most proper; then soften and blend the whole with a large long hog's brush, which, with the strength and body of the drying oil, will melt and sweeten altogether, in such a manner, as will seem surprisingly finished. Remember the tints will sink, and lose a little of their strength and beauty in drying. All grounds, as walls, &c. should be finished at once painting; but if they want to be changed, glaze them with a little of the dark shade and drying oil, driven very bare, on which, with a few light touches of the colour that is wanting, you may improve their hue. The dark shadows may also be strengthened and improved by glazing, which should be done when they are nearly finished, for fear of making them too strong.

Rembrandt's grounds are rather brighter in the lights, and have more variety of tints than any other painter's; for he had observed, that those tints diminish in proportion with the lights; therefore his shadows have but a faint appearance of tints. He understood the gradations in perfection, by mixing and breaking the first lay of colours so artfully, that they deceive in dead strength.

Vandyck's general method was, to break the colours of the ground with those of the drapery. This will certainly produce harmony.

Premonysays, let the field or ground of the picture be pleasant, free, transient, light, and well united with colours which are of a friendly nature to each other; and of such a mixture as there may be something in it of every kind that composes your work, as it were the contents of your palette.

Curtains should be dead-coloured when we paint the ground; and should be done with clean colours, of a near hue to the intended curtain, such as will support the finishing colours, so it do with a tender sort of keep-
receive and preserve the finishing colours, than to show them in their first painting.

The sky should be done first, then all the distances; and so work downwards to the middle group, and from that to the foreground. Remember, all the parts of each group, all the lights and shades, or the like, are all painted with the group they belong to.

The greatest secret in dead-colouring is, to find the two colours which serve for the ground of the character of the sky; and the manner of these lights: the first of which is the dark shade with a little lake in it; the other colour is only burnt umber. These should be a little changed to the natural hue of the object, and then laid on with drying oil, in the same manner as we shade with Indian ink, which is a kind of glazing, and as such they should be left; otherwise they will be dark and heavy, and therefore would be entirely spoiled for the finishing glazing. Mix these colours and sympathize agreeably with all the lights, but should be laid before them.

The sky. The sky should be laid with a good deal of manner, and left with a faint resemblance of the parts of, to be burnt out and the manner of a lobe obscure than with finishing colours; the whiter it is left, the better it will bear out and support them; the distances should be made out faint and obscurely, with the dark shades, and some of their lights in different degrees, and laid so as best to find and show their principal parts. All the grounds of the trees should be laid or rubbed in, in order to leave an idea of their shapes and shadows faintly. The ground of their shadows must be clean, and lighter than their finishing colours.

In painting the lights, it is better to incline more to the middle tint, than to the very high lights; and observe to leave them with a sufficient body of clean colours, which will preserve the finishing colours better; all which may be done with a few tints. After this, go over all this with a sweetener very lightly, which will soften and mix the colours agreeably for finishing.

Second painting. Begin with the sky, and lay in all the azure, and colours of the horizon; then soften them; after that, lay in the general tint of the clouds, and finish on it with the high lights, and the other tints that are wanting, with light tender touches; then soften the whole with a sweetener, very lightly. The finishing of the sky should be done all at one painting, because the tender character of the clouds will not do so well as when the whole is wet. Observe, that the stiffer the azure and colours of the horizon are laid, the better the clouds may be painted upon them.

The greatest distance in the clouds are made with the colour of the sky; as they grow nearer and darker, glazed and scumbled the parts very thin, with such glazing shadow-colours as come nearest to the general hue of the group of objects are in. This glazing should be understood of a darkish hue; and that the first painting or dead-colour should be seen through it distinctly. On this lay, or ground, add the finishing colours.

Now, this glazed ground property adapted to the object and place, it will be easy to find the other colours, which are wanted for the lights and finishing of the same; but in laying do take care not to spoil the glazing; therefore be very exact in making those colours on the palette, and then be sure to lay them with light tender touches.

Before we proceed any farther, it will be proper to say something of the most useful glazing colours.

Lake, terreverte, Prussian blue, and brown pink, are the four principal. The more you manage them like Indian ink, and the more distinctly you lay them on, the better their transparent beauty will stand and appear, provided you do it with good drying oil. After these four glazing colours, burnt umber is a very good glazing warm brown, and of great use in the broken grounds and nearest parts; but the most acceptable colour for the darkest shadows, is the dark shade improved with lake. It is a fine warm shade; and blue, and burnt umber, mixes harmoniously in all the lights, as well as the shadows; and will find an excellent in the trunks and bodies of trees, and in all kinds of buildings.

Make out all the ground of the objects with such glazing shadow-colours as seem nearest to the object in that situation; but as the principal glazing colours themselves are often too strong and glaring, they should therefore be a little changed, and softened with such colours as are of a near resemblance to the object and the objects: thus, if it is in the distance the terreverte and the azure, which are the principal glazing colours, may be improved and made lighter with some of the sky tints; and as the distance comes nearer with the purple. In the middle group, the terreverte and Prussian blue may be changed with some of the green tints; such as are made without white, for white is the destruction of all glazing colours. As you approach the first group, there is less occasion for changing them; but the fore-ground and its objects require all the strength and force of glazing, which the colours are capable of producing.

After this glazing ground, follow with strong, burning the same in its extremes, and darkest places, in such manner as will seem easy to finish; which is the first lay of the second painting.

The colours that come next for finishing, are in the degree of middle tints: these should be carefully laid over the greatest breadth of lights, in such manner as not to spoil and cover too much of the glazing. Do it with a good body of colour, as stiff as the pencil can agreeably manage. Remember, the colour of the middle tint should be of a clean beautiful hue. According to these methods, it will be easy to finish all the second painting down from the sky, through the middle group. As you come to the first group, where the work should be perfectly finished, finish their under or most distant parts, before you paint any of the other, which appear nearer. Observe this method down to the last and nearest objects of the picture: and where it so happens that painting one tree over another does not please, forbear the second until the first is dry. Thin near trees of different colours will do better, if you let the tender parts dry before you add the finishing colours.

Third and last painting.

If oiling is necessary, lay the least quantity that can be; which should be done with a stump tool or pencil, in the places that is to be oiled, so as to oil no more than is wanted; then wipe the whole place that is oiled, with a piece of silk handkerchief.

When going to finish any objects, remember to use a great variety of tints, very nearly of the same colour, but most of all when finishing trees. This gives a richness to the colouring, and produces harmony. The greens will be better, if they are not so much glazed, for it is highly necessary to improve and force them, by exaggerating the lights, and making an allowance in using them so much the lighter. For the same reason, take great care not to overcharge and spoil the beauty of the glazing: for if you do, it will be dull and heavy, and will consequently grow darker.

The method of painting near trees is, to make the first lay very near nature, though not quite so dark, but more in the degree of a middle tint, and follow it with strengthening the shadows; then the middle tints; and last of all lay the high lights and finishing colours. The first lay should be, at one painting: therefore the best way is, to do no more than the first lay with the faint shadows, and leave it to dry.

Then begin with improving the middle group.

The third and last work is, adding all the lights and finishing colours in the best manner you are able. This method of leaving the first and second parts to dry separately, not only makes the whole much easier, and more agreeable, but leaves the colours in the greatest perfection; because most of the work may be done with scumbling and glazing, and some parts without oiling. The lights also may be laid with a better body of colour, which will not be mixed and spoiled with the wet ground.

The figures in the landscape are the last work of the picture: those in the fore-ground should be done first, and those in the distance should be the last painted. The figures in the first and farthest group are painted, it will be much easier to find the proportions of those in the middle parts of the picture.

And observe, that the shadows of the figures should be of the same hue, or colour, with those of the group or place they are in.

Miniature.

The art of painting in miniature is of very antient date. It is practised either on vellum or ivory.

The best method, in painting on vellum, is to glue the edge of the vellum to a copper-plate or board, over which it is strained, in this manner: Let your vellum be every way as large as, or a little larger than what you strain it on. Moisten the back, or side of the vellum with a piece of fine wet linen, and put a piece of white paper to the other side. Then apply it to the plate or board, stretching it equally in all directions, lay the edges nicely round and glue them, taking care to let no glue pass under the part of the vellum on which you mean to paint. When the glue dries, and the edges of your vellum are thus fastened, you may proceed with your
work; or you may (agreeably to the practice of some painters) previously give the yellow a little water; the white lead well purled, to serve as a ground.

But ivory being the material most frequently used at present for painting in miniature, we shall here give the most approved rules for preparing ivory.

It is scarcely necessary to remark, that the first essential point towards excellence in this, as in all other branches of painting, is a thorough and well-grounded knowledge in drawing both from phostron, and from life; without correctness of drawing the greatest brilliancy of tints will at last be unsatisfactory. We should therefore recommend to the student in miniature, to continue, at his leisure hours, to copy from large drawings or busts, in clacks or water-colours, as correctly as possible, which is the best means of giving facility to the hand in the drawing of smaller figures.

Painting in miniature is of all others the most delicate and tedious in its process, being performed wholly with the point of the pencil. It is only fitted for works of a small size, and must be viewed near.

Colours used in miniature painting.

In painting the face, the yellows that are used are five, viz. gall-stone, terra sienna, Nottingham ochre, Roman ochre, and yellow-oxide; the latter three of which are opaque colours, the other transparent.

The greens are confined to one, which is sap-green. The blues are verditer, Prussian, indigo, small, ultramarine, and Antwerp.

The reds are, carmine, drop lake, Chinese vermilion, and Indian red. Under the class of reds, may also be put burnt terra sienna, its colour inclining much that way, though more to the orange. The grey browns or blacks, any used in the face, are burntumber and terra de Cassel, and they are only to be used in the mixture of dark shades.

For painting draperies, we shall only add to the above colours, lamp-black, king's yellow, and lake white.

Qualities of the above colours when used in miniature.

Yellows. Gall-stone is one of the finest and brightest colours, and a lasting one; but it should be sparingly used in the flesh tints, its brilliancy being apt to overpower all the other colours.

Terra di Siena unburnt, is of a greyish nature, but is used as a warm yellow; burn-ed, it is more beautiful, partaking of three tints, yellow, red, and brown.

Nottingham ochre works well; but on account of its heavy qualities must be used with caution.

Roman ochre is used with success in miniature painting, as it works, when properly portioned with gum-water, extremely transparent and easy; and being in itself a warm colour, communicates that quality to the tints it is worked in.

Naples yellow, although adopted by some artists, is of a sickly hue, and has this very bad quality, that it absorbs all colours that are either worked on it, or mixed with it.

Blues. Ultramarine excels all others in permanency.

Prussian blue has no substitute, on account of its strength of effect and transparency.

Small is so hard that nothing but an agate flag and muller will pulverize it sufficiently. It is not to be depended on for permanency.

Indigo is a useful blue, though it must be sparingly used, on account of its extreme depth of colour, nearly approaching to black; the best is called the rock indigo, and it is an excellent colour for dark shades.

Verditer is a fine blue, and much used by miniature painters, not only in their skin tints, but likewise in the delicate parts of the face. It requires to be very finely ground on a hard flag. As to durability, it changes in time to a dirty greenish colour; on account of its being made from copper, care should be taken not to put the pencil it is used with much in the mouth, as its qualities are pernicious.

Antwerp blue, is one of the greatest de-

ceptions in the world, being, when dry, a most beautiful bright blue; but when wet and prepared, a very dingy colour, and totally unfit for the face of a miniature. It may be used in blue draperies or background.

Sap-green is a highly useful colour, when judiciously mixed with other colours; producing warm flesh tints, which cannot be produced without it. Its extreme transparency and brilliance are strong recommendations in its favour.

Reds. Carmine, is a fine bright crimson, inclining to the scarlet, and is rather an opaque colour: from it a variety of fine tints may be obtained, but it is a very dangerous kind of colour, it is prepared by chemists, but the deep kind is the best, the lighter sort being frequently made so by adulteration.

Drop-lake, made from the shearings of scarlet cloth, is a pleasing crimson colour: its inclining to the purple makes it peculiarly useful for the carnation tints in painting delicate subjects.

Chinese vermilion, when good, is a bright red, and useful in miniature pictures, though not to be freely used, its opacity rendering it dangerous to mix much with other colours; but by itself, in touching the parts that require extreme brightness, it is useful. It is difficult to find the real kind, the common vermilion, mixed with lake or carmine, being a general substitute; but the spurious and the genuine kind are so different in kind, that any mixture of the two is so impairing the colour.

The native or mineral cinnabar, or vermilion, is likewise very fine in Spain; and the French have mines of it in Normandy.

There is a method of preparing facsimiles of cinnabar, viz. Take six ounces of sulphur, and eight of quicksilver, mix them well; then set them on the fire, till part of the sulphur is consumed, and the powder remains black; after this is done, place twice the powder at the bottom of which the cinnabar remains very heavy, and streaked with the lines or needles, some red, and others brilliant like silver; then take it, and purify it in the following manner: grind it well in fair water, on a marble, put it into a glass or earthen vessel to dry, then put urine to it, and mix it so that it be thoroughly wet and swim; then let it settle, and the cinnabar being precipitated, pour out the urine and inclination, and put fresh in the room of it,

leaving it so all night, and repeating the process till the cinnabar is thoroughly purified. Continue the process with beating up the white of an egg, which mixing with fair water, pour it upon the cinnabar, and stir the whole about with a wooden spoon. The water will oxidize the cinnabar two or three times as above, and keep the vessel close covered from dust; when used for water-colours, temper it with gum-water, and a small quantity of saflron dissolved will add to the brilliancy.

Indian red is an excellent colour, not only for touching the deep red parts, but likewise in strong flesh tints, in bright background, and drapery.

Brown. Umber is very grey, and mixes unkindly; but, when burnt, is very useful in many parts of miniature.

Terra de Cassel, or Vandyck brown, so called from the very great estimation the inimitable painter of that name held it in, is the finest rich brown in the world; in itself producing a more beautiful colour than can be formed by the junction of any colours whatever. It is, in its natural state, rather more greasy than burnt ochre; when prepared, it amply repays the labour.

Lamp-black is useful for mixing in hair colour and in painting draperies. The smoke of a candle received on a plate, is found the best being blacker than the common lampblack.

King's yellow is a bright opaque colour, admirably calculated for painting lace, gilt buttons, &c. &c. but is a rank poison, therefore should be cautiously used.

Flake white, or refined white lead, is not to be used by itself as a white, for to a certainty it will turn black, which circumstances should be nicely attended to by all artists.

If used in miniature painting, for linens, &c. it should be immediately covered with a glass, which method is the only one which stands a chance of preserving its purity. For a further account of the qualities of these colours, see Colour.

Among the above necessary colours, there are three which require to be burnt; viz. terra di Siena, umber, and lamp-black. For these performer are to be put in a crucible, which is to be covered and placed on a hot fire: and when you think that the lamp of colour is hot through, take the crucible from the fire, and let the colour cool.

The lamp-black is to be prepared thus: Take some of the common kind; put it on a clean fire-stove or plate of iron, over the fire; immediately on receiving the heat, it will begin to smoke, on the ceasing of which you will find your lamp-black freed from the oily substance it originally contained, and fit for immediate use.

Gum water. Choose the large white pieces or gum aralac, which are brittle and clear. Put them into a clean plial, and pour water on them, well-strained and divested of all sandy particles. Let the gum-water be about the thickness of water-gruel, that is, so thin that you can feel it in your fingers.

The fresher made, the better.

Grinding the colours, and preparing them for the pencil.

Provide yourself, if possible, with an agate flag and muller; but if that cannot conven-
PAINTING.

IVORY.

Method of choosing, bleaching, and preparing it.

Of ivory there are various kinds, the distinction of which in this art is of very material consequence. Ivory, newly cut, and full of sap, is not easily to be judged of: the general transparency it exhibits in that state, almost precluding the possibility of discovering whether it is coarse-grained or fine, streaky or the contrary, unless to the artist who, by a long continued and careful inspection, is familiarised to it. The best way to discover the quality of it, is by holding it grainways to the light, then holding it up and looking through it, still turning it from side to side, and very narrowly observing whether there are any streaks in it; this you will, unless the ivory is very freshly cut, easily discover; and in this you cannot be too particular. There is a species of ivory which is very bad for painting on, as it contains no sap in it, being of a horny coarse nature, which will never suffer the colours to be thrown out in the brilliant manner a fine species of ivory will; you are therefore not only to be on your guard against streaks from this species of ivory, but likewise that which has the finest grain, and coarse. We shall now proceed to treat on the manner of preparing the ivory for painting on.

You are to heat a smoking iron so in small a degree that you can hold your hand on the face of it, so long as you can reckon three or four in moderate time: then put your ivory between a clean piece of folded paper, on which place the hot iron, turning your ivory frequently, until it becomes a transparent white; for you are to observe that very particularly, an opaque white not answering for face-painting in miniature, as it would give a harshness and unpleasant appearance to your picture.

When you think your ivory is sufficiently white for your purpose, lay it under some flue until it cools, as that will prevent its warping. Then proceed to prepare it: for whatever purpose you must pound some pumice-stone in a mortar, as clear and fine as you can, with the linen or fabric bag, tying it about midway, tight, but leaving room for the pumice-dust to sift through the bottom. Then get a long nutsshell-bottle, perfectly clean and dry, in which the pumice-dust is sifted, then place the bottle flat with the muzzle of the bag, so that nothing can come out; then shake the bottle smartly in your hand, when the fine particles of the pumice will sift out, and remain at the bottom. Take the coarser grain of coarse grains from being amongst what you are going to use, which would very materially injure your ivory. Your pumice-dust being prepared, scrape the leaves of ivory with a sharp pen-knife, until the scratches of the cutting saw are entirely obliterated; then take either a piece of Dutch polishing rush, or a piece of middling fine glass paper, and carefully polish your ivory with it, not by passing it head backwards and forwards, but in a circular manner, until you have it pretty level; then stroke some of your pumicestone on the ivory, and put a few drops of water on it; which done, with your muller work it on in a circular manner as before, until you find every part has equally received the pumice, of which you will know by its exhibiting a dead bare appearance; those parts which have not received the pumice continuing to shine in spots, which you must still labour to do away with your pumice and water. If you should not be satisfied with your satisfaction, take a clean sponge and fair water, with which gently wash your ivory free from the pumicestone: taking care not to rub it hard, for fear of giving the ivory a glassy or glossy gloss, which would prevent your colours from taking on it so pleasant as you could wish: after this lay your ivory to dry, and in a few hours it will be fit for use. Take then another piece of paper, and with the hand of the paint you will go along the pumicestone, and for a few minutes; and then proceed to work.

Instructions for using compound tints for the face.

Purple is formed of either ultramarine, Prussian blue, small, or indigo, mixed with either carmine or drop lake. Under dyers, although it is not to be considered of the brilliant sort of colours by itself, yet in any mixture it loses that perfection, but still retains a sufficient score of brightness to render it a desirable tint in the purples of grey, and other tints of the face. Prussian blue mixed as before-mentioned, makes a bright or dark purple, according as the quantities of either colours are proportioned; but indigo makes still darker, owing to its great natural depth of colour. Small and carmine, or lake, form nearly the same tint as ultramarine, and may be used nearly for the same purposes.

Grey. Of grey tints there are various kinds, according to the subjects they are required for. A warm grey tint may be made by duly portioning burnt terra Sienu, Prussian blue, and drop lake: the more terra Sienu in it, the warmer the tint; the more Prussian blue and lake, the colder. A grey tint may be acquired, although it be in eminent miniature painters, was composed of Prussian blue and Chinese vermillion, but on account of the unkind manner with which vermillion incorporates with any other colours, and especially with any that are more harsh than ordinary to make them work or keep together. A third grey tint, which is an excellent one, is formed of drop lake, sap green, and Prussian blue.

Olive tints. A very fine olive tint is formed of gall stone, Nottingham ochre, and carmine, or lake; and another of sap green and lake simply.

Of hair tints. A beautiful hair colour, either dark or light, according to the quantities of colours, is made with careful lamp black, and sap green. The manner of forming it is only to be acquired by practice; but when once attained, will be found worth the time of the trial. That very different tint which is often to be met with in children's hair, by the proper junction of these colours will be produced to perfection. Other hair tints may be made of terra de Cassel simply, or by the addition of lamp-black. Some excellent painters make all their burnt terra Sienu, lamp-black, and Nottingham ochre, the latter being added only.
PAINTING.

The first washing in; and lastly, marking consists in the sharp-tipped brushes given to the different features, in order to give that emphasis of line which so necessary to constitute a fine picture.

Black drapery is formed of lamp-black burnt, and flake white; and must be laid in with a good deal of the latter, as otherwise it would be very difficult to manage the shadows shall be to produce the darkest shade, and a blackish cast.

Blue drapery may be made of either Prussian blue, or Antwerp blue, mixed with white; indigo being too much inclined to a blackish cast.

Green drapery is well made of king's yellow, and Prussian and Antwerp blue. The more blue, the darker the green; and the more yellow, the contrary.

Yellow drapery cannot be so well represented by any colour as king's yellow, laid thin, with a moderate quantity of gum in it.

Drab-colour is well represented by a judicious mixture of umber, in its raw state, and flake white.

A queen's brown, as it is called, is made of burnt umber ochre, a little lamp-black and lake, and flake white. The mixture of undersize.

Claret colour may be well represented by a mixture of terra de Cassel, a little lamp-black, and lake. The more black and lake, the deeper the colour.

Dark brown can be formed by a junction of Noltinghame lake, and lamp-black.

Lilac is made of carmine, Prussian blue and flake white.

Grey can be formed only of lamp-black, flake-white, and the smallest quantity of lake laid in very thin.

Reddish brown is best made of Indian red, very little lamp-black, and flake white.

Scarlet is a colour very difficult to lay down rules for making, as in some pictures it is dangerous to make it too bright, for fear of hurting the effect of the face, by its brilliance catching the eye too readily; consequently, if the subject you are painting from life is very pale, you run a very great risk by an excessive amount of it to his picture.

We shall therefore only mention that a very bright scarlet is made of Chinese vermilion and carmine, ground together (without any flake-white); and if you want it still rendered brighter, when it is dry, fill your pencil with plain carmine, mixed with thin gum-water, and glaze over it nicely; but if, on the contrary, you wish to soften, or take away a share of its brilliancy, add a little flake white to it, and that will have the desired effect.

Of painting the face in miniature.

You are first to provide yourself with a mahogany desk for painting on, which is a box about fourteen inches high, and a foot broad on the top; there is to be a lid covered with green cloth, which is to have a pair of small hinges fixed at each end, but the centre of it left free, to fasten your ivory by, slipping it between the mahogany and green cloth.

The next thing you are to observe is the choice of your light, which in this kind of painting cannot be too particularly attended to; it not being like oil-painting, where the rays of the sun may be kept out by blinds, &c., without causing any material inconvenience. As much as possible, to it, must be attained. If there are more than one window in the room, the second must be closed, so as to admit no light; and the one you sit at is to have a green baize curtain against the lower part of it, to reach about a foot higher than your head, as you sit at your painting desk, with your left hand towards the light.

Having placed your sitter at the distance of about a yard and a half from you, begin drawing the outlines of the face; and in this be very particular, as much depends on it. When you have them drawn correctly, begin to lay in the colour, finally, of the iris of the eye, the shadow under the eye brows in a grey tint, and under the nose rather a warm purple, in broad faint washes: ever keeping this in your mind; that you must, in the process of painting the face of a miniature, go beginning, and not hurried in your colours, as such conduct will, to a certainty, make your tints look dirty, and your picture harsh and disagreeable. Having, as before observed, laid your very tinted shadows are to fall, go on heightening them by degrees, working in hatches with a middling full pencil, not too woosy, nor too dry; as the former would be the means of muddying your colour, and the latter making it raw.

When you think you have pretty strongly marked out, and worked up the shadows, mix a wash of either umber, or Antwerp burnt lake, and drop lake, with which faintly go over the flabby parts of the face, where the shadows do not come; and then proceed to heighten the carnations on the cheeks, the colour of the beard, if any such appears, the handles in the handling manner already mentioned, in various directions; so that, after some time working, the intersections appear like so many nice points or dots. Observe, as a general rule, that it is much easier to keep the tints of your face, than to cool them, by working over your washes or over it. It is therefore best to begin with cool greys and purples, and towards the finishing of the picture, to add warmth, if necessary, by brushing on such colours as garnets, terre Senna, or the like; and in addition to the carmine or lake that may be necessary to produce the tint of nature.

GENERAL OBSERVATIONS.

From the variety of style adopted by different miniature painters, it is very difficult for a young beginner to ascertain which is best to be followed; and as there is a certain degree of mechanic, paid to the management of the water-colours, to preserve them clear and free from muddiness, which is difficult to attain, we recommend to the young artist to procure a good miniature, or possible, after having given attention to be observant of the style of penciling and management of the colour, at the same letting nature be his guide in the marking of his features and colouring of his picture.

In the management of backs-ground, the young painter is to observe their twofold purpose: that of giving the lights their proper value, and on the other hand, of harmonizing
Painting.

Generally and cooked, I'm to calking, off. The first mention of sizes, to be retrieved to Venetian, and the most esteemed among the works of the moderns are those in the church of St. Peter, at Rome. There are also very good ones at Venice.

Mosaic work is composed of small pieces of glass, marble, precious stones, &c., of various colours, cemented on a ground of stucco or mortar, by the art of painting. It is generally employed in copying original pictures of the highest value in the art.

In performing this work, it is requisite to prepare little pieces of glass of as many different colours as can possibly be got.

For this purpose a glass-maker's furnace being prepared, and the pots and crucibles full of the matter of which glass is made, put into each crucible what colour or dye you think fit, always adding quantity with the widest, and augmenting the strength of the colour from crucible to crucible till you come to the deepest tincture.

When the glass has been thoroughly concocted, and the colours as in their perfection, take out the glass, hot as it is, and pour it on a smooth marble, flattening it down with another similar marble, and then cut it into slices of equal bigness, and about the thickness of an inch and a half; and so forth.

Then with an instrument, which the Italians call bocca di cune, you must make some pieces square, and others of different forms and sizes, as occasion requires. These pieces are to be orderly disposed in cases, as in painting in fresco. It is usual to range all the different tints in shells, and according to their colour.

If it is desired to have gold, either in the ground of the painting, or in the ornaments or draperies, take some of the pieces of glass, formed and cut in the manner before mentioned; moisten these on one side with gum-water, and afterwards lay them over with lead-gold; then put this piece, or several pieces at a time, on a marble slab, and in the mouth of the furnace, after you have first covered them with another hollow piece of glass. Let these stand till they are just red-hot, then draw the shrivel out all at once, and the gold will become so firmly attached to the glass, that it will never afterwards come off.

Now in order to apply these several pieces, and, out of them, to form a picture, in the first place proper or design, as this is to be transferred to the ground or plaster by calking, as in painting in fresco. See Fresco.

As the plaster is to be laid thick on the wall, and therefore will continue fresh and soft for a considerable time, there may be enough prepared at once to serve for as much work as will take up three or four days.

This plaster is then made of hard stone, with brick-dust very fine, gum tragacanth, and whites of eggs; and having been thus prepared and laid on the wall, and the design of what is to be represented transferred to it, take out the little pieces of glass, with a pair of pryors, and range them one after another, still keeping strictly to the light, shadow, different tints and colours which are to be represented, pressing or flattening them with a mallet, which serves both to sink them within the ground, and to render the surface even.

A long time and tedious labour are required to finish the work, which will be more beautiful as the pieces of glass are more uniform and ranged at an even height.

Pieces of mosaic work performed with exactness appear as smooth as a table of marble, and as finished and masterly as a painting in fresco, with this disadvantage, that they have a fine lustre and will last for ages.

Mosaic work of marble, and precious stones.

These two kinds of mosaic bear so near a resemblance to each other, as to the manner of working, that, to avoid repetition, we shall give them both under one, taking notice as we proceed, wherein the one differs from the other, either in the sawing or the ranging of the stones.

Mosaic work of marble is used in large works, as in pavements of churches and palaces, and in the incrustation and veining of the walls of edifices of the same kind.

Mosaic of precious stones is only used in small works, as ornaments for altar-pieces, tables for cabinets, &c., on account of the exceeding price of the materials.

Process of mosaic painting.

The ground of mosaic works wholly marble, is usually a massive marble, either white or black.

On this ground the design is cut with a chisel, after which it is called.

After it has been cut up, a considerable depth, i.e. an inch or more, the cavities are filled up with marble of a proper colour, (first selected according to the colours of the design, or original picture to be copied,) and reduced to the thickness of the incrustations with various instruments.

To make the pieces thus inserted into the incrustations cleave fast, (whose several colours or design,) a stucco is composed of lime and marble-dust, or a kind of mastic, which is prepared by each workman after a different manner peculiar to himself.

The figures being marked out, the painter or sculptor himself draws with a pencil the colours of the figures not determined by the ground, and in the same manner makes strokes or incrustations in the place where shadows are to be; after he has engraved with the chisel all the strokes thus drawn, he fills them up with a black mastic, composed partly of flurkandy pitch poured on hot, taking off afterwards what is superfluous with a piece of soft stone or sandpaper, together with water and beaten cement, taking care the mastic polishes the marble, and renders the whole so even that one would imagine it only consisted of one piece.

This is the kind of mosaic work that is seen in the church of the Invalids in Paris, and the chapel at Versailles, and with which some emperors of Italy, in their palaces are incrustated.

As for mosaic work of precious stones, other and finer instruments are required than those used in marble, as drills, wheels, &c. used by lapidaries, and engravers on stone.

As none but the richest marbles and stones are used in this work, to make them go the further they are sawn into the thinnest slices or coats imaginable, scarce exceeding half a line in thickness: the block to be sawn is fastened firmly with cords on the bench, and only raised a little on a piece of wood one or two inches high.

Two iron pins, which are on one side of the block, and which serve to fasten it, are put into a vice contrived for the purpose; and with a kind of saw or bow, made of fine brass wire bent on a piece of spungy wood, together with emery steeped in water, the slice is gradually fashioned by following the stroke of the design made on paper and glued on the piece.

When there are pieces enough fastened to form any one entire part of the design, they are applied to the ground.

The ground which supports this mosaic work is usually of freestone.

The matter with which the stones are joined together is a mastic, or a kind of stucco, laid very thin on the slices of marble, &c. as they are fastened on; this being done, the slices are applied with pliers; and if in any part they are not either squared or rounded sufficiently, so as to fit the place exactly into which they are to be inserted, they are brought down, when too large, with a brass file or rasp, and when too little, a drill, and other instruments used by lapidaries, are used to supply the deficient part.

Manner of performing mosaic work of gypsum.

Gypsum is a kind of coarse stone, or a shining transparent stone, found in the quarries of Mont-Maêtre, near Paris. It is different from the plaster of Paris, but retains the name which the Romans gave to the plaster, viz. gypsum.

Of this gypsum, or stone calcined in a kiln, and beaten in a mortar, and sifted, the French have made a sort of artificial marbles, incrusting precious stones, and of these they compose a kind of mosaic work, which does not come far short either of the durability or the nicety of the natural stones; and which, besides, has the advantage, that it contains of continued pieces or paintings of entire compartments without any visible joining.

Some make the ground of plaster of Paris, others of freestone. If it is of plaster of Paris, they spread it in a wooden frame, of the length and breadth of the work intended, and in thickness about an inch and a half.

This frame is so contrived that the tenons being only joined to the motrices by single pins, the ground may be taken up, without the frame being dismounted, when the plaster is dry.

The frame is covered on one side with a strong linen cloth, nailed all round, which being placed horizontally with the linen at the bottom, is filled with plaster passed through a wide sieve.

When the plaster is dry, the frame is set up perpendicularly, and left till it is quite
PAINTING.

That the work appears like a large picture seen through a diminishing glass.

The following is the manner of proceeding: A piece of very thin white tissue is sized with starch in the most equal manner possible; or pieces of glass about two inches square, the angles of which are blunted in order that the cloth may be without wrinkles.

When these pieces of cloth are sufficiently dry, a layer of white lead finely ground in oil of pinks or poppies (the whitest that can be procured) is applied on them with a knife.

To this layer, when dry enough to admit of scratching, more or less colored it necessary.

As it is of the greatest importance for the preservation of this kind of painting, that the layers are purged of oil, in order that they may imitate the colours laid on them, it is necessary that their surface is made very smooth, and is very dry and hard.

The artist is next provided with a circle of copper, nearly two inches in diameter, and one-fourth of an inch in height, extremely thin, and nearly white with a black glaze.

This circle is employed to contain the water on the surface of the picture.

Water distilled from rain or snow is preferable to any other; ordinary water, on account of the dust and impurities contained in it, is inconsiderable to this mode of painting.

The colours, also, must be ground between two Oriental agates, most carefully preserved from dust; and mixed with oil of poppies, or clay of lead or some other vitriol, which has been extracted without fire, and impregnated with lead.

All the colours being ground, are placed in a small heap, on a piece of glass covered with distilled water, in a tin box.

The materials being thus prepared, the subject to be painted is faintly traced with a black-lead pencil on one of the pieces of cloth above-mentioned.

The dots are formed on the pallet from the little heaps under the water, and the pallet placed as usual in the left hand.

The picture is held between the thumb and fore-finger, supported by the middle, and the necessary nails between the third and little fingers.

The artist, standing on the back of a chair, to give a full liberty of bringing the work near, or removing it from the eye.

The pencils are cleaned with ease of rectified spirit of naphtha.

After having made the rough draught with the colours still fresh, the circle of copper which ought to surround the picture is fitted exactly to the surface.

That the distilled water is poured within this circle till it rises to the height of one-eighth of an inch, and the eye is held perpendicular over the object. The third finger of the right hand must rest on the internal right angle of the circle, which gives it a freer play without any interior.

The artist retouches his work, adding colour and softening as he finds requisite.

As soon as the oil swins on the top, the water is poured off, and the picture carefully covered with a watch-glass, and dried in a box by a gentle heat.

When it is dry enough to be scraped nearly smooth with a knife, the artist repeats the same method till he is satisfied with his work.

It is at this period that the advantage of this new method particularly shews itself for the purpose of finishing; as the water poured on the picture discovers every fault of the pen-
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do not know with what degree of progress. The monuments of Egyptian painting, says Winckelmann, with which we are not acquainted, are the chevets of their mummies, which have endured so long that they appear to be secure from the injuries of time. That learned antiquarian gives the following account of the method of painting used on these chevets: "White, made up as it was first laid on as a ground, and the outlines of the figure are traced on this ground with black. The colours afterwards used are four in number, namely, blue, red, yellow, and green, and these are laid down without any mixture or shading. The red and blue prevail most, and seem to have been prepared in the coarsest manner. The light is formed by leaving the white lead ground, where it is necessary, in the same manner as white paper is treated in drawings."

In the travels of Norden in Upper Egypt, there is a description of some colossal figures, coloured in the same manner as the mummies. The colours are laid on the ground prepared in the manner of fresco, and they are said to have retained their freshness for many thousands of years.

The painting of the chests of mummies, of earthware, and of ornaments on their barges, appears to have been the chief employment of the Egyptian artists. Pliny relates that they painted also on the precious metals, but in what manner they exercised this latter branch of art is unknown.

This style of Egyptian painting is supposed to have continued till the reign of the Ptolemies.

In ancient Etruria, now called Tuscany, the arts flourished at a very early period. Pliny says that painting was carried to great perfection in Italy before the foundation of Rome, and it appears that even in his time the painters of Etruria were held in great esteem.

The only Etrurian paintings which are now remaining were found in the tomb of the Tarquins. They consist of long painted friezes, and pictures painted on wooden panels which occupied the whole space from the base to the cornice. These paintings are on a ground of thick mortar, and many of them in a high state of preservation.

Winckelmann observes, that in Campania also the art had been introduced by the colonies of Greeks who settled at Naples and Nola; but considers as purely Campanian works some medals of Capua and Tarentum, whether the Greeks had not reached, and praises the beauty of several. The authority, however, of these metals is questioned.

There have been discovered also, says the learned abbe, a great number of painted Campanian vases, which, for the most part, lie out of fashion, and are worthy of a place in the works of Raffael, and give us a high idea of the perfection of ancient art.

But it is in Greece that the history of painting is first deserving of particular attention. The Greeks have, with the most singular diligence, preserved the names of their artists from the earliest introduction of the arts amongst them. Aricles of Corinth, and Telephus and Crato of Sicily, are noticed at a period when much less regard had advanced no farther than the mere circumscrition of shadows by single lines. To this mode of design they gave the name of vagolography. Those artists taught something of the effect of light and shade, and of course gave an appearance of roundness to the object represented. This step of art was first cultivated in Etruria. To this period of the monochromists, a numerous list: the first of whom was Cleophas the Corinthian, who filled up his outline with a single colour, every where of equal force, and there gave the name of encomiasts (or of one colour) to his paintings.

Cimon Cleonarck invented the art of varying the attitudes of his figures, distinguishing the joints and muscles, and investing the forms with their proper features. But the highest credit, being given of him by Athan, is that he somewhat improved the rude art of his time.

The antique schools were those of Sicyon, Rhodes, Corinth, and Athens. Pliny mentions that the authority of Euphranor, the painter of Sicyon, was of so great weight that, whereas before him there were only two schools, the Attic and the Grecian, they were from his time divided into three, the Attic, Sicyonian, and Ionian.

Aelapion and Polygnotus of Thasos, who lived about 400 years before Christ, were the first painters of eminence. Polygnotus is said to have been the first who gave the air to the drapery, and dresses of his male figures, and to have opened the mouth so far as to show the beauty of the teeth. Aristotle speaks of him as excellent in expression. But the art of painting may be still considered to have been in an inferior state till the time of Timanthes, Parrhasius, and Zeuxis, who flourished about the period of the Peloponnesian war.

In the contest between the two latter of these great painters, Zeuxis declared himself to be overcome, because a cluster of grapes, painted by him, had only deceived the birds, but he himself deceived a bird. But the way was opened by a certain picture painted by his rival. The latter is said to have painted in an inferior state till the time of Timanthes, Parrhasius, and Zeuxis, who flourished about the period of the Peloponnesian war.

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Parrhasius was esteemed superior to others in correctness of outline and softness of colouring. Timanthes is chiefly celebrated for expression, and, in particular, for his picture of the sacrifice of Iphigenia; in which he covered the face of Agamemnon with a mantle, because he thought it impossible to represent any expression adequate to the feelings of his situation.

The fame of these great artists was surpassed by the class of painters who immediately succeeded them. Protogenes, Pamphilus, Melanthius, Antiphilus, Theron, Euphranor, and Apeles, excelled the art of painting to the utmost perfection which it has ever attained. They were chiefly eminent in separate provinces of art. Euphranor united a great skill in various branches, and Apeles eclipsed all other painters in limbs and powers of giving elegance and grace to his figures.

From the time of these pre-eminent masters, painting gradually declined in Greece; and, the Romans becoming masters of the whole country, the arts sunk into insipidity and insufficiency.

The undisputed and unrivalled excellence of the Greek schools appears to have consisted in drawing and expression. None of their greatest works remaining to our time, we can only take the accounts of historians respecting their powers of colouring; but it is evident that they were capable of making very fine distinctions in this branch of art, from the comparison made between two pictures of Tenebrist painted by different artists, in one of which the hero was said to appear as if he had been on roses, and in the other on fuch.

It is still more particularly doubtful whether the ancients possessed the knowledge of chiaroscuro in so eminent a degree as it has since been shown in the works of the Lombard and Flemish schools. The present remains of ancient paintings do not yield any warrant in their favour, although many passages in their historians tend to make us believe them skilled in this point; and, as the works that remain are undoubtedly executed by inferior artists, their authority may be thought of little weight against the general testimony on the contrary side.

The character of the antique school of art is thus given by a Greek writer: "The paintings of the ancients," says Dionysius of Halicarnassus, "are at first simple and unvaried in their colouring, but correct in their drawing, and distinguished by their elegance. Those which succeeded, less correct in their drawing, were more finished, more varied in their light and shades, trusting their effect to the multitudo of their colours."

Roman art. We have already seen that before the foundation of Rome the arts were cultivated in Etruria. Pliny also mentions some paintings at Arles, Lamuvian, and Cæs are, older than Rome, but it is uncertain by what artists these were executed. As long as the Roman emporiums remained free, they were indifferent to the cultivation of the arts; but towards the year of Rome 450, and 303 years before Christ, one of the Fabii, a patrician family in Rome, thought it no discredit to employ a painter. He painted the temple of the goddess Salus, and assumed the name of Fabius Pictor, or the painter. His works remained till the temple itself was destroyed by fire in the reign of Claudius.

The example of Fabius did not excite imitation. More than a century elapsed before the tragic poet Pacuvius followed his example, and painted the temple of Hercules. Tullius, a Roman knight, was not a painter, modern, and contemporary with Pacuvius. Painting did not come into great repute till the time of Messala, who, as well as Lucius Scipio, painted representations of his own victories. Few names of Roman painters, even in the time of Augustus, are mentioned by writers. The arts, however, flourished in high reputation amongst the emperors, particularly from the time of Nero in Antoninus; and Nero is said to have prided himself on his skill in painting. A colossal painting of 190 feet in length was executed by his orders, and was
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The paintings of the antique artists were either moveable, or on the ceilings or compartments of buildings. According to Pliny, the most eminent painters were employed on moveable pictures. The latter were either on fir-wood, larch, box-wood, or canvas, as in the instance of the colossal picture mentioned above, and sometimes on marble. When they employed wood, they laid on first a white ground. Among the antiquities of Turin are four paintings on white marble.

Their immovable paintings on walls were either in fresco, or on the dry stucco in distemper. Indeed, all the ancient paintings may be reduced to, first, fresco-painting; secondly, water-colour or disegno-painting; and thirdly, encaustic painting.

The ancient fresco-paintings appear to have been always on a white stucco-ground. The outlines of the ancient paintings on fresco were probably done at once, as appears from the depth of the impression, and the boldness and freedom of the design.

In general, the pictures painted on a dry ground, even in their buildings, as appears from the Herculaneum antiquities, most of which are executed in this manner. In Rome and Naples, the first (deepest) coat is of true Puzzolana (of the same nature with the terras now used in mortar, to prevent the setting of the plaster, in the sky, about one thicker thickness, the next of good marble, or alabaster, and sometimes of pure lime or stucco, in thickness about one third of the former. Upon this they appear to have laid a coat of black, and then another of red paint; on which last the subject itself was executed.

Such seems to have been their method of painting on walls; but in their moveable pictures, and in the performances of their first artists, and where effect of shade and light was necessary, they doubtless used white.

The colours employed, they seem to have mixed up with size: this appears to have made the colours so durable and adhesive, that the ancient paintings lately found, bear washing with a soft cloth and water, and sometimes even diluted aquafortis is employed to clean their paintings in fresco. Pliny says, that glue dissolved in vinegar, and then dried, is not again soluble.

What the encaustic painting of the ancients was, has been much disputed. From the works of Vitruvius and Pliny, it appears evidently that it was of three kinds:

First, when they were painted in the common way, was covered with a varnish of wax, melted, diluted with a little oil, and laid on warm with a brush.

Secondly, where the colours themselves were mixed up with melted wax, and the mixture used while warm; and

Thirdly, where a painting was executed on ivory by means of the cærum or violcum.

Some experiments on this last method by Mr. Colebrook may be found in the Phil. Trans. There are more particular directions in Muntz's treatise on encaustic painting. See ENCAUSTIC.

It appears from ancient writings of the best authority, that in the earliest and purest times of the art, the painters used few or no colours, as well as the Egyptians; but the use of white, or more correctly, of the perfect white of the natural marble, has been regarded as the perfection of the art, in the highest degree.

A great variety of ground has been used by the ancients, and particularly in Minoan and the other ancient works, for this purpose. The ground was generally considered as the last thing in art, and as the groundwork for the whole, and as the means of the perfection of the art, the profession of the artist, as they thought, consisted in the execution of this ground, and as the colours were not fixed, but could be removed and renewed at pleasure, this art was held in the highest estimation in the antique world.

Of the methods of painting, and colours employed by the ancients.

Of the moderns, in addition, have magisterial care of the utmost, little used; and ought to have the cakes of tin and zinc.

Of blacks, the ancients had preparations similar to lamp, ivory, and Franklin black (also to lamp, and common writing ink; and they used what we do not, the precipitate of the black dyes' vats.

The ancients possessed a species of vermilion, or fine cinabar, a coarser cinabar, red lead, various colours burnt and unburnt, apparently similar to the red ochre; Venetian red, Indian red, Spanish brown, burnt terra di Sienna, and scarlet ochre; they had also a substance alike in colour and in name to our dragoon's blood. See COLOURS.

The yellow pigments of the ancients were generally the same with our orpiment, king's yellow, Naples' yellow, &c. They did not possess turbeth mineral, mineral yellow, or gamboge; nor do they appear to have known of gall-stone as a pigment.

Of blue papers they had preparations from the lapis syamus, and lapis armenius. India they had, and perhaps blue and small; for they made blue glass, but whether from some ore of cobalt, or of wolfram must be uncertain; they had not Prussian blue, verditer, nor linsimus, which we have. We do not use the blue precipitate of the dyer's vats, nor mountain blue, which they certainly employed.

Of green colours they had verdigris, terra vert, and malachite, or mountain green. The latter is not in use among us. Sap green, green verditer, and Scheell's green, appear to have been known to them: like us, they procured as many tints as they pleased, from blue and yellow vegetables.

We have no original purple in use; that from gold, by means of tin, though very good when well done, is too dear perhaps, and unnecessary. Their purple was a tinged earth. Their orange of Sardarac, (red ophthalm) we also possess. Hence there does not appear to have been any great want of pigments, or any material difference between the colours they used, and such as we generally employ. Perhaps the full effect of colouring may be obtained without the use of exceeding brilliant pigments, depending chiefly on the proportion and opposition of tints.

The ancients could not know any thing about the spirit varnishes, distillation being modern invention; but they were undersized the art of using the better oil varnishes, that is, with the use and effect of resinous gums, dissolved in boiling inspissated oil.

One of the best preserved mummies in the British Museum, had the astonishing brightness of colours on the outside of the coffin, which was covered with a varnish. Thousands of years have not impaired them; they are as fresh as if they had been laid yesterday.

From an accurate observation of one of those mummies belonging to the university of Cambridge, it appeared that the varnish which covered the colours could not be dissolved, nor in the least affected by common water, and that they resisted the dissolving powers of the strongest acids; hence it is reasonable to conclude, that the coffins of the mummies were not covered with size, but with a fine transparent oil varnish. It was discovered at the same time, the colours themselves were not prepared or mixed with oil: for where the external varnish was damaged, broken, or rubbed off, even common water would wash the colours away, and affect the chalk ground under them.

Pliny has described the general and particular effects of the varnish of Apelles, under the name of attrix, which is, that nobody can mistake the thing, or the mixture he is speaking of. He has mentioned the shining glossy skin of the varnish, which exudes the brightness of the colours, and preserves them against decay; and that, whereas, the skin was laid on so thick, that it could not be discerned at any distance; nor was he less accurate in reporting the particular effects of that mixture which Apelles made use of; it harmonized, and lowered the tone of the brightest florid colours in an imperceptible manner, and the whole appeared as if it had been seen through glass. The chemists and connoisseurs are fully of opinion that no liquid substance or mixture of any kind is fit to produce these effects besides the oil-varnishes; and if there are not, Apelles and the Greeks were certainly acquainted with these varnishes: a fact, which might be strongly urged in behalf of their knowledge of colours.

The black outlines of the figures of the most ancient Greek paintings yet extant, that is, in Etruscan vases, are so sharp, so thick, and drawn in so easy and masterly a manner, that one cannot help looking upon
them as having been drawn in oil-colours. Had they been in distemper or water-colours on the red clay ground on which they are applied, they would have been exhibited and sealed into it. Our china and enamelled painters, prepare and apply their colours with spike or other liquid oils; and the Greek masters seem to have done the same, unless they should appear to have burnt their vessels before they painted them, or to have used a mixture of dissolved wax or gum for giving a bodily to their colours, which might have answered the same end as oil. And this is the more probable, as there is some reason to believe, that these vessels went through two different fires, that of baking them, and that of smoking or burning-in their colours.

The Greek and Roman paintings that have been preserved or discovered at Rome and Herculaneum do not contain any supposition of oil-colours. On the other hand, Vitruvius, who has left us so many valuable notices of the antient arts, acquaints us that there was a kind of painting, which absolutely required a mixture of oil.

From these observations, the evidence which the antients have given us in behalf of themselves, and of their knowledge of oil-painting, may be summed up in few words.

They having been acquainted with the white chalk ground which many modern masters use for oil-painting on boards, proves no more than that the antients might have done the same.

The oil-varnishes used by the Egyptians and Apelles might have brought them to the discovery of oil-painting; but as it appears both from mumrtries, and from the works of Pliny, that their colours were not prepared and mixed with that varnish, and as it is plain rather that this varnish was externally laid over the finished pictures, no other conclusion can be drawn, except that they were within sight of the discovery, and that it is a matter of wonder that they should not have laid hold of it.

The outlines of the old Greek or Etruscan vases are merely fallacious appearances.

The old Greek and Roman paintings on walls and stones are either painted in distemper or fresco, or they have not been sufficiently examined.

The oil used in the coarser wax and wall paintings, proves at most, that experiments had been tried with it; but we have no direct proofs of oil-painting having been understood or used by the Egyptians, Greeks, or Romans; and however great their skill or ingenuity, they might very well have been within sight and reach of the discovery, and nevertheless have missed it.

**Rise and progress of painting among the moderns.**

**Italy.** The revival of painting in Italy was owing to Giovanni Cimabue, born at Florence in the year 1240. He constructed the first instructions from some inferior Greek painters then employed in that city, and laid the foundation of the art in his own country. His immediate followers were Giotto and his scholars, whose manner, like that of their master, was dry and hard; but the admiration bestowed on their works excited a general emulation, and they were succeeded by Masolini and Masaccio, the latter of whom began to advance the art by giving a superior air to his figures. Giunta di Leonardo da Vinci, Michael Angelo Buonarroti, and Raphael both displayed a greater knowledge of distribution in the parts of his pictures, as well as greater correctness of design.

Andrea Castagna was the first Florentine who painted in oil. But Lionardo da Vinci, and Michael Angelo Buonarroti, were the glory of the Florentine Art: the former possessed a fine imagination, and full of sensibility, entered into all the details of painting, and devoted himself to the expression of the affections of the soul. In, in this sublime branch of the art, he afterwards surpassed by Raphael, he could at least boast not only of excelling all the painters who went before him, but of having pursued and investigated a path none of them had attempted to enter. His design was remarkable for purity, and the most diligent exactness of forms.

Michael Angelo delighted in seeking the great and the terrible, rather than the graceful and pleasing. Being well acquainted with the art of many modern masters, and accurately than any other artist in what manner to express the forms and joinings of the bones, and the office of every muscle, its origin and insertion. In his figures," says Mengs, "the muscles, and the tendons, are so easy and free, that they appear to be made for the attitude in which he represents them." His style possessed a degree of grandeur beyond any other painter. He did not possess, in the opinion of Reynolds, so many delightful parts of the art as Raphael, but those which he had acquired were of a more sublime nature.

He informs us in one of his letters (continues sir Joshua), that he modelled in clay, or in wax, all the figures which he intended to paint, a method familiar to the painters of that time.

Vasari has recorded that he painted but one picture in oil, and resolved never to paint another; saying it was an employment for women and children.

Michael Angelo was born at Castel Caprese in Tuscany in 1474, and died at the age of ninety. His principal work is the chapel of the Sistina in the Vatican, which was painted by order of pope Julius the Second. It represents, in various compartments, the origin of the human race, and its progress to society; the empire of religion; and the last judgment.

The contemporary of Lionardo da Vinci, was Pietro Perugino, the master of Raffaello Sasso d'Urbino.

Raffaello was born in 1483, and was at an early age the pupil of Pietro. His first manner was that of Cimabue; but endowed with a transcendent genius, after carefully studying, and uniting in himself, all the excellencies of his predecessors and contemporaries, he formed a style more perfect than that of any other painter who went before, or has succeeded him. He was sent for to Rome by pope Julius the Second, who employed him to paint several apartments of the Vatican palace.

It was for the pope Raffaello, says Mengs, that he was born in what he terms the infancy of the art, and that he formed himself by copying nature, before he had access to the works of any great master. He began by studying, with great exactness, the simple truth in his figures; and thus habituated to imitate nature with precision, it was not difficult for him to carry the same accuracy into the supernatural parts of his pictures, first on the sight of the works of the great Florentine masters, and afterwards in imitation of the antients.

The chief excellences of Raphael. He had too high an idea of painting to consider it as a mute art; he made it speak to the heart; and this could only be done in subjects which required expression. Raphael did attain an excellence equal to the Greeks, he saw, at least, and imitated, whatever was most beautiful and expressive in nature. "The Greeks sailed ingenuously," says Mengs, "between earth and heaven; Raphael walked with propriety on the earth."

At Venice, about the same time with Lionardo da Vinci, flourished the Bellinis and Mantegna. Giovanni Bellini contributed greatly to the progress of painting. He is considered the founder of the Venetian school, by introducing the practice of oil-painting, which he managed very skilfully, and by teaching his scholars to paint after nature. He gave a noble air to his heads, and there is somewhat of harmony in his pictures; but his greatest glory is that he was the master of Giorgione and Titian: Vecelli, who carried the Venetian colouring to perfection.

Giorgione died in his 32d year, having excited the emulation of Titian, who soon surpassed him.

Titian was instructed to copy nature in the most servile manner in the school of Bellini, but after seeing the works of Giorgione, he conceived the ideal excellence of colouring. The beauties of his works are to be found in the happy disposition of colours, both proper and local, an art which he carried to the extreme of skill. The artists in the Florentine and Roman schools had painted chiefly in fresco and distemper, and misshapen their large works from previous sketches; but as Titian painted in oil, and finished directly from nature, this practice, joined to his natural talent, gave him extraordinary advantages, and the greatest truth to his pictures.

He is not eminent in historical pictures alone, but also in landscape. In this province his scenes are well chosen, his trees bold and varied in their forms, and their foliage admirably executed. He generally selected for his landscapes some singular appearance of nature.

In Lombardy, about the same period also, Bianchi, born at Modena, instructed in painting Antonio Allegri, better known by the name of Correggio. Correggio began, like the other painters of his time, to imitate nature alone, but soon enlarged his manner, and gave ease and grace to his designs. He painted chiefly in oil, a kind of painting susceptible of the greatest delicacy and sweetness, and he gave a pleasing and captivating tone to his pictures. His method was to let his colours very thick on the brightest parts of his pictures, in order to make them capable of receiving afterwards the highest degree of light. He perceived that the reflections of light correspond wit
the colour of the body which reflects them, and on these principles founded his system of colouring.  

A delicate taste in colour, a perfect knowledge of chiaroscuro, the art of uniting light to light and shade to shade, together with that of detaching all objects from their ground, and an inimitable harmony of design, placed Correggio in the class of the greatest masters whom Italy has known.

From these great masters descended the schools of Florence, Rome, Venice, and Lombardy, in which the most distinguished painters were Fra Bartolommeo di San Marco, Andrea del Sarto, Giulio Romano, Vasari, Polydoro, Michael Angelo da Caravaggio, Tintoretto, Paolo Veronese, the Bassains, Forloni, Parmigiano, and lastly, the Carraccis, who combining the merits of the various schools, became themselves the head of a school called the Bolognese school, from the place of their birth.

Ludivico Carracci was the master of the other two, Annibale and Agostino. He had studied the works of Titian and Paolo Veronese at Venice, those of Andrea del Sarto at Florence, those of Correggio at Parma, and those of Giulio Romano at Mantua; but he chiefly endeavoured to imitate the manner of Titian.  

Annibale studied equally Correggio and Titian, but he is principally esteemed for his knowledge of design. Agostino possessed a mind greatly cultivated by learning, and he devoted all his time to poetry and music. These three painters often united their skill in the performance of the same picture, and their works are often confounded together, although the style of each is strongly different from the other two. Ludivico had less fire, but more gracefulness and grandeur; Agostino's conceptions were more spirited; and Annibale is characterized by boldness, by a more profound design, and a more powerful readiness of execution. "Ludovico," says Sir John Reynolds, "appears, in his best works, to approach the nearest to perfection. His unaffected breadth of light and shadow, the simplicity of colouring, and the softness of his pictures, are such that his pictures, appear to correspond with grave and dignified subjects better than the more artificial brilliancy of sunshine, which enlightens the pictures of Titian. They are much admired in Italy, where they are at first called L'Accademia dei Dilettanti, but it was soon called by the name of the founders, because none more honourable could be given to it. In the schools of this academy were taught the art of modelling, perspective, and anatomy; lessons were given on the beauty of the proportion of nature, on the best manner of applying colour, and on the principles of light and shade. They held frequent meetings, to which men of general learning were admitted; but these meetings ceased on the departure of Annibale, when he went to Rome to paint the gallery of the cardinal Farnese.

The most eminent succeeding painters of the Bolognese school were Guido, Lanfranco, Albani, and Guercino. Guido is distinguished by the gracefulness of his style, and Guercino by boldness of colour and effect.

In the Roman school, Pietro da Cortona succeeded to those great imitators of their predecessors and nature; and finding it difficult to rival them in that kind of painting, he applied himself principally to composition, and the arrangement of numerous groups. He is known to his countrymen as "il Sacchi," followed by Carlo Maratti, who flourished at Rome about the middle of the 17th century, and aiming at extraordinary perfection, diligently studied the works of the great masters in particular Raphael and the school of the Carracci. He is the last eminent painter of the Roman school. His best disciple was Francesco Imperiali, after whom Pompeo Battoni is the only one with whose works we are acquainted.

At Naples, in the early part of the 17th century, Giuseppe Ribera, called Spagnolotto, painted in the style of Caravaggio, and surpassed him in invention, design, and choice of subject. Luca Giordano was his disciple, who afterwards studied under Pietro da Cortona at Rome, and returning to Naples, became the founder of the Neapolitan school. Of this school Schifani and Sebastian Conca are the principal ornaments.

During the fourteenth and fifteenth centuries, painting began to appear anew in Germany, France, Holland, and Flanders.

German. The names of Albert Durer, Kranach, Holbein, and Amberg, stand high at Nuremberg, Augsburg, Basel, and Weimar, in the beginning of the 16th century, but the capital of Vienna afforded no encouragement to painting till the reign of Rodolph the Second. The succeeding monarchs, principally from Ferdinand the Third to Leopold the First, were great promoters of the arts; but the perpetual wars which they were all involved in, prevented the progress of painting; and it was not till the total repulse of the Turks from the Austrian frontiers, under the last of these princes, that painting began to flourish at Vienna. The artists of the German school are numerous, but few of them have risen to eminence. Of these few, Albert Durer is the first in the order of time, and Mengs the latest.

Albert was born in 1471, and excelled in painting and engraving. His pictures were characterized with great exactness, but his manner was dry and hard. His principal works were painted at Prague in the palace of the emperor Maximilian, by whom, as well as by Charles the Fifth, he was held in great esteem. Raphael is said to have hung the prints of Albert Durer in his own apartment.

Holbein was nearly contemporary with Durer. He is known by a multitude of accurate portraits, and was likewise eminent for richness of invention, which he displayed in numerous designs for gravers, sculptors, and jewellers. His Dance of Death, painted in the town hall of Basel, is universally celebrated. He is remarkable for having engraved the portraits of Terpsichore, Tullus, and Trachon, the Roman, performed all his works with his left hand.

Kneller, born at Lubeck, in the duchy of Holstein, was a disciple of Rembrandt. He painted chiefly portraits, which were highly celebrated in England during the reigns of Charles the Second, James the Second, William the Third, Anne, and George the First.

Antonio Raffael Mengs, one of the most scientifie painters of any country, was educated in Germany; but painted chiefly at Rome, and at Madrid; to which latter capital he was invited by Charles the Third. He practised his art with an extreme diligence, which has deservedly rendered him eminent. His works possess many beauties of composition, and mechanical execution. His writings are too frequently metaphysical, but contain many excellent disquisitions on painting, calculated to inspire the artist with exalted ideas of his profession.

Hollond and Flemings. The Dutch and Flemish schools are nearly as much distinguished by the number, as by the excellence of their artists.

In the former school, the precedence of fame in point of date, is given to Lucas van Leyden, born in 1494. He was a laborious competitor of Albert Durer, and resembles him in manner and style.

Polemburg, Osballe, Gerard Dow, Meriers, Wouwermans, Cyp, Bergen, Vanderwerff, V. Huysum, Schalcken, Brouwer, Hems-kirk, are amanuenses painters of the Dutch school; but they are all greatly surpassed by the truly astonishing genius of Rembrandt, many of whose works are even to surpass nature in force and effect. His etchings also are highly and deservedly valued. It is not, however, to be omitted, that the singular merit of his original conceptions and compositions is counterbalanced by the grossness of his forms.

The honour of founding the Flemish school is attributed to John of Bruges; and the names of his successors are too many to admit of detail. Their works are to be found in every cabinet. The most illustrious masters of this school are Rubens and Van Dyck.

To John of Bruges, better known by the name of John van Eyck, was for a long time associated the name of oil-painting; but he had the honour of being the first who introduced it to Italy, where a picture painted by him, and sent to Alphonse, king of Naples, first divulged his discovery. Frans Floris is celebrated as the Raphael of Flemings. De Vos, Seghers, Dulleghem, Terbrugghen, Jordaens, stand prominent in the catalogues of merit in the same school.

Rubens possessed a most fertile and extensive genius, and produced an immense number of works. This extraordinary painter distinguished himself equally in the lie of portrait, landscape painting, in animals, fruits, and flowers. He was both invented and executed with the utmost facility. His drawing, although overcharged, is not without considerable merit. He had great knowledge of anatomy; he was hurried away by the ardour of execution, and too often sacrificed form and correctness to splendour, and the effect of colour. He excelled in colouring, and chiaro-scuro. He studied principally in Lombardy, after the works of Titian, Paolo Veronese, and Tintoretto, from whose excellence he formed rules for his own practice, from which he seldom deviated.

He was not only an eminent painter, but...
PAINTING.

an accomplished scholar, and rose to high employment in the service of his country, visiting several courts in the character of an ambassador.

Of the disciples of Rubens, Vandyck best comphrehended the rules and forms of his master; and even surpassed him in the delicacy of his colouring, particularly in portraits, in which he stands one of the highest masters of his art.

France. The French school or schools may be classed in three different ages, and characterized by as many different styles: two prior, and one modern, since the period of the late revolution. The artists of the former schools chiefly adopted the manner of the various painters whose works they studied or imitated. But Poussin, Vouet, Le Brun, and Le Sueur, are those masters who have given distinction to the French school in the province of history. The first and last of these have been compared by the French to Raphael, whose example Le Sueur in particular considered as his model. Poussin studied the antique statues with such great devotion, that his figures frequently bear a resemblance to these. Le Brun's battles of Alexander are deservedly celebrated for their spirit, composition, and correct drawing. Gaspar Dughet (commonly called Gaspar Poussin, from his master's name, which he adopted), and Claude Gelle (called Claude Lorraine, from the place of his birth), are eminent examples of excellence in landscape. The latter appears to stand without a rival, or at least stood univalved in his time. Both these painters derived their professional knowledge, as well as their choice of subjects, from the fascinating and classic objects of imitation which they found in Italy, where they studied and flourished.

The arts which had been raised in France by the masters before-mentioned to very considerable dignity, sunk in the second school of boucher and their inclinations to indulgence and affectation. The reputation of a colourist was sought by exaggerated tints, and the hand of a master was conceived to consist in ostentatious pencilling.

In a more recent period, and particularly since the recent style has been introduced into the arts, Vien was the first reformer of this class, and his example has been vigorously followed by David and his contemporaries. They have endeavoured to substitute a simple and rigid taste in the place of false and glittering manners. The attempt is laudable: the result will be judged of by posterity.

The comparative merits of those modern schools which have been hitherto mentioned, are thus given by Richardson:

"The painters of the Roman school were the best designers, and had a kind of greatness, but it was not antique. The Venetian and Lombard schools had excellent colourists and a certain grace, but entirely modern, especially those of Venice; but their drawing was generally incorrect, and their knowledge in history and the antique very little; and the Bolognese school is a sort of composition of the others. Even Annibale himself possessed not any part of painting in the perfection that is to be seen in those from whom his manner is composed; though, to make amends, he possessed more parts than perhaps any other master, and in a very high degree.

"The works of those of the German schools have a dryness and ungracefulness not like any other in other countries, that has something in it pleasing however; but this is odious, and as remote from the antique as Gothicism could carry it.

"The Flemings have been good colourists, and finished nature, as they conceived it; that is, instead of raising nature, they fell below it, though not so much as the Germans, nor in the same manner. Rubens himself lived and died a Fleming, though he would have caricatured his manner; that is, they have been more Rubens in his defects than he himself was, but without his excellences."

"The French, excepting some few of them (N. Poussin, Vouet, Le Brun, and Le Sueur), as they have not the German stiffness, nor the Flemish ungracefulness, neither have they the Italian solidty; and in their airs of heads and manners, they are easily distinguished from the artists of other schools: they may have endeavoured to imitate it."

Spain. The art of painting began to flourish in Spain during the reigns of Charles the Fifth and Philip the Second. The style of painting, however, was not distinguished by great excellence until the works of Velasquez appeared. From the masterly imitation of nature displayed in his pictures, the school of the modern was caused to suffer.

Zurbaran and Herrera are among the best painters before Velasquez; and Murillo for the most distinguished after him. The softness of touch, the harmony of colour in the paintings of Murillo seem to enshroud the eye.

In Russia the arts are at present cultivated with great energy, and with unremitting attention on the part of the government.

In America also, great establishments are forming at New York and Philadelphia, with the same view to the promotion of the arts. It now only remains to speak of the art of painting in the United States. The style of painting is yet in its infancy, but the attempt is now making great advances towards excellence.

Painting has been cultivated in England at several periods with various success. We shall here give the account of it from Mr. West's letter in the third number of Academic Amals, published by the Royal Academy of London.

"Many sovereigns of this country have noticed and patronized the fine arts. Edward VI. caused several chapels to be embellished with painted glass and enamelled monuments, as well as with paintings on the walls, representing scriptural subjects, and others from the church legends, together with portraits of those existing characters of both sexes. The chapel of St. Stephen, Westminster, was the most conspicuous."

"Henry the Seventh gave patronage to many ingenious men, both in painting, sculpture, and architecture, to visit his capital. Raffaele and Titian he wished to see at his court; and he endeavoured to draw them thither by the most splendid offers: but not succeeding in his desire, he procured several of their works; in particular the picture of St. George, by Raffaele, at present in the possession of the king of Spain, and the two pictures by Titian, in the gallery of the mansion house of Stafford; the subjects of which are Diana and Acteon, and Diana and Calisto. He was more fortunate in his invitation to Holbein, at that time famous as a portrait painter, who resided in Henry's palace, and whose works were soon spread through the kingdom."

"Charles the First, more attached to the fine arts than any of his predecessors, formed a splendid collection of the works of the great Italian and Flemish masters. He invited to his court Rubens and Vandyck, and other painters of considerable eminence, from Flanders and Holland; and he gloried in counting among his natural subjects Inigo Jones, his architect, and Dobson, who endeavoured to eminence in painting. These were the two first English artists who enjoyed the patronage of royal favour."

"Charles the Second was proud to follow the liberal example of his father, in bestowing rewards on ingenious artists. He patronized most of those who visited his court from Italy, Flanders, Germany, and Holland; of whom he was patronized, from the walls of Windsor-castle, and the palace of Hampton-court, by Verrio, and others, are evident proofs; besides many pictures from poetical subjects, by Gennari, as well as portraits by several masters of considerable eminence. The favours which this monarch showered on the arts, were, however, confined to foreign artists."

"Queen Anne was the first of our sovereigns who called into activity the British pencil, as the paintings in the cathedral of St. Paul's, and the hospital at Greenwich, by Sir James Thornhill, and others under his direction, sufficiently evince. In architecture, Sir Christopher Wren was equally distinguished by her favour."

"But to form the great epochs of patronage conferred by a British king on British artists, in painting, sculpture, and architecture, was reserved for the reign of his present majesty, George the Third."

"In the year 1768, his majesty gave his royal sanction to a plan formed for the establishment of an academy of painting, sculpture, and architecture, of which he was graciously pleased to become the protector and patron."

"In the three branches of art which constitute this academy, he found many artists already formed: among others of considerable celebrity in painting, Reynolds, Wilson, Hayman, Gainsborough, Hoare, Dun, Mortimer, Barrett, Sandby, Wright, Cotes, and West; in sculpture, Bacon, Nollekens, and Wilton; in architecture, Chambers, G. Dance, Stuart, T. Sandby, Gwyn, and the two Adams."

"At the same time, Strange, Woollett, Hall, Green, and Mac Ardel, endeavoured, with marked eminence among the engravers, to render the works of our engravers, blended with the labours of the painter, opened a new avenue to fame. The harmonious finish of Strange; the united skill of Wilson and Woollett, in landscape, as seen in the prints of Nollekens, Placoton, Ceyx, Celidon and Amelie, &c;
the portraits in mezzotinto from Sir Joshua Reynolds, by M' Ardell, Fisher, &c.; the successful combination of West with Earlom, Greenwood, Hall, &c., in historical works, as seen in the prints of Agrippina, Regulus, Hannibal, Wolfe, La Hogue, the Boyne, Penn, Cromwell, and the Restoration, &c., spread the celebrity of English works of art through the medium of engraving; and the circumstance of these prints rising to a higher price in every market throughout the continent than had ever been known in the animals of the arts, inspired those commercial wits which afterwards produced the pictures of Shakespeare, under Boydell; the poets, under Macklin; historical, under Bowyer, &c. &c.; giving to this country a new source of commerce, highly beneficial to its interests, and unexampled in any other.

"English school." To the list of painters mentioned by West, are to be added several who unfortunately experienced no royal patronage. Among these is Hogarth, whose unrivalled excellence in works of humour is probably as well known to us by the numerous engravings from his pictures.

Of the modern English school, Sir Joshua Reynolds was the founder, and his works still remain its greatest glory. They not only give him the most distinguished rank among the artists of the present age, but the effects produced by them on the rising artists, as well as by the elevated principles inculcated in his discourses delivered at the Royal Academy, will secure his reputation as long as England shall pay respect to superior talents. The English taste appears to be formed on the great masters of the Italian and Flemish schools. Reynolds professed an admiration and preference of Michael Angelo, but his own works are in no point similar to that great master of design.

The names of Gainsborough and Wilson stand the highest in landscape painting.

The painters of this school have been distinguished as less rigid with regard to the forms and correctness of their drawing, than ambitious of striking and poignant effect. "Beauty," says the French Encyclopaedia, "ought to be the characteristic of the English school, because the artists have it so frequently displayed before their eyes. If this beauty is not precisely similar to the antique, it is not inferior to it."

"The English school should also be distinguished for the truth of expression, because the liberty enjoyed in that country gives to every passion its natural and unabridged operation."

The best accounts of painting and painters are to be found in the works of Leonardo da Vinci, Alberti, Lomazzo, and Bellori; and in the Lives of the Painters, by Vasari and Du Piles; Pelibon's Entretiens sur les Vies des Peintres, and his other writings; the Discourses delivered by Reynolds in the Royal Academy of London; the various Treatises by Mengs; Richardson on Painting; and De Arte Graphica, by Du Fresny.

The later publications of Barry, Shee in his "Sketches," and Hone in his Inquiry into the present State of the Arts in England, convey the most accurate information concerning the progress of painting in this country.

PAKE, or white copper, a metal composed of copper, nickel, and zinc. The zinc amounts to nearly one-half of the whole, and the proportions of copper and nickel are as 5 to 11. This copper metal is much used among the Chinese.

PALESTRA, in Grecian antiquity, a public building, where the youth exercised themselves in wrestling, running, playing at quoits, &c.

PALAMEDEA, a genus of birds belonging to the order of grallifers. The character of this genus is, the bill bends down at the point with a horn, or with a tuft of feathers crested near the base of it; the nostrils are oval; the toes are divided almost to their origin, with a small membrane between the bottoms of each.

There are two species; the first of which is the palamedea cornuta, or horned screamer. It is about the size of a turkey; in length about three feet four inches. The bill is two inches and a quarter long, and black; the upper mandible is a little gibbons at the base; the under shunts beneath it, as in the gallinaceous tribe: the nostrils are oval and peri-

PALE, in heraldry, one of the honourable ordnaries of an escutcheon, being the representation of a pale or stake placed upright, that extends along the whole height of the coat from the top of the chief to the point. See HERALDRY.

PALISADE, or Palisado, in fortification, an inclosure of stakes or piles driven into the ground, each six or seven inches square, and eight feet long, three whereof are laid under ground. Palisades are generally used to fortify the avenues of open forts, gorges, half-moons, the bottoms of ditches, the parapets of covert-ways, and in general all posts liable to surprise, and to which the access is easy. Palisades are usually planted perpendicularly, though some make an angle inclining towards the ground next the enemy, that the ropes cast over to tear them up may slip.

PALSADERS, Turning, are an invention of M. Coehorn, in order to preserve the palisades of the parapet of the covert-way from the besieger's shot. He orders them so, that as many of them as stand in the length of a rod, or in about ten feet, turn up and down like traps, so as not to be in sight of the enemy till they just bring on their attack, and yet are always ready to do the proper service of palisades.

PALLISSE, in heraldry, a bearing like a range of palisades before a fortification, represented on a fesse, rising up a considerable height, and pointed at top, with the field appearing between them.

PALLADIUM. In the month of April, 1803, it was announced by a public notice, that a new noble metal called palladium was sold at Mr. Forster's, Gerard-street, Soho, London. Some of its properties are mentioned in the following, and the discovery is concealed. Mr. Chemists, suspecting imposition from the unusual manner in which the discovery was announced, made some experiments on it to discover its composition and quality, and this property could not be referred to any known metal. This induced him to purchase all that remained in the hands of the vendor. It was sold at the rate of 25 grains per guinea.

It had been worked by art, and was offered for sale in thin laminae. When polished, it had exactly the appearance of platinum. The laminae were very flexible. The specific gravity varied from 10.972 to 11.482. The effects of galvanic electricity on it were the same as on gold and silver. When exposed to the blowpipe, the side farthest removed from the flame became blue. A very violent heat is necessary to melt it. The button, by fusion, lost a little of its weight, but its specific gravity was increased from 10.972 to 11.871. It was harder than iron, and appeared cristallized. The fracture was brittle.

When strongly heated, if it is touched with sulphur it melts, and continues melting till the compound ceases to be red-hot. The sulphuret is brittle, and whiter than palladium. It was not altered by charcoal. If
ammonia, a valuable red solution. Muriatic acid, when long boiled upon palladium, acquires a fine red colour, and dissolves a portion of it; but its action is not very powerful. Nitric acid acts with much greater energy, and oxidizes and dissolves it for a very beautiful red solution. Muriatic acid, when long boiled upon it, becomes a beautiful red colour. Nitro-muriatic acid attacks it with great violence, and forms a fine red solution.

The alkalies and earths throw down a fine orange powder from these solutions; and when ammonia is used, the supernatant liquid is sometimes of a fine greenish blue. Sulphat, nitrat, and mucit of potas and of ammonia, throw down orange precipitates, as they do from the solutions of platinum. Muriat of tin throws down a dark orange or brown, more-or-less acetatalized salts of palladium. Sulphat of iron throws down palladium in the metallic state. Prussiat of potas occasion a olive-coloured precipitate, and water containing sulphurated hydrogen gas a dark brown one. Fluor, arsenic, phosphoric, ovale, tartaric, citric acids, and their salts, precipitate some of the solutions of palladium, and form various compounds with it.

Such are the properties of palladium ascertain by Mr. Chenevix. They indicate a substance different from every other known metallic body. Still he considered the substance as a compound, and tried various ways of forming one similar. At last, he suspected mercury and platinum as likely to be its constituents; and after various trials, hit upon the following mode of forming it, which succeeded.

One hundred parts of platinum, previously purified by solution in nitro-muriatic acid, and precipitation by sal ammoniac, were dissolved in nitro-muriatic acid. To the solution 200 grains of red oxide of mercury were added. Then introducing the solution of acid, he continued to add nitre till the acid was saturated. A solution of sulphat of iron was put into a long-necked matras; the mixed solution of platinum and mercury was poured into it, and the matras heated on a sand bath. A copious precipitate soon fell, and the inside of the matras was coated with a thin metallic crust. This crust, collected and washed, was put into a charcoal crucible, and exposed to a violent heat; a button of metal was obtained, which possessed the properties of palladium. From the proportions employed, Mr. Chenevix concluded, that palladium is composed of two parts of platinum, and one of mercury.

The extraordinary consequences that follow from this experiment will occur at once to the reader. Here is a compound of two metals, which is not known to be such. And if we know one such compound, why may not many of the other supposed metals be such compounds?

We have here a compound containing mercury, one of the most volatile substances in nature, in such a state as to resist the most violent heat without quitting its combination; so that one of the most apparently whimsical and most the alchymistical opinions is here verified.

But the specific gravity of palladium is one of the most extraordinary circumstances. It is considerably less than that of the lightest of its component parts. The specific gravity of platinum cannot be stated at less than 22.

The specific gravity of mercury may be stated at 13.5; but the actual specific gravity was only 11.2. So that an expansion amounting to more than a third of the whole has taken place.

The experiments of Mr. Chenevix were repeated by some of the eminent chemists in London; among others, by Dr. Wollaston and Mr. Tennant: but these gentlemen could not succeed in obtaining palladium. Hence doubts are still entertained by some concerning the composition of this substance. But the well-known precision of Mr. Chenevix, and the uncertainty which he has himself cast on the subject by his long series of experiments, ought to induce us to give him full credit.

Dr. Thompson tried the experiment with all the precautions he could think of to ensure success. The metal thus possessed by Mr. Chenevix was formed; and upon heating it violently in a charcoal crucible, a button was obtained of a white colour, and very like platinum. It was very porous, and therefore through many of the cracks under the hammer. Its specific gravity was only 11.26. But this was partly owing to its porosity. It was acted upon by the three mineral acids; but the action of neither of them was violent, and the solution, instead of red, was a dirty reddish-brown. He could detect no iron by the usual tests; but the solutions gave unequivocal marks of the presence of platinum. In short, the button was not platinum, but at the same time it was not palladium.

PALASSIA, a genus of the syngecnisia polygamia frusticans class and order. The receptacle is chaffy; the root stems, 9; cylindrical; there is one species, a shrub-like plant of Lima.

PALLET, in heraldry, is nothing but a small pale.

PALM. See Watch.

PALS. See Medicine.

PALSY. See Medicine.

PALM, or PATE, in heraldry, is when the shield is divided into four or more equal parts, by perpendicular lines falling from the top to the bottom.

PAN FERMENTATION. See fermentation.

PANAX, GINSENG, a genus of the direct order, in the polygamia class of plants. There are in the umbel the corolla is five-petaled; stamina five; hermaphrodite calyx five-toothed; superior styles two; berry two-seeded; male calyx entire. There are nine species of this plant: 1. Quinquéfolia. 2. Triphi. 3. Fruticosa. 4. Arbores. 5. Epimic. 6. Aculeata. 7. Chrysophilla. 8. Simplex. 9. Attenuata.

Ginseng was formerly supposed to grow only in Chinese Tatar, affecting mountainous situations, shaded by close woods; but it has now been long known that this plant is also a native of North America, whence M. Sarrasin transmitted specimens of it to Paris in the year 1787; and the ginseng was discovered in Canada, Pennsylvania, and Virginia, by Lantie, Kalim, Bartram, and others, has been found to correspond exactly with the Tatarian species; and its roots are now regularly purchased by the Chinese.

The dried root of ginseng, as imported here, is scarcely the thickness of the little finger, about three or four inches long, frequently forked, transversely wrinkled, of a brownish texture, and both internally and externally of a yellowish-white colour. On the top are commonly one or more little knots, which are the remains of the stamens of the preceding year, and from the number of which the age of the root is judged to. If the taste it discovers a muffling sweetness, approaching to that of licorice, accompanied with some degree of bitterness, and a slight aromatic warmth, with little or no smell. It is far sweeter, and more grateful small, than the roots of fennel, to which it has by some been supposed similar; and differs likewise remarkably from those roots in its very peculiar and pleasant peculiarities. Its active principles, the sweet matter of the ginseng being preserved entire in the watery as well as the spirituous extract, whereas that of fennel-roots is destroyed or dissipated in the watery or spirituous extract of the root by the decoction. The slight aromatic impression of the ginseng is likewise in good measure retained in the watery extract, and perfectly in the spirituous one.

The Chinese ascribe extraordinary virtues to the root of ginseng; and have long considered it as a sovereign remedy in almost all diseases to which they are liable, having no confidence in any medicine unless in combination with it. It is observed by Mr. Wollaston, that the most eminent physicians in China have written volumes on the medicinal powers of this plant. We know, however, of no roots of the efficacy of ginseng in Europe, and from its sensible qualities, we judge it to possess very little power as a medicine.

PANCNANTHUM, a genus of the hexandra monogynia class of plants, the flower of which consists of six stamina, six cleft petals, twelve-cleft nectarium with eight sepals. It is a native of Europe; and from its sensible qualities, we judge it to possess very little power as a medicine.

PANCIENIUM, a genus of the diceris monogynia class and order. There is no calyx or corolla; male anther sessile; female stigmas two; fruit compound. There is one species.

PANDECTA, in the civil law, collections made by Justinian's order, of five hundred and thirty-four decisions of the eminent lawyers, on so many questions occurring in the civil law; to which that emperor gave the force and authority of a sacred statute. The pandects consist of fifty books, and make the first part of the body of the civil law. See CIVIL LAW.

PANNE, in law, See Panel. In Sec...
Scotch live, pannel signifies the prisoner at the bar, or person who takes his trial before the court of justiciary, for some crime.

Panell, in jottery, is a tymanum, or square piece of thin wood, sometimes carved, frequently grooved in a larger piece, between two upright pieces and two cross pieces. Pannel, in majority, is one of the faces of a barn stone.

Panonea, a genus of insects of the order Lepidoptera; the generic character is, most horn-like, with two feelers; stemata three: antennae longer than his tail of the male chelated or clawed. The most familiar species of this genus is the panonea comins of Linnaeus, an insect very frequently seen, the only one during the early part of summer. It is a longitudinal flying moderate size, with four transparent wings elegantly variegated with deep-brown spots: the tail is small, which is generally carried in an upright position, is furnished with a forcipae, somewhat in the manner of a lobster's claw.

The panonea comins is a native of Greece and the islands of the Archipelago, and is in sect of a very queer appearance. It is considerably larger than the preceding, and is distinguished by having the lower wings so extremely narrow or slender as to resemble a pale of_lists in a row, with an oval dilatation at the tip, while the upper wings are very large, oval, transparent, and beautifully variegated with yellow-brown bars and spots. See Plate Nat. Hist. fig. 340.

Panther, Devil Fells.

Papaver, the poppy, a genus of the monogynia order, in the polycladra class of plants, and in the natural method ranking under the 27th order, rheraceae. The corolla is tetramerous, the only peltiphyllous, the capsular bilocular, opening at the peduncle below a persistent stigma. There are nine species: 1. The somniferum, or somniferous common garden poppy. There are of this a great many varieties, all of them extremely beautiful. The white officinal poppy is one of the varieties of this sort. It grows often to the height of five or six feet, having large showy flowers, both single and double, succeeded by capsules or heads, each as orange, each containing about 5000 seeds.

We are told, that in the province of Bahr in the East Indies, the poppy-seeds are sown in the month of October and November, at about eight inches distance, and well watered, till the plants are about half a foot high; when a compost of dung, nitrates earth, and ashes, is spread over the areas; and a little before the flowers appear, they are again watered profusely till the capsules are half grown, at which time the opium is collected, far when fully ripe they yield but little juice; two longitudinal incisions from below upwards, without penetrating the cavity, are made at sun-set for three or four successive evenings; in the morning the juice is scraped off with an iron scoop, and worked in a bowl pot in the sun's heat, till it is of a consistence to be formed into lumps of about four pounds weight; these are covered over with the leaves of poppy, tobacco, or some other vegetable, to prevent their sticking together, and in this situation they are dried. See Narcotic Principle.

2. The rhazus, or wild, globular-headed poppy, rises with an upright, hairy, multifo-}

rotus stalk, terminated by many red and other-coloured flowers in the varieties, succeeded by globular smooth capsules. This plant is common in corn-fields, and flowers in June and July. The capsules of this species, so like those of the somniferum, contain a milky juice of a narcotic quality, but the quantity is very inconsiderable, and has not been applied to any medicinal use, but an extract prepared from them has been successfully employed as a sedative. The flowers have somewhat of the smell of opium, and a cuculiaceous taste, accompanied with a slight degree of bitterness. The same flower is directed in the London Pharmacopoeia, which has been thought useful as an astringent and pectoral, and is therefore prescribed in coughs and catarrhal affections; but it seems valued rather for the texture of its colour than for its virtue as a medicine.

3. The cambricus, or Welsh poppy, has a perennial root, pinnated cut leaves, smooth, upright, multiform stalks, a foot and a half tall, terminated by globe, smooth flowers, succeeded by smooth capsules.

4. The orientalis, or oriental poppy, has a large, thick, perennial root; long, pinnated, sawed longitudinally, smooth, multiform stalks, terminating in one large, deep-brown flower, succeeded by oval smooth capsules. The flowers appear in May.

Paper, sheets of a thin matter, made of vegetable substance.

Paper-Making. Under this word we cannot do better than by giving a concise view of the art of making paper.

The first instrument is called the duster, made in a cylinder, four feet in diameter, and five feet in length. It is altogether covered with a wire net, and put in motion by its connection with some part of the machinery. A convenient quantity of rag before the selection of its colour than for its virtue as a medicine.

The selection is then to be made; and it is found more convenient to have the tables for cutting of the knots and stitching, and for forming the paper, in the same place with the cutting-table. The surface both of these and of the cutting-table is composed of a wire net, which in every part of the operation allows the remaining dust and refuse of every kind to escape.

The rags, without any kind of pretence, are again carried from the cutting-table back to the duster, and from thence to an engine, wherein, in general, they are in the space of six hours reduced to the stuff proper for making paper. The hard and soft of the same quality are placed in different lots; but they can be reduced to stuff at the same time, prepared in soft is put somewhat later into the engine.

The engine is that part of the mill which performs the whole action of reducing the rags to paste, or, as it may be termed, of triturating the substance. The power of the engines depends on the extent of the paper, or on the force of water, or on the construction of the machinery.

When the stuff is brought to perfection, it is conveyed into a general reservoir, which supplies the vat from which the sheets of paper are formed. This vat is made of wood; and generally about five feet in diameter, and two and a half in depth. It is kept in temperature by means of a grate introduced by a hole, and surrounded all the inside of the vat with a case of copper. For fuel to this grate, they use charcoal or wood; and frequently, to prevent smoke, the wall of the building is brought into contact with one part of the vat, and the fire is communicated with the place where the paper is made.

Every vat is furnished on the upper part with planks inclosed inwards, and even railed in with wood, to prevent any of the stuff from running over in the operation. Across the vat is a plank which they call the trepan, pierced with holes at one of the extremities, and resting on the planks which surround the vat.

The forms or moulds are composed of wire cloth, and a moveable frame. It is with those that they fetch up the stuff from the vat, in order to form the sheets of paper. The sides of the form are made of oak, which is previously steeped in water, and otherwise prepared to receive the stuff. The wire cloth is made larger than the form of paper, and the excess of it on all sides is covered with a moveable frame. This frame is necessary to retain the stuff of which the paper is made on the cloth; and it must be exactly adapted to the form, otherwise the edges of the paper will be ragged and badly finished. The wire cloth of the form is varied in proportion to the fineness of the paper and the nature of the stuff.

The sheets are pieces of woollen cloth spread over every sheet of paper, and upon which the sheets are laid to detach them from the form, to prevent them from adhering together, to imbibe the part of the water with which the stuff is charged, and to transmit the whole of it when placed under the action of the press. The two sides of the felt are differently raised, that of which the hair is longest is applied to the sheets which are laid down; and any alteration of this disposition would produce a change in the texture of the paper. The stuff of which the felts are made should be sufficiently strong, in order that it may be sufficiently packed on the sheets without forming into folds; and, at the same time, sufficiently pliable to yield in every direction without injury to the wet paper. As the felts have to resist the reiterated efforts of the press, it appears necessary that the warp be very strong, of combed wool, and well twisted. On the other hand, as they have to imbibe a certain quantity of water, and to return it, it is necessary that the weft be of carded wool, and drawn out into a slack thread. These are theutenals, together with the press, which are used in the apartment where the sheets of paper are formed.

The vat being furnished with a sufficient quantity of stuff and of water, two instruments are employed to mix them: the one of which is a simple pole, and the other a pole armed with a piece of board, rounded and full of holes. This operation is repeated as the stuff falls to the bottom. In the principal weaving-machine, them use for this purpose what is called a hog; which is a machine within the vat, that, by means of a small wheel on the outside, is made to turn

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constantly round, and keep the stuff in perpetual motion. When the stuff and water are properly mixed, it is easy to perceive whether the previous operations have been complete. When the stuff floats close, and in regular flakes, it is a proof that it has been well triturated, and the parts of the stuff which have escaped the rollers also appear.

After this operation the workman takes one of the forms, furnished with its frame, by the middle of the short sides; and fixing the frame round the wire cloth with his thumbs, he plunges it into the hollow spaces made by the wire cloth to be partly filled up. Meanwhile, the effort which is made in detaching the form, produces an infinite number of small hairs on every part of the stuff, and these hairs are raised, without destroying the paper, by a lever placed into the vat, beginning by the long side, which is nearest to him. After the immersion he raises it to a level; by these movements he fetches up on the form a sufficient quantity of stuff; and as soon as the form is raised, the water escapes through the wire cloth, and the superfluity of the stuff over the sides of the frame. The fibrous parts of the stuff arrange themselves regularly on the wire-cloth of the stuff in imitation of the water escapes, but also as the workman favours this effect by gently shaking the form. Afterwards, having placed the form on a piece of board, the workman takes off the frame that sides the form towards the catcher; who, having previously laid his hands, places it with his left hand in an inclined situation, on a plank fixed on the edge of the vat, and full of holes. During this operation the workman applies his frame, and begins a second sheet. The catcher seizes this instant, takes with his left hand the form, now sufficiently dry, and, having laid the sheet of paper upon the felt, returns the form by gliding it along the trepan of the vat.

They proceed in this manner, laying alternately a sheet and a felt, till they have made six quires of paper, which is called a post: and this they do with such swiftness, that, in many sorts of paper, two men make upwards of twenty posts in a day. When the last sheet of the post is covered with the felt, the workmen about the vat unite together, and subdue a little the edge of the form of the press. They begin at first to press it with a middling lever, and afterwards with a lever about fifteen feet in length. After this operation, another person separates the sheet of paper from the felt, laying them in a heap; and several of these heaps collected together are again put under the press.

The stuff which forms a sheet of paper is received, as we have already said, on a form made of wire cloth, which is more or less fine in proportion to the stuff, and surrounded with a wooden frame, and supported in the middle by many cross bars of wood. In consequence of this construction, it is easy to perceive, that the sheet of paper will take and preserve the impressions of all the pieces which compose the form, and of the empty spaces between them.

The traces of the wire cloth are evidently perceived on the side of the sheet which was attached to the form, and on the opposite side, they form an arrangement of parallel and rounded risings. As in the paper which is most highly finished, the regularity of these impressions is still visible, it is evident that all the operations to which it shews itself to be chiefly in view for the prevention of these impressions without destroying them. It is of conse-

quence, therefore, to attend to the combination of labour which operates on these impressions. The catcher, in turning the form on the felt, flattens a little the rounded eminences which are in relief on one of the surfaces, and destroys the hollow places made by the wire cloth to be partly filled up. Meanwhile, the effort which is made in detaching the form, produces an infinite number of small hairs on every part of the stuff, and these hairs are raised, without destroying the paper, by a lever placed into the vat, beginning by the long side, which is nearest to him. After the immersion he raises it to a level; by these movements he fetches up on the form a sufficient quantity of stuff; and as soon as the form is raised, the water escapes through the wire cloth, and the superfluity of the stuff over the sides of the frame. The fibrous parts of the stuff arrange themselves regularly on the wire-cloth of the stuff in imitation of the water escapes, but also as the workman favours this effect by gently shaking the form. Afterwards, having placed the form on a piece of board, the workman takes off the frame that sides the form towards the catcher; who, having previously laid his hands, places it with his left hand in an inclined situation, on a plank fixed on the edge of the vat, and full of holes. During this operation the workman applies his frame, and begins a second sheet. The catcher seizes this instant, takes with his left hand the form, now sufficiently dry, and, having laid the sheet of paper upon the felt, returns the form by gliding it along the trepan of the vat.

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The paper is afterwards collected into reams of 20 quires each, and for the last time pressed under the press, where it is continued for 2 hours, or as long as the drain of the paper-dries. It fully explains the structure of one of the best paper-mills now in use.

Plate Paper Mill, &c. figs. 1, 2, 3, explains the construction of an engine paper-mill. The OEfig. 3 is a large vat of wood, lined with lead; and is prepared with two bolted pieces of wood, \( F, G \); the piece \( E \) has a strong lever \( H \) jointed to it; the other end of this lever enters a mortise in the piece \( F \), and has as near its shaft as \( F \); which, as the pipe descends, it comes through the top of the piece \( F \) and is put on to \( H \), by turning which the lever can be raised or lowered at pleasure. In the middle of each of the levers \( H \), is a brass socket, in which the spindle of the cylinder \( I \) lies; and on the outer end of this spindle \( I \) is a motion \( K \), working into other cog wheels, connecting with the water-wheel, steam-engine, &c. which gives it motion. The cylinder is furnished, in the great number of steel cutters fixed into it, an axis. These cutters act against a similar set fixed into a block of wood \( L \); this block goes through a hole in the side of the vat, and a partition \( N \) in the middle of the vat. Some of the rags get through between them; the bottom of the vat is raised up at \( M \), and to the same lever with the axis of the cylinder, goes the cutters. Its concurrence is possible without touching, and then suddenly falls down to the block \( L \). At the back of the vat a small feedister \( O \) connects with it; through a hair sieve \( P \) is a crooked pipe, which brings clean water to the vat; the end of this pipe has a damal bag tied on to catch any impurities which may be in the water.

Fig. 1. is a box which is put over the cylinder, and rests upon the edge of the vat, and the partition \( N \); at each edge of this box is fixed a trough \( b \); when the box is put in its place, these connect with the top of the leaden pipes of fig. 3, on the side of the vat: on the edge of these troughs hair sieves \( g g \) are fixed; and before these boards, one of which is shown at \( a \), are slits in grooves in the sides of the box. The operation of the machine is as follows: The vat is filled with clean water, the box fig. 2, is put over the cylinder, and a quantity of rags is put into the vat. Water being turned round with a velocity of 120 revolutions per minute in the direction of the arrow in fig. 2, draws the rags in between the cutters in the cylinder and the block \( L \), and tears them to pieces; from the cylinder they go forwards into the vat, and turn slowly round in it till they come under the cylinder again. The great velocity of the cylinder throws the rags and water up against the sieve \( g \) in the box fig. 1; the other end goes through the sieve into the trough \( b \), and from it into the pipes \( Q Q \), which convey it away, and the clean water is brought to the vat by the pipe \( P \); when the boil water is wanted to be kept in
the boards are slid down before the sieve, as at A, fig. 5, which prevents the water going through the sieves. In larger mills two different engines are used; that into which the rolls are first put is like fig. 3; the other one which is used to finish the rolls is similar to it, but has much finer cutters and a lever let down much nearer the block L by the screw A.

The lower compartment of Plate Paper-making, represents one of the tables used in the manufactories in and near London, for printing the paper used for the hangings of rooms. A, is a square water-tight box, called the sieve, mounted upon legs; this box is about 4 ft. filled with water, mixed with paper-shavings, &c. and then another box B is put into it, so that it floats on the water; the bottom of this box is of parchment, and a frame covered with a piece of felt is laid upon it; the door D, where the printing is performed, has two pieces of wood fixed upright in it; these have the use in them to receive the ends of a brass wire, which is put through the middle of the roll of paper A; the paper from this roll goes over the edge of the table, and is laid upon a horse, fig. 4, which has on its top a board to lie on. On one part of this horse a number of small sticks e, a little longer than the width of the paper, are laid. The operation is conducted as follows: the workman takes a roll of paper (each of which is 12 inches long, and 22 inches wide) from the shelf F, under the table, and puts a brass wire through it, and lays its ends in the pieces a, as shown in the figure 4; he then puts the roll of paper to the end of the table. In the middle time a boy, called the tier-boy, who stands on the stool E, brushes the felt which lies in the sieve B over with the colour used in the printing; the workman then takes up the block (in which the device to be printed is cut as in wood-cuts), by putting his hand through the strap nailed to the back of it, and presses its face upon the felt in the colour-sieve B: the water which is under causes the paper to be printed the block, and take colour equally over the surface of the block: he then removes the block, and lays it upon the paper near the end of the table; and takes up a mallet with a leaden head, called the hammer, with the left hand, and a piece of cloth in his right hand, and gives the block two blows on the back of it, to make the impression. He then puts down the mallet, and lifts up the block (which his left hand never quits), and turns round to take colour at the sieve; as he turns round to bring the block over the paper again, he takes hold of the edge of the paper with his right hand, and pulls it forward the proper distance to print again; in laying the block down, he keeps it to its place, with his right hand, and when it is laid he takes up the roll as before. In this manner he proceeds till the end of the paper touches the ground; the tier-boy then goes and puts it over, fig. 6, and returns to the sieve. When the middle of the paper nearly touches the ground, he goes again to the end of the paper, and pulls it straight over the horse, and lays it on the ground as in the figure. This process is necessary till the pieces are finished; he then takes the poll, fig. 6, from the ground, and puts one of the sticks e, fig. 5, into the groove across its top. He then puts the paper on the sticks, and lifts them all together to the ceiling of the room, where he lodges the ends of the sticks upon a black mark for the purpose: he then takes down the pole, and puts another stick in a different part, so as to hang up all the pieces in two or three loops to dry. In those prints which are very full, or which is more difficult to lay on, the mill is not sufficient to give the impression; a lever is then used instead. Two of the legs of the table MN project some inches above it; between these, two bars P are bolted, the middle of which is furnished by an upright post Q, whose end is fastened to the ceiling. The shelf R has a piece m put into it; the workman takes his colour, and places the block on the paper m before; but instead of putting a portion of gum arabic or of size, he places the middle of the lever (the end of which was under the bar P, and the middle resting on the piece m) over the block, and presses his weight upon the outer end of the lever, which gives the impression; he then lifts up the lever, slides it right hand to the middle of it (keeping his left at the outer end), and returns the lever on to the piece m, then lifts up the block to take colour as before.

PAPER, Marbled. See MARBLING.

PAPER-OFFICE, an office in which all the public writings, mathematical proclamations, letters, intelligences, negotiations abroad, and generally all dispatches that pass through the offices of the secretaries of state, are lodged, by way of library.

PAPER-OFFICE is also an office belonging to the court of king's bench.

PAPIER MACHE', is a substance made of cuttings of white or brown paper, boiled in water, and beaten in a mortar till they are reduced into a kind of paste; and then boiled with a variety of gum Arabic or of size, to give tenacity to the paste, which is afterwards formed into different toys, &c. by pressing it into oiled moulds. When dry, it is covered with a mixture of size and lamp-black, and afterwards varnished.

PAPILIO, butterfly, a genus of insects of the order lepidoptera. The generic character is, antenae thickening towards the extremity, commonly terminating in a knob or clavated up; wings (when sitting) erect, and markings upon the under wing.

The prodigious number of species, amounting to many thousands, in this genus, renders it absolutely necessary to divide the whole into sections or sets, instituted from the habit or general appearance, and in some degree, from the disposition of the colour on the wings. This division of the genus is conducted by Linnaeus in a peculiarly elegant and instructive manner, being an attempt to point out, amongst so great a number of the natural and civil history, by attaching the memory of some illustrious antient name to an insect of a certain particular cast.

The first Linnaean division consists of the equites, distinguished by the shape of their upper wings, which are longer, if measured from their hinder angle to their anterior extremity, than from the same point to the base. Some of this division have filiform or plate-like wings, which are particularly those which resemble moths, but may generally be very clearly distinguished by their habit or general shape. The equites are either Eros (for Trojans), distinguished by having red or blood-coloured spots or patches on each side their breasts; or Achivi, Greeks, without red marks on the breast, and gayer colours in general than the former, and having an eye-shaped spot at the inner corner of the lower wings.

The next division consists of the Heliconites. These are distinguished by the narrowness of their wings, which are also, in general, of a more transparent appearance than the other divisions; their upper wings are also generally much more oblong than the lower, which are short in proportion.

The third division consists of the Danaus, from the sons and daughters of Danaus. They are divided into danai candidi, or those in which the ground-colour of the wings is generally white; and the danai festivi, in which the ground-colour is never white, and in which a greater variety of colour occurs than in the candidi. The wings of the danai are of a somewhat rounder shape than those of the heliconi, or less stretched out.

The fourth section consists of the nymphalides, and is distinguished by the wings being more or less divided into the nymphalis cristata, in which eye-shaped spots are seen either on all the wings, or on the upper or lower pair only; and into the nymphalis phalerata, in which no ocularated spots are visible on the wings, but, in general, a great variety of colours.

The fifth section contains the plebeii. These are, in general, smaller than the preceding kinds of butterflies, and are subdivided into plebeii urticae, or those in which the wings are marked by semitransparent spots; and plebeii rurales, in which the spots or patches have no transparency.

The large of butterflies are universally and emphatically known by the name of catterpillars, and are extremely various in their forms and colours, some being smooth, others beset with simple or ramified spines, &c. and some, especially those belonging to the division equites, are observed to protrude from their front, when disturbed, a pair of short tentacula or feelers, somewhat analogous to those of a snail.

The papilionides insects in general, soon after the enlargement from the chrysalis, and commonly during their first flight, discharge some drops of a red-coloured fluid, more or less intense in different species. This circumstance, exclusive of its analogy to the same process of nature in other animals, is peculiarly worthy of attention from the explanation which it affords of a phenomenon sometimes considered, both in antient and modern times, in the light of a prodigy; viz. the descent of red drops from the air, which has been called a shower of blood: an event recorded by several writers among the prodigies which took place after the death of the great dictator.

Among the equites trees, the papilio prinum should take the leading, not only from the corresponding dignity of the name, but from the exquisite appearance of the animal itself, which Linnaeus considered as the most beautiful of the whole papilionideous tribe.

This admirable species measures more than six inches from wing's end to wing's end: the upper wings are velvet-black, with a broad band of the most beautiful green-green, and of a satiny lustre, drawn from the shoulder to
the tip; and another on the lower part of the wing, following the shape of that part, and of a somewhat undulating appearance as it approaches the tip; the lower wings are of the same color as the upper, edged with violet-black, and marked by the same spots, brownish white, while at the upper part of each, or at the part where the upper wings lap over, is a symmetrical orange-coloured spot: the thorax is black, with sprinklings of lucid green in the middle, and the abdomen is of a bright yellow, or gold colour. On the under side of the animal the distribution of colours is somewhat different, the green being disposed in central patches on the upper wings, and the lower being marked by more numerous black as well as orange spots. The red or bloody spots on each side of the thorax are not always to be seen on this the Trojan monarch. The Papilio primum is a very rare insect, and is a native of the island of Ambonya.

P. Hector is very happily named, being of a deep or violet-black colour, with the lower wings marked by numerous blood-red spots: the thorax is red on each side, and the upper wings have a thin brown, white, transverse or bars. It is a native of the East Indies. See Plate Nat. Hist. fig. 313.

Among the equites achivi, the P. memin-

пус may be considered as one of the most splendidly beautiful of the butterfly tribe. Its size is large, measuring, when expanded, about six inches; and its colour is the most brilliant of silver-blue that imagination can conceive: changing according to the variation of the light, into a deeper blue, and in some lights to a greenish cast: on the under side it is entirely brown, with numerous deeper and lighter undulations, and three large occluded spots on each wing. It is a native of South America.

The P. machaon is an insect of great beauty, and may be considered as the "only British species of papilio belonging to the tribe of equites.* It is commonly known among the English collectors by the title of the swallow-tailed butterfly, and is of a beautiful yellow, with black spots or patches along the upper edge of the posterior wings: all the wings are bordered with a ring of black, decorated by a double row of crescent-shaped spots, of which the upper row is blue, and the lower yellow: the under wings are tailed, and are marked at the outer angle or tip with a round red spot bordered with blue and black. The caterpillar of this species feeds principally on fennel and other umbelliferous plants, and is sometimes found on rue. It is of a green colour, encircled with numerous black bands spotted with red, and is furnished on the top of the head with a pair of short tentacula of a red colour, which occasionally protrude from that part. In the month of July it changes into a yellowish-grey angular chrysalis, affixed to some convenient part of the plant, or other neighbouring substance, and from this chrysalis in the month of August proceeds the complete insect.

Of the division called heliconii the beautiful insect the papilio podalirius, is the only species. It is a native of many parts of Europe, but has not yet been observed in our own country.

* Unless we admit the papilio podalaris to be a British species also.

and is somewhat larger than the common great cabbage-butterfly; of a white colour, with a slight semitransparency towards the tips of the wings, which are decorated with violet-black spots; and on each of the lower wings are three oblong white spots, consisting of a carmine-coloured circle with a white centre and black exterior border.

Of the division entitled danai candidi, the common large white butterfly, or P. brassica, is a familiar example: this is well known to require particular description, and it may be only necessary to remind the reader that it proceeds from a yellowish caterpillar, streaked with blue and black spots, and which changes during the autumn into a yellowish-grey chrysalis, alighted in a perpendicular direction to some wall, tree, or other object, some filaments being drawn across the thorax in order the more conveniently to secure its position. The fly appears in May and June, and is seen through all the summer.

Of the danai festivi the P. midamus may serve as an example; an elegant Asiatic species, of which the upper wings are of a brown, white, and yellowish-straw yellow; the lower pair are streaked longitudinally with numerous white lines, and edged with a white border.

Among the nymphales gemmata few can exceed in elegance the P. io, or peacock butterfly, a species by no means uncommon in our own country; the ground colour of the upper wings is brown, with black bars separated by yellow intermediate spaces on the upper edge of the superior wings, while at the tip of each is a most beautiful large eye-shaped spot, formed by a combination of black, brown, and blue, with the addition of whitish specks: on each of the lower wings is a still larger eye-shaped spot, consisting of a black central patch, varied with blue, and surrounded by a zone of pale brown, which is itself deeply bordered with black: all the wings are scioloped or denticulated. The caterpillar is black, with numerous white spots, and black ramified spines; it feeds principally on the nettle, changing to crys-

aPary, the fly appearing in August.

P. jurtina is a species equally common, though far less beautiful. It is chiefly observed in meadows, and is of a brown colour, the upper wings having a much brighter or orange-ferruginous bar towards the tips, with a small, black, eye-shaped spot with a white centre; on the opposite or under side of the insect the same distribution of colours takes place.

Of the nymphales phalerata, few can surpass the common English species called P. atalanta, or the admirable butterfly: it is of the most intense velvet-black colour, with a rich carmine-coloured bar across the upper wings, which are spotted towards the tips with white: while the lower wings are black, with a deep border of carmine colour marked by a row of small black spots: the under surface of the wings is a most beautiful mixture of colours: the caterpillar is brown, striped and spiny, feeds on nettles, and changes into a chrysalis in July, the fly appearing in August.

Of the last division, termed plebeii, may be adduced as an example a small English butterfly called P. naive, of a blackish or brown colour, with numerous whitish and semitransparent spots. It belongs to the plebeii urbiola.

To this division also belongs a very beauti-

f ul exotic species, a native of India, and of a lemon-yellow colour, wholly edged with black, and further ornamented by having each of the lower wings tipped with two narrow black tu-touched processes. It is the P. Pyranthera Linnaeus. See Plate Nat. Hist. figs. 311 and 313.

PAPISTS, persons professing the papish religion. By several statutes, if any English priest of the Church of Rome, born in the do-

minions of the crown of England, came to England from beyond the seas, or tarried in England three days without conforming to the law, he was guilty of high treason; and they also incurred the guilt of high treason who were reconciled to the see of Rome, or procured others to be reconciled to it. By these laws also, persons were disabled from giving their children any education in their own religion. If they educated their children at home, for maintaining the schoolmaster, they were liable to forfeit 10l. a month, and the schoolmaster was liable to the forfeiture of 40s. a day: if they sent their children for education abroad, they were liable to forfeit 100l. and the children so sent were incapable of inheriting, purchasing, or enjoying, any lands, profits, goods, debts, legacies, or sums of money: saying mass was punishable by a fine of 200l. and 100 marks; and hearing it by a forfeiture of 100l.

But during the present reign the Roman Catholics have been in a great measure relieved from the restrictions formerly imposed on them. See 18 Geo. III. c. 60; and 31 Geo. III. c. 22.

PAPPHORUM, a genus of the class and order triantria dinia. The calyx is two-valved, two-flowered; corolla two-valved, many-awned. There is one species, a grass of America.

PAPPUS, down. See Botany. PAP, in commerce. See Exchange.

PARABOLA, in geometry, a figure arising from the section of a cone, when cut by a plane parallel to one of its sides. See Go-

nic Sections.

PARABOLIC CONOID, in geometry, a solid generated by the rotation of a para-

bola about its axis: its solidity is \( \frac{1}{3} \) of that of its circumscribing cylinder.

The circles conceived to be the elements of this figure, are in arithmetical proportion, decreasing towards the base. A parabolic conoid is to a cylinder of the same base and height, as 1 to 2; and to a cone of the same base and height, as \( \frac{1}{3} \) to 1.

PARABOJING.

PARABOLIC SPACE, the area contained between any entire ordinate and the curve of the incumlab parabola.

The parabolic space is to the rectangle of the semi-ordinate into the absciss, as 2 to 3; to a circle of the same area, as \( \frac{1}{3} \) to 1.

PARABOLOIDES, a name given to para-

boloids of the higher kind, which are algebraic curves.

PARACENTRIC MOTION, in astro-
nomy, denotes so much as a revolving planet approaches nearer to, or recedes from, the sun, or centre of attraction.

**PARADISE, bird of.** See **PARADISE.**

**PARADISEAN, or PARADISEAN, a genus of birds belonging to the order of Pica.** The head is covered with a belt or collar of downy feathers at the base, and the feathers on the sides are very long.

"Birds of this genus (says Latham) have the bill slightly bending, the base covered with velvet-like feathers. The nostrils are small, and concealed by the feathers. The tail consists of ten feathers; the two middle ones, and sometimes more in several of the species, are very long, and wielded only at the base and tips. The legs and feet are very long and strong: they have three toes forward, one backward, and the middle connected to the outer one as far as the first joint. The whole of these genera have till lately been very imperfectly known: few cabinets possessing more than one species, viz. the greater, or what is called the common bird of Paradise; nor has any set of birds given rise to more wonders. The peculiar objects of this class are to be found in every author; such as, their never touching the ground from their birth to death; living wholly on the air; and being produced without legs. The last error is scarcely at this moment wholly eradicated. The circumference which gave rise to it did not indeed at first proceed from an intention to deceive, but merely from accident. In the parts of the world, however, the wing and belly is covered and the natives make use of them as sigretes, and other ornaments of dress; and in course threw away the less brilliant parts. The whole trouble they were at on this occasion was merely to skin the bird, and, after pulling off the legs, corner parts of the wings, &c. thrust a stick down the throat into the body, letting an inch or two hang out of the mouth, beyond the bill: on the bird's dying, the skin collapsed about the stick, which became fixed into the body, thereby covered the whole. They had then no more to do than to put this end of it into a socket fitted to receive it, or fasten it in some manner to the burban, &c. By degrees these were inserted into the skiffs for the natives, and afterwards were covered by the Japanese, Chinese, and Persians, in whose countries they are frequently seen, as well as in many parts of India; the grandees of these last parts not only ornamenting themselves with these beautiful plumages, but adorning even their horses with the same."

Latham enumerates eight species, but suspects there may be more.

1. The largest bird of paradise is commonly two feet in length; the head is small; the bill hard and long, of a pale colour. The head and back part of the neck are lemon-coloured, a little brown on the eyes; about the neck, the bird is of the brightest greenish-blue, soft like velvet, as is also the breast, which is black: the wings are large and chestnut-coloured; the back part of the body is covered with long, straight, narrow feathers, of a pale brown, longer, and more pointed of the ostrich. These feathers are spread when the bird is on the wing; for which reason he keeps very long in the air. On both sides of the belly are two tufts of stiff and shorter feathers, of a golden yellow, and shining. From the rump proceed twelve feathers, which are thicker on their extremities.

These birds are not found in Key, an island 50 Dutch miles east of Banda; but they are found at the Aroo Islands, lying 15 Dutch miles farther east than Key, during the winter or dry monsoon; and they return to New Guinea as soon as the calmer or wet monsoon sets in. They come always in a flock of 30 or 40, and are led by a bird which the inhabitants of Aroo call the king. This leader is black, with red spots; and constantly flies higher than the rest of the flock, which never forsake him, but settle when he settles; a circumstance that frequently proves their run when the king lights on the ground, whence they are not able to rise on account of the singular structure and disposition of their plumage. They are likewise unable to fly with the wind, which would ruin their loose plumage; but take their flight constantly against it, cautious not to venture out in hard-blowing weather, as a strong wind frequently obliges them to come to the ground. During their flight, they cry like starlings, and throw their heads to one side more to the crooking of ravens; which is heard very plainly when they are in distress from a fresh gale blowing on the back of their plumage. In Aroo, these birds settle on the highest trees; especially on the genus Benja-

minia of the Hortus malabaricus, commonly called the warangia tree. The natives catch them with birdlime or in nooses, or shoot them with blunt arrows; but though some of them are still alive in their hands, the catchers kill them immediately, and sometimes cut the legs off; then they draw out the entrails, dry and fumigate the bodies with sulphur or smoke only, and sell them at Banda for half a rixdaal each; but at Aroo they may be bought for a spike-nail, or a piece of old iron. Flocks of these birds are often seen flying from one island to the other against the wind. In case they find the wind becomes too strong they lift up into the air, till they come to a place where it is less agitated, and then continue their flight. During the eastern monsoon, their tails are monicated, so that they haul them in a peculiar manner to the eastern monsoon. See Plate Nat hist. fig. 315.

2. The smaller bird of Paradise is about 20 inches long. Its head is lead-coloured, and palmer at the point. The eyes are small and inclined in black about the neck. The head and back of neck are of a dirty yellow, the back of a greyish yellow, the breast and belly of a dusky colour, the wings small and chestnut-coloured. The long plumage is about a foot in length wider than in the large species; as in general the colours of this bird are less bright than the former. The two long feathers of the tail are constantly thrown away by the natives. This is in all respects like the greater sort; and they likewise follow a king or leader, who is, however, blacker, with a purplish cast, and thinner in colour than the rest.

3. and 4. The large black bird of Paradise is brought without wings or legs for sale; so that no accurate description of it has yet been given. Its figure, when stuffed, is narrow and round, but stretched in length to the extent of four spans. The plumage on the head, neck, and belly, is black and velvet-like, with a base of purple and gold, which appears very strong. The bill is blackish, and one inch in length. On both sides are two bunches of feathers, which have the appearance of wings, although they are very different, the wings of these birds being very soft, similar to peacock's feathers, with a greenish hue. Birds of this kind are brought only from one particular place of New Guinea. Besides the large black bird of Paradise, there is still another sort, whose plumage is equal in length, but thinner in body, black above, and without any remarkable gloss, not having those shining peacock-feathers which are found on the greater species. This wants likewise three long-pointed feathers of the tail belonging to the larger black species.

5. The last species we shall mention is the king's bird. This creature is about seven inches long, and somewhat larger than a sparrow. Its head and eyes are small, the bill straight, the eyes included in circles of black plumage, the crown of the head is flame-coloured, the back of the neck blood-coloured, and the neck and breast have a ring of the brightest emerald-green. Its wings are in proportion strong, and the quill feathers dark, with red shining plumes, spots, and stripes. The tail is straight, short, and the feathers brown. Two long naked black shafts project from the rump, at least a hand-breadth beyond the tail, having at their extremities semilunar twisted plumage, of the most glaring green colour above, and dusky below. The plumage on the under side is in each side a tuft of long plumage, feathered with a broad margin, being on one side green and on the other dusky. The back is blood-red and brown, shining like thick mahogany. The long pointed feathers are in size like those of a large, three-fingered and one back-toe. This bird associates not with any of the other birds of Paradise; but flies solitary from bush to bush, wherever he sees red berries, without ever getting on tall trees.

**PARADOX, in philosophy, a proposition seemingly absurd, as being contrary to some received opinion, but yet true in fact.**

No science abounds more with paradoxes than geometry: thus, that a right line should continually approach, but never reach it, is a true paradox; and in the same manner, a spiral may constantly approach to a point, and yet not reach it, in any number of revolutions, however great.

**PARALLACTIC, in general, something relating to the parallax of heavenly bodies.** See **PARALLAX.**

The parallactic angle of a star, &c, is the difference of the angles CEA (Plate Misc. fig. 179.) BTA, under which its true and apparent distance is seen; or, which is the same thing, it is the angle TSE.

The sines of the parallactic angles ALT, AST (fig. 180.), at the same or equal distances, ZS, from the zenith, are in the reciprocal ratio of the distances TS, and ZT from the centre of the earth.

**PARALLAX, in astronomy, denotes a change of the apparent place of any heavenly body, caused by being seen from different points of view; or it is the difference between the true and apparent distance of any heavenly body from the earth.**
Thus let AB (Plate Miscel. fig. 151.) be a quadrant of a great circle on the earth's surface, A the place of the spectator, and the plane of the heaven the vertex and zenith.

Let VNH represent the star's apparent place, M the apparent horizon, in which suppose the star C to be seen, whose distance from the centre of the earth is TC. If this star was observed from the centre T, it would appear in the plane of C and E, and elevated above the horizon by the angle DE; this point E is called the true place of the phenomenon or star. But if an observer viewing it from the point V and elevating himself at D, which is called the visible or apparent place; and the arch DE, the distance between the true and visible place, is what astronomers call the parallax of the star, or other phenomena.

If the star rises higher above the horizon to M, its true place visible from the centre of M, and its apparent place N; whence its parallax will be the arch PN, which is less than the arch DE. The horizontal parallax, therefore, is the greatest; and the higher a star rises, the less is its parallax; and if it should come to the vertex or zenith, it would have no parallax at all; for when it is in Q, it is in the same plane T and A in the same line TAV, and there is no difference between its true and apparent place. Again, the farther a star is distant from the earth, so much the less is its parallax; thus the parallax of the star E is only GD, which is less than DE the parallax of C. Hence it is plain that the parallax is the difference of the distances of a star from the zenith when seen from the centre and from the surface of the earth: for the true distance of the star M from the zenith is the arch VP, and its apparent distance VN, the difference between which PN is the parallax.

These distances are measured by the angles VTM and VAM, but VAM = VTM = TMA. For the external angle VAM = C ATM + A M T, the two inward and opposite angles, so that AMT measures the parallax, and upon that account is itself frequently called the parallax, and this is always the angle under which the semidiameter of the earth, AT, appears to an eye placed in the star; and therefore where this semidiameter is seen directly, there the parallax is in the horizon. Hence when the star rises higher, the sine of the parallax is always to the sine of the star's distance from the zenith, as the semidiameter of the earth to the distance of the star from the earth's centre; hence if the parallax of a star is known at any one distance from the zenith, we can find its parallax at any other distance.

If we have the distance of a star from the earth, we can easily find its parallax: for on the triangle TAC (fig. 151.) rectangular at A, having the semidiameter of the earth, and TC the distance of the star, the angle ACT, which is the horizontal parallax, is found by trigonometry; and, on the other hand, if we have this parallax, we can find the distance of the star; since in the same triangle, having AT, and the angle ACT, the distance TC may be easily found.

Astronomers, therefore, have invented several methods for finding the parallaxes of stars, in order thereby to discover their distances from the earth. However, the fixed stars are so remote as to have no sensible parallax: and even the sun, and all the primary planets, except Mars and Venus when in perigee, are at so great distances from the earth, that their parallax is too small to be observed. Indeed, the parallax is found to be very considerable, which in the horizon amounts to a degree or more, and may be found thus: In an eclipse of the moon, observe when both its horns are in the same vertical circle, and at that instant take the difference of the altitudes of both horns; the difference of these two altitudes being ha ded and added to the least, or subtracted from the greatest, gives nearly the visible or apparent altitude and the moon's centre; and the true altitude is nearly equal to the difference of the centre of the shadow at that time. Now we know the altitude of the shadow, because we know the place of the sun in the ecliptic, and its depression under the horizon, which is equal to the altitude of the opposite point of the ecliptic in which is the centre of the shadow.

And therefore having both the true altitude of the moon and the apparent altitude, the difference of these is the parallax required. But as the parallax of the moon increases as she approaches towards the earth, or the perigee of her orbit, therefore astronomers have made tables, which shew the horizontal parallax for every degree of its anomaly.

The parallax always diminishes the altitude of a phenomenon, or makes it appear lower than it would do if viewed from the centre of the earth; and this change of the altitude, according to the different situation of the ecliptic and equator in respect of the horizon of the spectator, cause a change of the altitude, longitude, declination, and right ascension of any phenomenon, which is called their parallax. This parallax, therefore, increases the right and oblique ascension; diminishes the declension; diminishes the northern declination and latitude in the eastern part, and increases them in the western; but increases the southern both in the eastern and western part; diminishes the longitude in the western part, and increases it in the eastern. Hence it appears, that the parallax has just opposite effects to refraction.

PARALLELEPIPED, or PARALLELOPED, in geometry, a regular solid composed of six parallelograms, the opposite ones whereof are similar, parallel, and equal. See Geometry.

PARALLEL PLANE, in geometry, a plane which is parallel to another plane throughout; or, in the plane of a given line, and at a given distance from it, it may be infinite or finite; and will be parallel if the given line is parallel to itself.

PARALLEL RAYS, in optics, are those which keep at an equal distance from the visible object to the eye, which is supposed to be infinitely remote from the object; and so joined together by cross blades as to open to different intervals, accord and reconcile, and yet still retain their parallelism. See INSTRUMENTS, MATHEMATICAL.

The use of this instrument is obvious; for one of the rulers being applied to a given line, and the other, when given to a point, a right line drawn by its edge through that point, is a parallel to the given line.

PARALLELS, or PARALLEL CIRCLES, in geography, called also parallels or circles of latitude, are lesser circles of the sphere conceived to be drawn from west to east, through all the points of the meridian, commencing from the equator to which they are parallel, and terminating with the poles. They are called parallels of latitude because all places lying under the same parallel, have the same latitude.

PARALLELS OF LATITUDE, in astronomy, are lesser circles of the sphere parallel to the ecliptic, and being produced, pass through every degree and minute of the colures. They are represented on the globe by the divisions on the quadrant of altitude, in its motion round the globe, when screwed over the pole of the ecliptic. See Globe.

PARALLELS OF ALTITUDE, or Altunumants, are circles parallel to the horizon, imagined to pass through every degree and minute of the colures, and being produced, produce in the horizon and zenith, having their poles there. They are represented on the globe by the divisions on the quadrant of altitude, in its motion about the body of the globe, when screwed to the zenith.

PARALLELS OF DECLINATION, in astronomy, are the same with parallels of latitude in geography.

PARALLEL SPHERE, that situation of the sphere wherein the ecliptic coincides with the horizon, and the poles with the zenith and nadir. In this sphere all the parallels of the equator become parallels of the horizon, consecutively no stars ever rise or set, but all turn round circles parallel to the horizon; and the sun, when in the equinocials, wheel round the horizon the whole day. After rising to the elevated pole, he never sets for six months; and after his entering again the other side of the line, never rises for six months longer.

This is the position of the sphere to such as live under the poles, and to whom the sun is never higher than 23° 30'.

PARALLELOGRAM, or PARALLELOGRAM, in geometry, a regular solid composed of six parallelograms, the opposite ones whereof are similar, parallel, and equal. See Geometry.

All parallelepipeds, prisms, cylinders, &c., whose bases and heights are equal, are themselves equal. A diagonal plane divides a parallelepiped into two equal prisms; so that a triangular prism is half a parallelepiped upon the same base and of the same altitude.

All parallelepipeds, prisms, cylinders, &c., are in a ratio compounded of their bases and altitudes: wherefore, if their bases are equal, they are in proportion to their altitudes; and conversely, the lesser circles of these solids, and also of their altitudes.

Equal parallelepipeds, prisms, cones, cylinders, &c, reciprocate their bases and altitudes.
PARALLELISM of the earth's axis. See Astronomy.
PARALLELOGRAM. See - GEOMETRY.
PARALOGISM, in logic, a false reasoning, or a fault committed in demonstration, when a consequence is drawn from principles that are false; or, though true, are not proved; or when a proposition is passed over that should have been proved by the way.
PARALYSIS, the palsy. See Medicine.
PARAMECIUM, a genus of the order trichomida, invisible to the naked eye, simple, pellicular, flattened, olbong. There are seven species. The P. aurelia is compressed, longitudinally plaited towards the fore-part, acute behind. It is found in ditch-water and infusions; membraneous, four times as long as it is broad, the fore-part obtuse, hyalin; the hind part filled with molecular cubules; the gold reaching from the middle to the tip.
PARAMETER, in conic sections, a constant line, otherwise called latus rectum. See Conic Sections.
The parameter is said to be constant, because in the parabola the rectangle under it and any abscissa is always equal to the square of the corresponding semidiameter; and in the ellipse and hyperbola, it is a third proportional to the conjugate and transverse axis.
Thus, if \( r \) and \( e \) are the axes in the ellipse and hyperbola, and \( x \) and \( y \) an abscissa and its ordinate in the parabola, it will be

\[
\frac{x}{r} = \frac{y}{e} \leq \frac{1}{2}
\]

the parameter in the ellipse and hyperbola, and

\[
\frac{x}{r} = \frac{y}{e} \leq \frac{s}{a}
\]

the parameter in the parabola.
PARAMOUNT, the supreme or highest lord of the fee. This seigniory of a lord paramount is frequently termed an honour, and not a manor; especially if it has belonged to an antient feudal baron, or has been at any time in the hands of the crown. 2 Blac. 91.
PARAPET, in fortification, an elevation of earth designed for covering the soldiers from the enemy's shot. The thickness of the parapet is from 18 to 20 feet; its height is six feet on the inside, and four or five on the outside. It is raised on the rampart, and has a slope above called the superior talus, and sometimes the glacis of the parapet. The exterior talus of the parapet is the slope facing the country: there is a bartizan or two for the soldiers who defend the parapet to mount upon, that they may the better discover the country, foe, and counter-carp, and fire as they find occasion.
Parapet of the covert way, or corridor, is what covers that way from the sight of the enemy, which renders it the most dangerous place for the besiegers, because of the narrow bounds of the faces, flanks, and curve of the place.
PARAPER, is also a little wall raised breast-high on the banks of bridges, quays, or high buildings, to serve as a stay, and prevent people falling over.
PARAPHERNIALIA, are the woman's apparel, jewels, and other things, which, in the life-time of her husband, she wore as the ornaments of her person, to be allowed by the discretion of the court, according to the quality of her and her husband. The husband cannot take any ornaments or jewels of his wife; though, during his life, he has power to dispose of them. But if she continues in the use of them till his death, she shall afterwards retain them against his executors and administrators, legatees, and all other persons, except creditors where there is a deficiency of assets. 2 Black. 436.
PARAPLEGIA, or Paraplenia, in medicine, a species of paralysis or palsy, usually succeeding an apoplexy. See Medicine.
PARASANG, an ancient Persian measure, different at different times, and in different places; being sometimes 20, sometimes 40, and sometimes 50 stadia or furlongs.
PARASITES, or Parasitical plants, in botany, such plants as are produced out of the trunk or branches of other plants, from whence they receive their nourishment, and will not grow upon the ground, as the mistletoe, &c.
PARCEL-MAKERS, two officers in the exchequer, who make parcels of the exchequer's accounts, in which they charge them with every thing the king uses, within the time of their office, and deliver the same to one of the auditors of the court, to make accounts therewith.
PARCHMENT, in commerce, the skin of sheep or goats, prepared after such a manner as to render it proper for writing upon, covering books, &c.
The manufacture of parchment is begun by the Skinner, and finished by the parchment-maker. The skin having been stripped of its wool, and placed on the lime-pit, in the manner described under the article SHAMMY, the Skinner stretches it on a kind of frame, and pares off the flesh with an iron instrument; this done, it is moistened with a rag, and powdered chalk being spread over it, the Skinner takes a large pumice-stone, flat at bottom, and rubs over the skin, and thus scours off the flesh; then he goes over it again with an iron instrument; he then washes it before, and rubs it again with the pumice-stone without any chalk underneath: this smooths and softens the flesh-side very considerably. He then drains it again, by passing it through the chalk as before. The flesh-side being thus drained, by scraping off the moisture, he in the same manner passes the iron over the wool or hair side; then stretches it tight on a frame, and scruples the flesh-side again; this finishes its draining; and the more it is drained, the whiter it becomes. The Skinner then throws on more chalk, sweeping it over with a piece of lambkin that has the wool on, and this smooths it still further. The skin, now left to dry, and when dried, taken off the frame by cutting it all round. The skin thus far prepared by the Skinner, is taken out of his hands by the parchment-maker, who first, when it is dry, pares it on a summer (which is a calf skin stretched in a frame) with a sharper instrument than that used by the Skinner, and working with the arm from the top to the bottom of the skin, takes away about one-third of its thickness. The skin thus equally pared on the flesh-side, is again rendered smooth, by being rubbed with the pumice-stone, on a bench covered with a sack stuffed with docks, which leaves the parchment in a condition fit for writing upon. The parchings thus taken off the leather, are used in making garters, stays, &c.
What is called vellum, is only parchment made of the skins of abortives, or at least sucking calves. This has a much finer grain, and is whiter and smoother than parchment; but is prepared in the same manner, except in not being passed through the lime-pit.
PARDON, is the remitting or forgiving a felony or other offence committed against the king.
Blackstone mentions the power of pardoning offences to be one of the greatest advantages of monarchy in general above every other form of government; and which cannot subsist in democracies. Its utility and necessity are defended by him on all those principles which do honour to human nature. See 4 Black. 266.
Pardons are either general or special; general as by act of parliament, of which, if they are without exceptions, the court must take notice ex officio; but if there are exceptions therein, the pardon must assure he is none of the persons excepted. 3 Inst. 253.
Special pardons are either of course, as to persons convicted of manslaughter, or se defending, and by several statutes to those who shall discover the accomplices in several felonies; or of grace, which are by the king's charter, of which the court cannot take notice ex officio, but they must be pleaded. 3 Inst. 253.
A pardon may be conditional, that is, the king may extend his mercy upon what terms he pleases; and may annex to his bounty a condition either precedent or subsequent, on the performance whereof, the validity of the pardon will depend; and this by the common law. 2 Haw. 37.
All pardons must be under the great seal. The effect of a pardon is to make the offender a new man; to acquit him of all corporal penalties and forfeitures annexed to that offence; and to give him a new credit and capacity: but nothing but an act of parliament can restore or purify the blood after an at-tinder.
PAREGORICS. See Pharmacy.
PARENCHYMA of plants, that part of the plant that lies immediately below the epidermis. It is of a deep-green colour, very tender, and succulent. See Plants, physiology of.
PARENTHESIS, in grammar, certain intercalary words, inserted in a discourse, which interrupt the sense or thread, but seem necessary for the better understanding of the subject.
PARENTS AND CHILDREN. If parents run away, and leave their children at the charge of the parish, the churchwardens and overseers, by order of the justices, may seize the rents, goods, and chattels, of such parents, and dispose thereof towards their children's maintenance.
A parent may lawfully correct his child, when under age, in the same manner; but the legal power of the father over the persons of his children, ceases at the age of 21. 1 Black. 452.
PARIHELION. See Optics.
PARIAN CHRONICLE. See AUS.
DELIAN MARBLES.
PARIAN MARBLE, in the natural history of the ancient, the white marble used them, and to the mighty, for carving statues, beds, and coffins, by us at this time statuary marble. Too many of the later writers have confounded all the white marbles under the name of the Parian; and among the workmen, this and all the other white marbles have the common name of alabaster: so that it is in general forgotten among them that there is such a thing as alabaster different from marble; which, however, is the case. Almost all antiquarians have also confounded the Carrara marble with this, though they are really very different; the Carrara kind being of a finer structure and clearer white than the Parian, but less bright and splendid, harder to cut, and not capable of so glittering a polish. The true Parian marble has usually somewhat of a faint blueish tinge among the white, and often has blue veins in different parts of it.

PARIANA, a genus of the monoeica polyantha class and order. The male flowers in whors, forming spicis; calyx two-valved; corolla two-valved, larger than the calyx; filaments 40. Female flowers solitary in each whors, calyx two-valved; corolla two-valved; stigma two-seeded, three-angled. There is one species, of no note.

PARIETALIA OSSA. See ANATOMY.

PARIETARIA, pellitory of the wall, a genus of the monoeica order, in the polygamia class of plants, and in the natural method ranking under the 53d order, scabridae. The calyx is the herma, bracteae is quadrifid; there is no corolla; there are four stamina; one style; and one seed, superior and elongated. The female calyx is quadrifid; there is no corolla; nor are there any stamina. There is one style; and one seed, superior and elongated. There are 10 species, of which one, named the officinale, is used in medicine. The plant has a cooling and diuretic quality. Three ounces of the juice taken internally, or a fomentation externally applied, have been found serviceable in the strangury. The plant laid upon heaps of corn infused with wort, is said to drive away those destructive insects, which infest the wheat, and ruin it. The plant is also useful in the dressing of wounds, and to promote the healing of them; it is frequently employed to this purpose.

PARIJE, herb Paris, or trachee, a genus of the tritygia order, in the octandra class of plants, and in the natural method ranking under the 11th order, sarmentaece. The calyx is triquetulous; there are four petals, narrow in proportion; the berry quadrifidunlari. There is but one species, growing naturally in woods and shady places in England. It has a single dark-leaf, greenish blossom, and bluish-black berries. Though this plant has been reckoned of a poisonous nature, being ranked among the poisons, yet late authors attribute quite other properties to it, esteemting it to be a counter-ponson, and good in malignant and pestilential fevers.

PARIISH. In England there are 9913 parishes, of which 3945 are churches proper, and the rest are annexed to colleges or church dignities. In many of these parishes, on account of their large extant and the number of parishioners, there are several chapels.

PARIISH-OFFICERS, officers chosen annually to regulate and manage the concerns of the parish.

PARK, a piece of ground inclosed and stored with wild beasts of chase, which a man may have by prescription or the king's grant. Yet, if any person shall pull down or destroy the pale or wall of a park, he shall forfeit 30l.

PARK of artillery. See Artillery, park of.

PARKINSONIA, so called in honour of the English botanist Parkinson, a genus of the monogynia order, in the decandria class of plants, and in the natural method it ranks under the 33rd order, lomantaceae. The calyx is unifloresculic; there are five petals, all of them of one color and of the lowest, which is in a form; there is no style; the legumen moniliform, or like strong beads. We know but one species of this plant, which is very common in the Spanish West Indies, but has of late years been imported into some of the colonies of the viva, in parliament assembled.

PARLIAMENT, is the legislative branch of the supreme power of Great Britain, consisting of the king, the lords spiritual and temporal, and the knights, citizens, burgesses, representatives of the commons of the realm, in parliament assembled.

The power and jurisdiction of parliament is so transcendent and absolute, that it cannot be confined, either for causes or persons, within any bounds. 1 Inst. 30.

The house of commons is a denomination granted to the house of parliament, in a free state, every man, who is supposed a free agent, ought to be, in some measure, his own governor; and therefore a branch at least of the legislative power should reside in the house of the people. In clear Esta for representatives for Great Britain, actually, all the people had votes; but king Henry VI. to avoid tumults, first appointed that now should vote for knights—such as were freeholders, were to return in the county, and had forty shillings yearly revenue. In so large a state as ours, therefore, it is very wisely contrived, that the people should do that by their representatives which it is impracticable to perform by themselves. The representatives chosen had a number of minute and separate districts, wherein all the voters are or may be easily distinguished. The counties are therefore represented by knights, elected by the proprietors of lands; the cities and boroughs are represented by citizens and burgesses, chosen by the merchant or supposed trading interest of the nation.

The peculiar laws and customs of the house of commons, relate principally to the raising of taxes, and the elections of members to serve in parliament.

The method of making laws is nearly the same in both houses. In the house of commons, in order to bring in the bill, if the relief sought is of a private nature, it is first necessary to prefer a petition; which must be presented by a member, and usually set forth a grievance required to be remedied. This petition, when founded on facts of a disputable nature, requires two judges, members, who examine the matter alleged, and accordingly report it to the house; and then (or otherwise upon the mere petition), leave is given to bring in the bill. In public matters, the bill is brought in upon motion made to the house, without any petition.

If the bill begins in the house of lords, if of a criminal nature, it is referred to two lords, to make report. After the second reading, the bill is said to be committed, that is, referred to a committee; which is selected by the house, in matters of small importance; or upon a bill of consequence, the house resolves itself into a committee of the whole house. A committee of the whole house is composed of every member; and to form it the speaker calls the chair, and may consequently sit and debate upon the merits of it as a private member, another member being appointed chairman for the time. In these committees the bill is usually debated clause by clause, amendments made, and sometimes it is entirely new-modelled. Upon the third reading, further amendments are sometimes made; and if a new clause is added, it is done by taking a separate piece of parchment on the bill, which is called a rider. 1 Black, 182.

The royal assent may be given two ways: 1. In person, when the king comes to the house of peers, in his crown and royal robes, and seating for the commons to the bar, the clause is read, which are of both houses are read; and the king's answer is declared by the clerk of the parliament. If the king consents to a public bill, the clerk usually declares, le roy le veut, the king wills it; and if it be not a public bill, soit comme il est désiré, be it as it is desired. If the king refuses his assent, it is in the gentle language of, le roy renonce ses loyal sujets, accepte leur bienveillance, et aussi le veut; the king thanks his loyal subjects, accepts their benevolence, and also wills it to be. By the stat. 33 H. VIII. c. 21, the king may give his assent by letters patent under his great seal, signed with his hand, and notified in his absence to both houses, upon the orders, and papers, the upper house. And when the bill has received the royal assent in either of these ways, it is then, and not before, a statute or act of parliament.

An act of parliament thus made is the exercise of the highest authority that this kingdom acknowledges upon the earth. It has power to bind every subject in the land, and the dominions thereunto, belonging, nay even the king himself, if particularly named in it; and it cannot be altered, amended, dispensed with, suspended, or repealed, but in the same form, and by the same authority, of parliament.

Adjournment is no more than a continuance of the session from one day to another, as the word itself signifies; and this is done by adjournment of the house separately every day, or for a longer period; but the adjournment of one house is no adjournment of the other. 1 Black, 182.

Prorogation is the continuance of the parliament from one session to another, as an act of parliament. The prorogation was made from day to day. And this is done by the royal authority, expressed either by the lord chancellor, in his majesty's presence, or by
commission from the crown, or frequently by proclamation; and by this, both houses are prorogued or dissolved, as the will of the crown, or of the parliament. The session is never understood to be at an end until a prorogation; though unless some act is passed, or some judgment given by parliament, it is in truth no session at all.

A dissolution is the civil death of the parliament; and this may be effected three ways: 1. By the king's will expressed either in person or representation, as by the demise of the crown; 2. By the length of time; 3. By the will of the king; for as the king has the sole right of convening the parliament, so also it is a branch of the royal prerogative, that he may, whenever he pleases, prorogue the parliament for a time, or put an end to its existence.

By the demise of the crown: this dissolution formerly happened immediately upon the death of the reigning sovereign; but the present act of succession, immediately on the inauguration of the successor being found inconvenient, and dangers being apprehended from having no parliament in being, in case of a disputed succession, it was enacted by statutes 7 and 8 Will. III. c. 7, that the parliament in being shall continue for six months after the death of any king or queen, unless sooner prorogued or dissolved by the successor; that if the parliament is at the time of the king's death separated by adjournment or prorogation, it shall notwithstanding assemble immediately; and that if no parliament is then in being, the members of the last parliament shall assemble and be again a parliament.

Lastly, a parliament may be dissolved or expire by length of time. The utmost extent of time that the same parliament was allowed to sit by the stat. 33 W. c. 3 was three years; after the expiration of which, reckoning from the return of the first summons, the parliament was to have no longer continuance. But by stat. 1 Geo. I. c. 38. in order professively to prevent the great and constant expenses of frequent elections, and the violent heats and animosities consequent thereupon, and for the peace and security of the government just then recovering from the late rebellion, this term was prolonged to seven years. So that as our constitution now stands, the parliament must expire, or die a natural death, at the end of every seventh year, if not sooner dissolved by the royal prerogative. See ELECTION.

PARLIAMENT, the high court of; is the supreme court of the kingdom, not only for the making but also for the execution of laws, by the trial of great and enormous offenders, whether lords or commoners, in the method of parliamentary impeachment. An impeachment before the lords, by the commons of Great Britain in parliament, is a prosecution of the already known and established law, and has been frequently put in practice; being a presentiment to the most high and supreme court of criminal jurisdiction by the most solemn grand inquest of the whole kingdom. A commoner cannot, however, be impeached before the lords for any misdemeanours, or only for high misdemeanours; a peer may be impeached for any crime. And they usually, in case of an impeachment of a peer for treason, address the crown to appoint a lord high steward, for the greater dignity and regularity of their proceedings; which high steward was formerly elected by the peers themselves, though he was generally commissioned by the king; but it has of late years been strenuously maintained, that the appointment of a high steward in such cases is not indispensably necessary, but the house may proceed without one. The articles of impeachment are a kind of bills of indictment, found by the house of commons, and afterwards tried by peers, who are in cases of misdemeanours considered not only as their own peers, but as the peers of the whole nation.

PARNASSIA, genus of Parnassia, a genus of the tetragnathy order, in the Pentandria class of plants. The calyx is quinquepartite; there are five petals, and as many nectarias, heart-shaped, and ciliate with glochular tops; the capsule quadri-valved. There is but one species, having a stalk about a foot high, angular, and often a little twisted, bearing a single white flower at top. The flowers are very beautifully streaked with yellow; so that though it is a common plant, growing naturally in moist pastures, it is frequently mistaken for a white flower of a larger kind. See PARLORS, a term signifying any thing done verbally or by word of mouth, in contradistinction to what is written; thus an agreement may be by parole. Evidence also may be divided into parole evidence and written evidence. A parole release is good to discharge a debt by simple contract. See Show. 417. The holder of a bill of exchange may authorize another to indorse his name upon it.

PAROLE EVIDENCE. See EVIDENCE.

PARONYCHIA, whitlow. See SURGERY.

PAROTIDES. See ANATOMY.

PAROXYSM. See Medicine.

PARRA, a genus of birds belonging to the order of graliae; the characters of which are: the bill is tapering at the base; the body is small and situated in the middle of the bill; the forehead is covered with testaceous, which are lobated; the wings are small and sinuous. There are five species; of which the most remarkable is the Charivaria, which is about the size of a domestic cock. The Indians in the neighborhood of Carthagena, who breed large flocks of poultry that stray in the woods, and train up the Charivaria to defend them against the numerous birds of prey, of no one of which will dare to encounter it. It is never known to desert the flock, and it returns every evening to roost.

The parra Dominica is about the size of the lapwing. The bill is yellow, as are also the head and upper parts; the under are of a yellowish-white bordering on rose-colour; the legs are also yellow. This species inhabits several of the warmer parts of America and St. Domingo.

The parra Senegalla, is about the same size with the former. Its bill is also yellow, tipped with black; the forehead is covered with a yellow skin, the chin and throat are black, the head and upper parts of the body and lesser wing-coverts are grey-brown. The lower part of the belly, and the upper and under tail-coverts, are dirty white. At the bend of the wing is a black spur. It inhabits Senegal, and thence derives its name.

The parra jacana, or spur-winged waterhen, is about the size of the water-rail. The bill is in length about an inch and a quarter, of an orange-colour; and on the forehead is a membranous flap, thinly and nearly as broad. On each side of the head is another of the same, about a quarter of an inch broad; and both together, they surround the base of the bill. The head, breast, neck, breast, and under-parts, are black; and sometimes the belly is mixed with white, &c. The birds of this species inhabit Brasil, Guiana, and Surinam; but are equally common at St. Domingo, where they frequent the marshy places, sides of ponds, and streams, and often quit the water. They are also generally seen in pairs, and when separated call each other continually till they join again. They are very shy, and most common in the rainy seasons in May and November. They are at all times very noisy; their cry sharp and shrill, and may be heard a great way off. This, as well as the other species, is called by the French chigrins. The flesh is accounted pretty good.

The parra variabilis, or spur-winged waterhen, is about nine inches long. The bill is about 14 inches in length, and in colour is orange-yellow. On the forehead is a flap of red skin; the crown of the head is brown, marked with spots of a darker colour; the hind part of the neck is much the same, but of a deeper dye. On the forepart of the wing is a yellow spur, &c. The legs are furnished with long toes, and are black, the colour of which is bluish ash. This species inhabits Brasil, and is said to be pretty common about Carthagena, and in South America. There are divers sorts in all.

PARRELS. In a ship, are frames made of trunks, ribs, and ropes, which having both their ends fastened to the yards, are so contrived as to go round about the masts, that the yards, by their means, may go up and down at the mast's will. These breast-ropes, fasten the yards to the masts.

PARROT, and PARROQUET. See PSITTACUS.

PARNLEY. See APIUM.

PARN-NEP. See PARSINACA.

PARSON, signifies the incumbent of a church. He is in himself a body corporate, in order to protect and defend the rights of the church by a speculatation of power. When a person is instituted and inducted into a rectory, he is then, and not before, in full and complete possession. 1 Black. 391.

PART, in music, the name of each of the melodies of any harmonic composition, and which, when performed in union, form its harmony. Four is the fewest number of parts with which the chords necessary to elaborate harmony can be completely filled.

PARDERIE, in gardening, a level division of ground, which, for the most part, faces the south, and best front of a house; and is generally furnished with grass, flowers, &c.

PARTHENIUM, a genus of the pentandria order, in the monotypic class of plants, and in the natural order under the 40th order, composite. The male calyx is common and pentalocular; the flowers of the disk monopetalous. The female has five florets of the radius, each with two male
fleurs behind it; the intermediate female superior; the seed is naked. There are two species.

This plant has been much neglected in Europe, having, on account of its small, been left to the care of parterres. It is therefore indebted for its culture to the distinguished rank it holds among the Chinese flowers. The skill of their florists, and their continual care, have brought it to so great perfection, that European gardens scarce know it. They have, by their attention to its culture, procured more than 300 varieties of it, and every year produces a new one.

PARTI, PARTIE, PARTY, or PARTED, in heraldry, is applied to a shield or escutcheon, divided or marked out into parts.

PARTICLE, in grammar, an adjective formed of a verb, so called because it participates partly of the properties of a noun, and partly of those of a verb.

PARTICLE, in grammar, a denomination for all the small words that tie or unite others together, or that express the modes or manners of words.

PARTIES, in law, signify the persons that are named in a deed or fine, viz., those that made the deed, or levied the fine, and also those to whom the same was made or levied.

Here it is to be observed, that if an indulture was made between two parties, mentioned particularly in the beginning of the deed, and therin one of them grants to another that is not named at the beginning thereof, such person is no party to the deed, nor can take any thing thereby. The parties to a suit at law are the plaintiff and defendant, who carry on the suit.

PARTNER, in law, signifies a division of lands, &c. descended by common law or custom among coheirs or parners, being two at least. Partition may also be made by joint tenants, and tenants in common, by joint, deed, or will.

PARTNER. If there are several joint partners, and a person has dealings generally with one of them in matters concerning their joint trade, whereby a debt becomes due to the one charged, but jointly and the survivors of them; but if the person only dealt with one of the partners upon a separate account, in that case the debt shall only affect that partner and his executors. If one or more of the joint traders become bankrupt, his or their proportions are only assignable by the commissioners, to be held in common with the rest who are not bankrupts. If one of two partners becomes a bankrupt, the commissioners cannot meddle with the interest of the other, for it is not affected with the bankruptcy of his companion. Payment to one of the partners, is payment to them all.

PARTRIDGE, in ornithology. See Te-TRAO.

PARUS, or TITMOUSE, in ornithology, a genus belonging to the order of passerines. The bill is very entire, covered at the base with short bristles; the palate is covered and hairy. There are 14 species of which the most remarkable are:

1. The crissatus, or crested titmouse, weighs 13 pennygildens; the bill is black, with a spot of the same colour above it; all the upper part of the body grey; the neck and under parts are white, with a faint tinge of red, which deepest just below the wings. The legs are of a lead-colour, the tarsi white, the back of a greenish yellow, the belly whitish, divided in the middle by a bed of black and with a white margin to the vent; the rump of a bluish-grey, the legs of a lead-colour, the toes divided to the very origin, and the back very large and strong. This species sometimes visits our gardens; but for the most part inhabits the woods, where it builds in hollow trees, laying about ten eggs. It feeds on insects, which it finds in the bark of trees. In the spring they do a great deal of mischief by picking off the tender buds of the fruit trees. Like woodpeckers, they are perpetually running up and down the branches of trees in quest of food. This bird has three cheerful notes, which it begins to utter in the month of February.

2. The violatus, or long-tailed titmouse, is about five inches in length, and seven inches in breadth. The bill is black, very thick and convex, differing from all others of this genus. The top of the head, from the bill to the hind part, is white, mixed with a few dark plumage; these black feathers: the back of white is entirely surrounded with a broad stripe of black, which, rising on each side of the upper mandible, passes over each eye, units the white of the part of the head, and continues along the middle of the back to the rump. The feathers on each side of this black stripe are of a purplish red, as are those immediately incumbent on the tail. The tail is of the same proportion to the bulk of any British bird, being in length three inches, the form not unlike that of a magpie, consisting of 12 feathers of unequal lengths, the middlemost the longest; those on each side growing gradually smaller.

These birds are often seen passing through our gardens, going from one tree to another, as in their road to some other place, never making any halt. They make their nests with great elegance, of an oval shape, and about eight inches deep, having near the upper end a hole barely large enough for the admission. The external materials are mosses and lichens curiously interwoven with wool. On the inside it is very warmly lined with a thick bed of feathers. The female lays from 10 to 17 eggs. The young follow their parents the whole winter, and from the slenderness of their bodies and great length of tail, appear while flying like as many darts cutting the air.

4. The remiz, or small species of titmouse. It is called parus pendulinus, and is often found in Lithuania. Mr. Coxe, in his Travels through Poland, gives the following account of this little bird:—"The wondrous structure of its pendant nest induced me to give an engraving of both that and the birds themselves. They are of the smallest species of titmouse. The head is of a very pale bluish ash, and the forepart of the neck and breast tinged with yellow; the belly white; wings black, back and rump of a yellowish rust-colour; quill feathers cinnabar, with the exterior sides white; the tail rust-coloured. The male is singularly distin-

guished from the female by a pair of black-pointed whiskers. Its nest is in the shape of a long porcupine, which it forms with amazing art, by interlacing down, gossamer, and minute fibres, in a close and compact manner, and then lining the inside with down alone, so as to make a snug and warm lodge for its young brood. The entrance is at the side, small, and round, with its edge more strongly marked than the rest of this curious fabric; the bird, attentive to the preservation of its eggs or little ones from noxious animals, suspends it at the lesser end to the extremity of the branches of a willow or some other tree over a river. Contrary to the custom of titmice, it lays only four or five eggs: possibly Providence hath ordained this scantiness of eggs to the remise, because, by the singular instinct imparted to it, it is enabled to secure its young more effectually from destruction than the other species, which are very prolific."
Passport also signifies a licence obtained for importing contraband goods, or for exporting and importing merchandise without paying the duties; these last licences are always given to ambassadors and other public ministers, and are called, &c. If any person forges or counterfeits a passport, commonly called a Mediterranean pass, for any ship, or shall alter or erase any pass made out by the commissioners for executing the office of vice versa, or shall write as true any forged, altered, or erased pass, knowing the same to be forged, &c. every such person being convicted in any part of his majesty's dominions where such offence is committed, shall be guilty of felony without benefit of clergy, by a Geo. II. cap. 18, sect. 1.

PASTE, in the glass trade, a kind of coloured glass, made of calcined crystal, lead, and metallic preparations, so as to imitate the natural gems: for the manner of effecting which see GLASS.

PASTEBORNE. See PAPER.

PASTINACA, the parsnip, a genus of the digynia order, in the pentadactyla class of plants, and in the natural method ranking under the 43rd order, umbellata. The fruit is a flat elliptical comma, the petals are involuted and entire. There are only three species of this genus, the principal of which is the pastinaca sativa, or garden parsnip, which is an exceedingly fine esculent plant. It is to be propagated by sowing the seeds in February or March, in a rich mellow soil, which must be deep dug, that the roots may be able to run deep without hindrance. It is a common practice to sow caraway at the same time with the parsnips; and if the carrots are designed to be drawn young there is no harm in it. The parsnips, when they are grown up a little, must be thinned to a foot distance, and carefully kept clear of weeds. They are best tasted just at the season when the leaves are decayed; and such as are desirable to eat them in spring should have them taken up in autumn, and preserved in sand. They are most nutritious when about four months old.

PATEE, or Patter, in heraldry, a cross small in the centre, and widening to the extremities, which are very broad.

PATIELLA. See ANATOMY.

PATELLA, or Limpet, a genus of insects belonging to the order venaticata. The shells are of that class which is called univalves; they have no contour, and are in the form of little pointed cones. They are always attached to some hard body; their summit is sometimes acute, sometimes obtuse, turned back, or perforated. The rock, or other hard body, to which they are always fixed adhering, serves as a kind of second or under shell to preserve them from injury; and for this reason Adrovandus and Roudetel have classed them among the bivalves; but in this error they have not been followed by any other writer. The shells consist of carbonat of lime. But when they are attached to some hard body, like horn; and when dissolved in acids, a semi-liquid gelatinous matter was left behind. There are 36 species of this genus, which are principally distinguished by peculiarities in their shells. See Patee, Hist. fig. 317.

PATTEN, in general, denotes something that stands open or expanded: thus a leaf is said to be patent when it stands almost at right angles with the stalk.

PATTERN, or Letters pattern, are writings sealed with the great seal of England, by which a man is authorized to do, or to enjoy, anything of himself he could not do otherwise. They are called so by reason of the figure; as being open, with their seal affixed, ready to be exhibited for the continuance of the authority delegated by them.

PATRONS, in the canon and common law, is a person, who having given a patronage to a parsonage, vicarage, or the like spiritual promotion, belonging to his manor, has, on that account, the gift and disposition of the benefit, and may present to it whenever it becomes vacant. 'Tis the patron's right of disposing of a benefice originally arises either from the patron or his ancestors, &c. being the founders of builders of the church; from their having given lands for the maintenance thereof; or from the church's being built on their ground; and frequently from all three together. See ADVOWSON.

PAVEMENT. See Paying.

PAVETTA, in botany, a genus of the tetrandra monogyne class of plants, with a monopetalous funnel-shaped flower, and a monopetalous berry. There are a few species, shrubs, natives of Africa, China, and the West Indies.

PAVILION. See ARCHITECTURE.

Pavilion, in heraldry, denotes a covering in form of a tent, which invests or wraps up the armories of the kings and sovereigns, depending only on God and their own power.

Paving, the construction of ground floors, streets, or highways, in such a manner that they may be conveniently walked upon. In Britain the pavement of the grand streets, &c. is usually of flint or rubblystone; courts, stables, kitchens, halls, churchyards, &c. are paved with tiles, bricks, flags, or freestone; sometimes with a kind of freestone and ragstone. In some streets, as of Venice, the pavement is of bricks, and churches are sometimes paved with marble, and sometimes with mosaic work, as the church of St. Mark at Venice. In France the public roads, streets, courts, &c. are all paved with gres or grit, a kind of freestone. In Amsterdam, and the chief cities of Holland, they call their brick pavement the burgomasters' pavement, to distinguish it from the stone or flint pavement, which usually takes up the middle of the street, and which they call for carriages; the brick which borders it being destined for the passage of people on foot.

Pavements of freestone, flint, and slabs, in streets, &c. are laid dry, that is, in a bed of sand; those of courts, stables, ground-rooms, &c. are laid in a mortar of lime and sand, or in lime and cement, especially if there are vaults or cellars underneath. Stonemasons, after laying a floor dry, especially of brick, always go over it again with a trowel; sweeping it backwards and forwards to fill in the cracks. The several kinds of pavement are as various as the materials of which they are composed, and whence they derive the name by which they are distinguished: as

1. Pebble-paving, which is done with
tones collected from the sea-beach, mostly brought from the islands of Guernsey and Jersey; they are very durable, indeed the most of any stone used for this purpose. They are used of various sizes; but those which are from one to two inches square are esteemed the most serviceable. When they are about three inches deep they are denominated bolters or bowlers; these are used for paving courts, and other places not accessible to receivers and loaded with heavy weights, and when laid in geometrical figures they have a very pleasing appearance.

2. Rag-paving was much used in London, but is very inferior to the pebbles; it is dug in the vicinity of Maudstone in Kent, from which it has the name of Kentish ragstone; there are squared stones of this material for paving coach-tracks and footways.

3. Purbeck pithens, squared stones used in footways: they are brought from the island of Purbeck, and also frequently used in courts; they are in general from six to ten inches square, and about five inches deep.

4. Squared paving, for distinction by some called “trihalation,” because the kind of the stone, laid in the manner that has been, and continues to be paved came from Scotland; the first was a clear close stone, called blue whynam, which is now disused because it has been found to two others since that figure is introduced in the order they are hereafter placed.

5. Granite, a hard material, brought also from Scotland, of a reddish colour, very superior to the blue whynam, and at present only used in London.

6. Guernsey, which is the best, and very much in use; it is the same stone with the pebble before spoken of, but broken with iron hammers, and squared to any dimensions required, of a prismatic figure, set with its smallest base downwards. The whole of the foregoing paving should be bedded and paved in small square.

7. Purbeck paving, for footways, is in general got in large surfaces about two inches and a half thick; the blue sort is the hardest and the best of this kind of paving.

8. Yorkshire paving, is an exceedingly good material for the same purpose; and is got of about the same thickness as the Purbeck. This stone will not admit wet to pass through it, nor is it affected by the frost.

9. Ryegate, or firestone paving, is used for hearths, stoves, ovens, and such places as are liable to great heat, which does not affect the stone if kept dry.

10. Newcastle flags, are stones about two feet square, and one inch and a half or two inches thick; they are very well for paving out-of-offices: they are somewhat like the Yorkshire.

11. Portland paving, with stone from the island of Portland: this is sometimes ornamented with black marble dots.

12. Swedlinton paving, is a black slate dug in Leicestershire, and looks well for paving halls, or in party-coloured paving.

13. Marble paving, is mostly variegated with different marbles; sometimes inlaid in marble.

14. Flat brick paving, done with brick laid in sand, mortar, or grout; as when liquid line is poured into the joints.

15. Brick-pitching paving, done with brick laid edge-wise in the same manner. Bricks are also laid flat or edge-wise in herring-bone. Bricks are also sometimes set endwise in sand, mortar, or grout. Paving is also performed with paving bricks; ten-inch tiles; foot tiles; clickers for stables and outer-offices: the use of bones of animals, for gardens, &c.

Pavements of churches, &c. frequently consist of stones of several colours: chiefly black and white, and of several forms, but chiefly square and lozenges, artfully disposed. Indeed there needs no great variety of colours to make a surprising diversity of figures and arrangements. M. Trucuet, in the Memoirs of the French Academy, has shewn by the rules of combination, that two square stones, divided diagonally into two colours, may be joined together chequerswise 64 different ways: which appears surprising enough, since only letters or figures can only be combined two ways.

The reason is, that letters only change their situation with regard to the first and second, the top and bottom remaining the same; but in the arrangement of those stones each in its limits of two, and in the arrangement of the other square may be changed 16 times, which gives 64 combinations.

Indeed, from a farther examination of these 64 combinations, he found there were only five different kinds of arrangements repeated twice in the same situation, though in a different combination; so that the two differed from each other only by the transposition of the dark and light parts.

PAULICIANS, christians of the seventh century, disciples of Paulinus, a native of Armenia, and a favourer of the errors of Manes; who, as the name Manichees has become odious to all nations, gave those of his sect the title of Paulicians, on pretence that they followed only the doctrine of St. Paul.

PAULINIA, a genus of the trigonyia order, in the octandria class of plants, and in the natural method ranking under the 22d order. The characters are these: the flower has a perigean emplacement, composed of four small oval leaves; it has four oblong oval petals, twice the size of the emplacement; and eight short stamens with a tufted stigma. One and a half inches across the stigma; and a large three- or four-cornered capsule with three cells, each containing one almost oval seed. There are 17 species, natives of the West Indies.

PAULINISTS, in church history, christians of the third century, disciples of Paul Samosatensis, bishop of Antioch, who denied Christ’s divinity. The name of Paulinus was avery useful one to the public, but only that he was so perfect a man, and so superior in virtue to all others, that he has this name given him by way of eminence.

PAVO, the peacock, in ornithology, a genus belonging to the order of gallinaceous. The head is covered with feathers which bend backwards; the feathers of the tail are very long, and beautifully variegated with eyes of different colours. Latham enumerates eight species. The most remarkable are

- The Cristatus, or common peacock, which is about one foot long, and appears common in the wild state in the warmer climates of the world, and wanting some care in the colder regions. In this bird does not come to its full plumage till the third year. The female lays five or six greyish white eggs; in hot climates 20, then a species of a turkey. These, if left alone, she lays in some secret place, at a distance from her usual resort, to prevent their being destroyed by the male, which is apt to take them. The time of sitting is usually 27 days. The young may be fed with curd, chopped leeks, barley-meal, &c. moistened; and are fond of grass-soppers and some other insects. In five or six months they will feed as the old ones, on wheat and barley, which is a small 22d. They can pick up in the circuit of their convenience.

This bird is found in India by carriage light to the trees where they root, and sometimes presents the bird presented to them at the same time; when they put out the neck to look at the figure, the spurious slips a noise over the head, and seizes its game. In most ages they have been esteemed a satisfactory food.

Hortensius gave the example at Rome, where it was carried to the highest luxury, and sold dear; and a young pavo-lbowl is thought a dainty even in the present times.

2. The pavo biclavus is larger than the common species, and has various tail feathers on the crown of the head, which are sufficiently long to form a crest, of a dull-brown colour. The neck is bright brown, striped across with dusky brown. The upper part of the back, shoulders, and wing-coverts, are dull-brown, dotted with paler brown and yellowish; besides which each feather is marked near the end with a roundish large spot of a gilded purple colour, changing into blue and green in different lights; the lower part of the back and rump are dotted with white; all the under parts are brown, striped transversely with black. The female is a third smaller than the male. This species is of Chinese origin, and some of them have been brought from China to England alive.

3. The pavo tibetanus is about the size of a pintado, being about two feet and nearly two inches long. The head, neck, and under parts, are ash-coloured, marked with dark lines; the wing-coverts, back, and rump, are grey, with such white dots; besides which, on the wing-coverts and back are large round spots of a fine blue, changing in different lights to violet and green gold. This species inhabits the kingdom of Tibet. The Chinese give it the name of chin-chuck-kia.
PAUPER, in law. See Forma PAUPERIS.

PAUSE, in music, a mark or character, consisting of a curve drawn over a dot, and signifying that the note or the rest, over which it is placed, is to be stretched out to the regular time. The exact length of the pause is not dictated by any stated rule, but left to the judgment, taste, and feeling of the performer; who sometimes is licensed by the words ad libitum, to introduce extemporaneous embellishments.

PAUSUS, a genus of insects, of the order coleoptera. The generic character is: antenna of two joints, the upper very large, inflated, moveable, and hooked; head stretched forwards; wing-sheaths flexible, deflected, truncated.

1. Pausus microcephalus. The head is uncommonly small; the thorax broader than the head, and very uneven, the two parts being entirely separated by a transverse furrow. This species is found on a small island, and Sierra Leone in Africa. Its color is a blackish brown. It is represented on the Plate, both in its natural size, and considerably magnified.

The 32 species, or pausus sphenocerus, is thus described by Dr. Azzellini, "There was a house building for the governor, on an eminence at the south end of Free-town, in Sierra Leone. I had not resided there many days, when one evening, having just lighted my candle, and begun to write, I observed something dropping from the ceiling before me upon the table, which, from its singular appearance, attracted my particular attention. It resembled a little while quite immovable, as if stunned or frightened, but began soon to crawl very slowly and steadily. I then caught it, put it into a box, and left it confined there for a day or two. One evening, going to look at it, and happening to stand between the light and the box, so that my shadow fell upon the insect, I observed, to my great astonishment, the globes of the antenna, like two lanterns, spreading a dim phosphoric light. This singular phenomenon raised my curiosity, and, after having examined it several times that night, I resolved to repeat my researches the following day. But the animal being exhausted, died before the morning, and the light disappeared; and afterwards, not being able to find any more specimens, I was prevented from ascertaining the fact by reiterated experiments at different times."

PAWLE, in a ship, a small piece of iron bolted to one end of the beams of the deck, close to the capstan, and yet so easily, as that it can turn about. Its use is, to stop the capstan from turning back, by being made to catch hold of the whelp; they therefore say, leave a pawle; that is, leave a little more, for the pawle to get hold of the whelp; and this they call pawling the cap-tan.

PAWN, a pledge lodged for the security of the payment of a sum of money borrowed. As the party that Pawn's the goods has a general property therein, they cannot be forfeited by the person that has them in pawn, for any offense committed by the owner thereof; but they being held for his debt: on the other hand, where goods are repawned for money, if after judgment is obtained against the pawnor for debt, the goods in the pawnor's hands are not liable to execution until such time as the money lost is paid to the pawnor. Whereupon money on a pawn is due again the pledge, when he repays the same, or he may bring an action for detaining it; and his very tender of the money revests the special property in him. Likewise it has been held, that where a broker refuses, on considering the money, to redeem the goods, he thereupon shall be indicted. In case goods are pawned for lilent money, and no day fixed for their redemption, they are said to be redeemable at any time during the pawnor's life; and though they may not be redeemed after his death, they may after the death of the pawnor. Where the pawn is redeemable on a certain day, it must be money observed, or upon failure of payment it may be sold. Also it is the common practice of the brokers, when no day is fixed for redemption, not to stay longer than a year for their money, at the expiration of which time they usually sell the goods. See also 39 and 40 Geo. III. c. 99.

PAYING, in the sea language. The seamen say, pay more cable, when they mean to let out more cable.

PAYING, among seamen. When the seams of a ship are laid over with a coat of hot pitch, it is called paying her; and when this is done with canvas, parcelling: also when, after she is graved, and the soil burned off, a new coat of tallow and soot, or one of train-oil, rosin, and brimstone boiled together, is put on her, that is also called paying of a ship.

PAYMENT, is the consideration or purchase-money for goods, and may be made by the buyer giving to the seller the price agreed upon, either by bill or note, or by his personal, or the seller's order. Where a day certain is appointed for payment, the party bound shall be allowed till the last moment of the day to pay it, if in an inland bill. 4 T. R. 173.

Payment of money before the day is, in fact, padowing, which cannot, in the presumption of law, be any prejudice to him to whom the payment is made, to have his money before the time; and it appears by the party's receipt of it, that it is for his own advantage to receive it. 7 T. R. 177.

PEACE, in law, signifies a quiet and harmless behaviour towards the king and his people. The king, by his office and dignity royal, is the principal conservator of the peace within all his dominions, and may give authority to any other to see the peace kept, and to punish such as break it: hence it is usually called the king's peace. All the great officers of state are generally conservators of the peace throughout the kingdom, and may not only break all breaches of it, but bind them in recognition to keep it. Also the sheriff, coroner, constables, and tithing-men, are conservators of the peace within their own jurisdiction; and may apprehend all breakers of the peace, and commit them till they find sureties to keep the peace. 1 Black. 330.

PEACE, justices of the, are persons appointed by the king's commission to attend to the peace of the county where they dwell. They are appointed for one year, and guardians of the peace till the 30th year of Edw. III. c. 12, where they are called justices.

A justice of the peace must, before he takes the oath of office, which is always done at the general quarter sessions for the county, by virtue of a dedimus potestatem out of chancery.

Sheriffs, coroners, attorneys, and proctors, may not act as justices of the peace.

The power, office, and duty of this magistrate, extends to an almost infinite number of instances, specified in some hundreds of acts of parliament, and every year accumulating.

The commission of the peace does not determine by the demission of the office, but is continued for six months after, unless sooner determined by the successor: but before his demise, the king may determine it, or may put out any particular person: which is most commonly done by a new commission, leaving out such person's name.

Justices of the peace can only be appointed by the king's special commission, and such commission must be in his name; but it is not requisite that there should be a special suit or application to, or warrant from the king for the granting thereof, which is only requisite for such as are of a particular nature; as constituting the mayor of such a town, and his successors, perpetual justices of the peace within their precincts for which commissions are neither revocable by the king, nor determinable by his demise, as the common commission of the peace is, which is made of course by the lord chancellor, according to his discretion. 1 Lev. 210.

The form of the commission of the peace, as it is at this day, was, according to Hawkins, settled by the judges about the 23 Eliz. 4 Inst. 471.

Qualifications. On renewing the commission of the peace (which generally happens when any person is newly brought into the same), a writ of dedimus potestatem is issued out of chancery to take the oath of him who is newly inserted, which is usually in a schedule annexed: and to certify the same into that court at such a day as the writ contains, in order to be sealed. Lists, in which oaths are usually annexed the oaths of allegiance and supremacy. Lamb. 53.

Jurisdiction. It seems now to be settled, that justices of the peace have no power to hear and determine felonies, unless they are authorized so to do by the express words of their commissions; and that their jurisdiction to hear and determine murder, manslaughter, and other felonies and trespasses, is by force of the word assignavit in their commission, which gives them, or two of them (whereof one is of the quront), power to hear and determine felonies, &c, 2 Haw. P. C. 38. And hence it has been lately adjudged, that the caption of an indictment of trespass before justices of the peace, without adding, nemo ad diversas felonias, &c assignavit, is naught. Thinn. 7 G. I, in B. R. But though justices of the peace, by force of their commission, have authority to hear and determine murder and manslaughter, yet they seldom exercise a jurisdiction herein, or in any other offenses in which clergy is taken away, for two reasons: 1. By reason of the monopoly and clause in the statutes prohibiting the clergy to expect the presence of the justices of assize. 2. By the direction of the statute of 1 and 2 P. and M. c. 13, which directs justices of the
peace, in case of manslaughter and other felonies, to take the examination of the prisoner, and the information of the fact, and prove it by two witnesses; and then to bind the prisoner if there is cause, and to certify with the same the delivery of general-goods; and therefore in cases of great moment they bind over the prosecutors, and hold the prisoner in all cases, but to the nearest general-goods; but in smaller matters, as petty larceny, and in some other cases, they bind over to the sessions; but this is only in point of discretion and convenience, not because they have no jurisdiction of the crime.

As to inferior offences, the jurisdiction herein given to justices of the peace by particular statutes, is so various, and extends to such a multiplicity of cases, that it would be endless to endeavour to enumerate them. 6 Mod. 128. It has been held, that not only assaults and batteries, but libels, barricary, and common night-walking, and haunting bawdy-houses, and such like offences, which have a direct tendency to cause breaches of the peace, are cognizable by justices of the peace, and they may act without the provision and name the meaning of the word. 1 Lev. 130.

Duty. Justices of the peace are to hold their sessions four times in the year, viz. the first week after Michaelmas, the Epiphany, Easter, and St. Thomas. They are justices of record; for none but justices of record can take a recognizance of the peace. Every justice of the peace has a separate power, and may do all acts concerning his office apart and by himself, and even commit a fellow justice upon suspicion, felony, or breach of the peace; and this is the ancient power which conservators of the peace had at common law. By several statutes justices may act, in many cases, where their commission does not reach; the statutes themselves being a sufficient commission. Wood, Inst. 79, 80.

Justices of the peace are authorized to do all things appertaining to their office, so far as they relate to the laws for the relief, maintenance, and support of paupers, provision for the poor, for passing and punishing vagrants; for repair of the highways; or to any other laws concerning parochial taxes, levees, or rates; notwithstanding they are rated or chargeable with the rates, with any place affected by such acts. Provided that this shall not empower any justice for any county at large to act in the determination of any appeal to the quarter-sessions of such county, from any order, matter, or thing, relating to any such parish, township, or place, where such justice is so charged or chargeable. 16 Geo. II. c. 18.

The power of justices is ministerial, when they are commanded to do anything by a superior authority, as the court of B. R. &c. In all other cases they act as judges; but they must proceed according to their commission, &c. Where a statute requires an act to be done by two justices, it is an established rule, that if the act is of a judicial nature, or the result of discretion, the two justices must be present to concert and join in it, otherwise it will be void; as in the orders of the apprentices, overseers, and the allowance of the indenture of a parish apprentice; but where the act is merely ministerial, they may act separately, as in the allowance of a poor-rate. This is the only act of two justices which has been construed to be ministerial; and the propriety of this construction has been justly questioned. 1 D. &a, East, 386.

If a justice of the peace does not observe the form of proceeding directed by a statute, it is comm non jus, and void; but if he acts according to the direction of the statutes, and the rules of his office, he has not been justly questioned. 1 D. &a, East, 386.

Where a justice shall exceed his authority in granting a warrant, the officer must execute it, and he is indemnified for so doing; but if it is in a case where he has no jurisdiction, or in a manner where he has no cognizance, the officer ought not to execute such warrant; for the officer is bound to take notice of the authority and jurisdiction of the justice. 10 Co. 76.

Justices acting improperly. If a justice of the peace where, on complaint to him made, execute his office; if he shall misbehave in his office, the party grievous may move the court of king's bench for an information, and afterwards may apply to the court of chancery to try him out of the commission. But the most usual way of compelling justices to execute their office, in any case, is by writ of mandamus out of the court of king's bench.

Where the plaintiff in an action against a justice, shall obtain a verdict, and the judge shall, in open court, certify on the back of the record, that the injury for which such action was brought, was wilfully and maliciously committed, shall have double costs. 24 G. II. c. 44. And if a justice of peace acts improperly, knowingly, information shall be granted. 27 G. III.

No justice shall be liable to be punished both ways, that is, criminally and civilly; but before the court will grant an information, they will require the party to relinquish his civil action, if any such is commenced: and even in the case of an indictment, and though the indictment is actually found, the attorney-general may revoke it; he shall not grant a noli proximo upon such indictment, if it appears to him that the prosecutor is determined to carry on a civil action at the same time. Bur. 710.

If any action shall be brought against a justice for any thing done by virtue of his office, he may plead the general issue, and give the special matter in evidence; and if he recovers he shall have double costs. Tae. c. 5. Such action shall not be laid but in the county where the fact was committed. 21 Ta. c. 12. And no suit shall be commenced against a justice of the peace till after one month's notice. And unless it is proved upon the trial that such notice was given, the justice shall have a verdict and costs. And no action shall be brought against any constable or other officer, or any person acting by his order and in his aid, for any thing done in obedience to the warrant of a justice, till demand has been made, or left at the usual place of his abode, by the party or by his attorney, in writing, signed by the party demanding the same, of the person and copy of such warrant, and the same has been refused or neglected for six days after such demand. And no action shall be brought against any justice for any thing done in the execution of his office, unless commenced within six months after the act committed. 24 G. II. c. 44.

PEACH, in botany. See AMYGDALUS.

PEACH, in law. See POACH AND PAN.

PEARLS OF DERBYSHIRE, a chain of very high mountains in the county of Derby in England, famous for the mines they contain, and for their remarkable caverns. The most remarkable of these are Posch-hole and Elen-hole. The former is a cave at the foot of a high hill called Cottomess, so narrow at the entrance that passengers are obliged to creep on all-fours; but it soon opens to a considerable height, extending to above a quarter of a mile, with a roof somewhat resembling that of an ancient cathedral. By the petrifaction water continually dropping in many parts of the cave, are formed a variety of curious figures, and representations of the works both of nature and art. There is a column here as clear as alabaster, which is called "the queen of Scots' pillar," because queen Mary is said to have proceeded thus far when she visited the cavern. It seems, the curiosity of that princess had led her thus far into the cavern; and here are few visitors who care to venture farther; but others, determined to see the end of all, have gone beyond it. After sliding down the rock a little way, is found the dreary cavern capped by a very high wall, and climbing from crag to crag, the traveller arrives at a great height, till the rock, closing over his head on all sides, puts an end to any further subterraneous journey. Just at turning down, beyond an opening, are two small clear streams, consisting of hot and cold water: so near each other, that the finger and thumb of the same hand may be put, the one into the hot water, and the other into the cold.

Elden-hole is a dreadful chasm in the side of a mountain, which, before the latter part of the last century, was thought to be altogether unfortifiable. In the time of queen Elizabeth a poor man was let down into it for seven years, but he was drawn up by a rope fixed to the top of an old lead-ore pit, four fathoms most perpendicular, and thence three fathoms more obliquely, between two great rocks. At the bottom of this he found an entrance into another cave, thence he descended along with a miner for 22 fathoms perpendicular. At last they came to a great river of water, which he found to be twenty fathoms broad and eight fathoms deep. The
miner who accompanied him, in-listed that this water chinked and flowed with the sea; but the captain disproved this assertion, by remaining in the place from three hours flood to two hours ebb, during which time there was no alteration in the height of the waves. As they walked on the edge of the water, they observed a hollow in the rock some feet above them. The miner went into this place, which was the mouth of another cavern; and walked for about 70 paces in it till he just lost sight of the captain. He then called to him, that he had found a rich mine, but immediately after came running out, and crying that he had seen an evil spirit; nor could any persuasions induce him to return. The floor of these caverns is a kind of white stone enamelled with lead ore, and the roofs are encrusted with shining spar.

On his return from this subterraneous journey, captain Sturmy was seized with a violent headache, which, after continuing four days, terminated in a fever, of which he died in a short time.

Several years ago this cavern was visited by the late Mr. James Ferguson, who tells us, that it consists of two hollows, called one another; but that the lowermost is now stopped up by planks of timber laid across it, which is a heap of stones thrown in at the upper mouth, with a design to fill up the cavern entirely; which, however, will probably never be accomplished, on account of its vast size.

PEAR, in botany. See PYRUS.

PEARCE, in ichthyology. See PERCA.

PEARL, in natural history, a white, shining body, usually roundish, found in various kinds of testaceous fishes.

Pearls, though esteemed by the number of gems by our jewellers, and highly valued, not only at this time, but in all ages, proceed only from a distemper in the creature that produces them, analogous to the bezoars and other stony concretions in several animals of other kinds.

The fish in which the largest and finest pearls are usually produced, is the East Indian pearl-oyster, as it is commonly called. Besides this shell there are many other kinds found to be the common oyster, the muscle, and several others, the pearls of which are often very good; but those of the true Indian beads, or pearl-oyster, are in general superior to all the small or seed-pearls, also called ounce-pearls, from their being sold by the ounce and not by tale, are vastly the most numerous and common; but, as in diamonds, among the multitudes of small ones, there are smaller numbers and fine ones found, so in pearls there are larger and larger kinds; but as they increase in size, they are proportionately less frequent; and this is one reason of their great price.

We have the pearls sold in bars as large as a little tare, some as big as a large pea, and some few of the size of a horsebean; but these are usually of a bad shape, and of little value in proportion to their weight. Philip H. of Spain had a pearl pawned by him in its shape and colour, and of the size of a pigeon's egg. The finest, and most prized is called the true shape of the pearl, is a perfect round; but if pearls of a considerable size are of the shape of a pea, as is not unfrequently the case, they are not less valued, as they serve for earrings and other ornaments. Their colour ought to be a pure white; and that not a dead and lifeless, but a clear and brilliant one: they must be perfectly free from any foulness, spot, or stain; and their surface must be naturally glossy and smooth; for they bring their natural polish with them, which art is not able to improve.

All pearls are formed of the matter of the shell, and consist of a number of coats spread with pearl regularity one over another, in the manner of the several coats of an onion, or like the several strata of the stones found in the bladders or stomachs of animals, only much thinner.

The manner of fishing for pearls in the East Indies is this: There are two seasons for pearl-fishing; the first is in March and April, and the last in August and September; and the more rain there falls in the year, the more plentiful are these fisheries. At the beginning of the season there are sometimes 250 banks on the banks: the larger banks have two divers, and the smaller one. As soon as banks arrive at the place where the divers are, and are on their backs, each diver binds a stone, six inches thick and a foot long, under his body, which serves him as a ballast, prevents his being driven away by the motion of the water, and enables him to walk more steadily under the waves. They also tie another very heavy stone to one foot, by which they are very speedily sent to the bottom of the sea: and as the oysters are usually firmly fastened to the rocks, they arm themselves with battle irons, to prevent their being wounded in pulling them violently off; but this task some perform with an iron rake. In the last place, each diver carries down with him a large net, in the manner of a sock, tied to his neck by a long cord, the other end of which is fastened to the side of the bark. This net is to hold the oysters gathered from the rock; and the cord is to pull up the diver when his bag is full, or when he wants air. In this equipment he sometimes precipitates himself sixty feet under water; and as he has no time to lose, he no sooner arrives at the bottom, than he begins to run from side to side, tearing up all the multitudes of oysters he meets with, and cramming them into his budget.

At whatever depth the divers are, the light is so great, that they easily see whatever passes in the sea; and, to their great con- sternation, sometimes perceive monstrous fishes, from which all their address in amidning the water, &c. will not save them, but they unhappily become their prey; and of all the dangers of the fishery, this is of the greatest and most mortal. The best divers will keep under water near half an hour, and the rest do not stay less than a quarter. During this time they hold their breath, without the use of oils or other liquor.

When they find themselves straitened, they pull the rope to which the bag is fastened, and hold fast by it with both hands; when those in the bark, taking the rope to them in a signal, leave the bag and unload them of their fish; which is sometimes 500 oysters, and sometimes not above 50. Some of the divers need a moment's respite to recover breath; others jump in again instantly, continuing this violent exercise without intermission for several hours.

On the shore they unload their barks, and lay their oysters in an infinite number of little pits dug in the sand four or five feet square, raising heaps of sand over them to the height of a man; and in this condition they are left till the rain, wind, and sun, have obliged them to open, which soon kills them: upon this the fishes and oysters are taken out of the pits of the greater height, they sift the sand several times, in order to find the pearl; but, whatever care they take, they always lose a great many. After cleaning and drying the pearls, they are passed through a kind of sieve, according to their sizes; the smallest are then sold as seed pearls, and the rest put up to auction, and sold to the highest bidder.

See also MYTA; and for the composition of the pearl, see the next article.

Mother-of-Pearl, is the shell not of the pearl oyster, but of another sea-fish of the oyster kind. This shell on the inside is extremely smooth, and of the whiteness and water of pearl itself; and it has the peculiar property of arising from the finest hairs or scales being cleared off with aquafortis, and the papillary milk. Mother-of-pearl is used in inlaid works, and in several toys, as snuff-boxes, &c.

Mother-of-pearl shells, when exposed to a red heat, crackle, blacken, and emit a strong fetid odour. They exfoliate, and become grey and white; when immersed in acids, they effervesce. The acids take up only the lime, and leave a number of thin enamellaceous substances, which still retain the form of the shell. From Mr. Hatchett's experiments we learn, that these membranes have the properties of coagulated albumen. Mother-of-pearl shells then are composed of alternate layers of coagulated albumen and carbonat of lime, beginning with the epidermis, and ending with the last-formed membrane. The animals which inhabit these shells increase their habitation by the addition of a stratum of carbonat of lime, secured by a new membrane; and as every additional stratum exceeds in extent that which was previously formed, the shell becomes stronger, it becomes larger.

The shell in general is the structure of the mother-of-pearl shells, yet there is a considerable difference between the proportion of the component parts, and the consistency of the albuminous part. Some of them, as the common oyster-shell, approach nearly to the pectolite, the albuminous portion being small, and its consistency nearly gelatinous; while others, as the haliotis iris, the turbo Collins, the real mother-of-pearl, and the pernix, as described by Hatchett, the membranes are distinct, thin, compact, and translucent. Mother-of-pearl contains

60 carbonat of lime
34 membrane

The pearl which is formed in some of these shells (see the preceding article,) arises them exactly in its structure and composition. It is a beautiful substance, of a bluish-white colour, iridescent, and brilliant. It is composed of concentric and alternate cost a
of thin membrane and carbonat of lime. Their iridescence is obviously the consequence of the laminated structure.

Mr. Hatchet found that what is called the bone of the cuttle-fish is exactly similar to mother-of-pearl shells in its composition.

From the comparative analysis of shells and bones Mr. Hatchett was induced to compare them, and has shown that porcine eggs bears a striking resemblance to enamel of teeth, while mother-of-pearl shells bear the same resemblance to the substance of teeth or bone: with this difference, that in enamel and bone the early salt is pherophat of lime, whereas in shells it is pure carbonat of lime.

PEARLS, artificial. Attempts have been made to take out stains from pearls, and to render the soul opaque-coloured ones equal in lustre to the Oriental. Abundance of processes are given for this purpose in books of secrets and travels; but they are very far from answering what is expected from them. Pearls may be cleaned indeed from any external fouling by washing and rubbing them with a little Venice soap and warm water, or with ground rice and salt, with starch and powder-blue, plaster of Paris, coral, white of an egg, tartar, cuttle-bone, pumice-stones, and other similar substances; but a stain that reaches deep into the substance of pearls is impossible to be taken out. Nor can a number of small pearls be united into a mass similar to an entire natural one, as some pretend.

There are, however, methods of making artificial pearls, in such a manner as to be with difficulty distinguished from the best Oriental. The ingredient used for this purpose was long kept a secret; but it is now discovered to be a fine silver-like substance found upon the under side of the scales of the bay or black. The scales, taken off in the usual manner, are washed and rubbed with fresh parches of fair water, and the several liquors suffered to settle; the water being then poured off, the pearl matter remains at the bottom, of the consistence of oil. Perseverance in this little of is dropped into a hollow head of glass, and taken about so as to line the interior surface; after which the cavity is filled up with wax, to give solidity and weight. This manufacture in this manner are distinguishable from the natural only by their having fewer blemishes.

PEARL, a well-known inflammable substance, used in many parts of the world as fuel. There are two species.

It consists, according to Kirwan, of clay mixed with calcareous earths and pyrites; sometimes also it contains common salt. While soft it is formed into oblong pieces for fuel, after the pyrites and stony matters are separated. By distillation it yields water, acid, oil, and ammonia; the ashes containing a small proportion of fixed alkali; and being either white or red, according to the proportion of pyrites contained in the substance.

The oil which is obtained from peat has a very pungent taste, and an empyreumatic smell, less feitid than that of animal substances, but more so than that of mineral substances; it solidifies in the cold into a pitchy mass, which liquefies in a small heat: it readily catches fire from a candle, and burns less vehemently than other oils, and immediately melts on the external heat; it dissolves almost totally in rectified spirit of wine into a dark brownish-red liquor.

It is evident that peat will vary as to composition, according to situation and circumstance; and in almost every place will be found somewhat different. The following is an account of the peat found near Newbury in Berkshire. It is a composition of the branches, twigs, leaves, and roots of trees, with grass, straw, and plants, particularly moss, having been a mass so soft as to be cut through with a sharp blade. The colour is a blackish-brown, and it is used in many places for firing.

There is a stratum of this peat on each side of the Kennet, near Newbury in Berks, which is from about a quarter to half a mile wide, and many miles long. The depth below the surface of the ground is from one foot to eight. Great numbers of entire trees are found lying irregularly in this peat. They are chiefly oaks, alders, willows, and firs, and appear to have been torn up by the roots: many horses' heads, and bones of several kinds of deer, the horns of the antelopes, the heads of boars, and the heads of beavers, are also found in it. Not many years ago an arm of a light-brown colour, large enough to hold a gallon, was found in the peat-pit in Speen Moor, near Newbury, five feet from the river, and four feet below the level of the near bouring ground. Just over the spot where the urn was found, an artificial hill was raised about nine feet high; and as this hill consisted both of peat and earth, it is evident that the peat was older than the urn. From the side of the river several semicircular ridges are drawn round the hill, with trenches beneath them. The urn was broken to shivers by the peat-diggers who found it, so that it could not be critically examined; nor can it be known whether any thing was contained in it.

The ashes, properly burnt, are advantageously used for a manure. See Husbrandry.

There are many low grounds, which nearly on a level with small rivers, and sometimes even below it, are alternately covered with earth and left by their waters, or admit them in such a manner as to be continually fermented by them. These grounds producing an enormous quantity of plants crowd-ed together, incessantly growing, and annually accumulating layer upon layer, their soil becomes loaded to a greater or less depth with remains of vegetables, ar herbaceous stalks, interwoven with each other in all directions, of a black and coaly colour, and of a disagreeable or even fetid smell, which indicates a considerably advanced stage of vegetable decomposition.

These remains, still solid and combustible, are known by the name of turf or peat; and the place from which they are taken are called bogs. Though peat consists of coherent masses being of much larger mass of one single piece of a more or less decomposed, yet by separating the filaments we may distinguish several of the plants which have contributed to their formation. They are separable into long, soft, brown, or black stalks, sometimes indeed of a blueish or violet colour, and are frequently united and consistence of the plants to which they belong. and are manifestly altered in their texture as well as in their nature.

When turf is heated in an apparatus for distillation, we obtain from it a yellow or reddish liquid, which, after being exceedingly, carbonates of ammonia and carbonated hydrogeen gas of a very disagreeable smell. The resinum is a coal, frequently pyrophoric, from which some salts may be extracted after incineration, particularly nitrates and sulphates of soda and potash, mixed with phosphate of lime, calcareous sulphate, and oxides of iron and manganese. Every person knows the manner in which turf burns in fire-places and furnaces, in the ill-smell it emits, and the reddish ferocious ashes it leaves. Attempts have been made with some success to divest it of these inconveniences, by half-burning it in close vessels, so as to char it like wood, but it has certainly its advantage. It must be mentioned, however, that this charcoal is inferior to that commonly made from wood; and that it is liable to take fire from the combined action of air and water as he is kept for use in close places well secured.

Peat therefore is in reality the residuum of plants or herbs half-decomposed, half-burned, reduced almost to the state of charcoal, analogous in its nature to fossil wood, which is equally combustible. It is used as fuel, where there is no other. It may be very useful in forgings: its ashes are employed as manure. See Husbrandry.

This compound, so combustible in moist air, burns them when they are exposed to it, and even occasions them to take fire. Some of them, such as those in the environs of Beauvais, are even capable of furnishing by incrustation sulphate of iron, which is formed in them by exposure to the air. There is no doubt that most peats may be employed for obtaining from them iron, and analogous to tar, as Becher proposed in 1689.

PEBBLES, the name of a genus of fossils distinguished from the flints by having a variety of colours. These are defined to be stones composed of a crystalline matter dis-posed by sands of various kinds in the same species; and then subject to veins, cracks, and other variegations, usually formed by ir-regular branch round a central nucleus, but sometimes the effect of a simple concrescence; and related like the aggregates of the motion through the fire, which they were formed in, giving their differently-coloured sub-

The variety of pebbles is so great, that a hasty describer would be apt to make almost as many species as he examined specimens. A careful examination will teach us, however, to distinguish them into a certain number of essentially different species, to which all the rest may be referred as accidental varieties. Very small differences, or those resulting from a mixture of the same, such as nature frequently makes in a number of stones, we shall easily be able to determine that these are all of them the same species,
though of different appearances; and this whether the matter is disposed of in one or two, or in 20 cruts, had regularly round a nucleus, or no; and the only recept. down the length of the thorns; abdomen, subalbated.

PEDICULUS, louse, a genus of insects of the order aptera: the generic character is, legs six, formed for walking; mouth furnished with an excisitive pincer; antennae very short; wings absent; abdomen, subalbated.

This is a very numerous genus of insects, far more remarkable for variety than elegance of appearance. Of these strange and unpleasing animals some infest the bodies of quadrupeds, others of birds, and some even those of insects themselves. It must, however, be here observed, that many small insects, infesting other animals, have been often referred to the genus pediculhus, which in reality belong to those of acarus, monocus, &c., &c.

The pediculus humanus, or common louse, is so well known as to render any particular description unnecessary. As a species, it is distinguished by its pale yellow, labelled, oval-shaped, eggs. It is produced from a small oval egg, properly called by the name of a nym, which is fastened or aggutinated by its smaller end to the hair on which it is deposited. From this the nym proceeds the complete in all its parts, and differing only from the parent animal in its smaller size. Some diminutive species are far preferable, for microscopic observation, to the full-grown insects, some of which are more or less conceal'd in the sheath or tube, of a very sharp form, and is furnished towards its upper part with a few reversed acute, or prickles; the eyes are large, smooth, and black; the stomach and intestines, which possess the greater part of the abdominal cavity, afford an extremely distinct and curious view of the peristaltic motion; while the ramifications of the trachea, or respiratory tubes, appear distinguish'd in a sagacious manner in various parts of the animal, and are particularly observable towards their orifices on the sides of the abdomen; the legs are each terminated by a double claw, not greatly unlike that of a lobster, but of a much shorter form; and the whole animal is everywhere covered by a strong granulated skin. It is affirmed by Leuwenhoek, that the male is furnished at the extremity of the abdomen with a sting, and that it is this extremity which causes the chief irritation suffered from these animals; the suction of the proboscis hardly seeming to have caused any perceptible pain on the skin of his hand. The male is therefore distinguished from the female by having the tail or tip of the abdomen rounded; in the female it is forked or orbicular. The same accurate observer (Leuwenhoek), being desirous of learning the proportion and time of the incubation of these insects, he exposed females in a black silk stocking, which he wore day and night for that purpose. He found that in six days, one of them had laid any eggs, and upon dissecting it, he found as many more in the ovary; he therefore concluded
that in twelve days it would have laid a hundred eggs; these eggs, hatching in six days, would be the natural time, would probably produce fifty males and as many females; and these females coming to their full growth in eighteen days, might be of them supposed, after twelve days more, to lay eggs, and so on ad infinitum. The disorder, however, commonly termed phthisis, is probably more owing to want of attention during the first stages of its appearance; which is the constitutional cause in the patient; it being entirely contrary to the nature of this insect to get under the cuticle, as commonly supposed; and utterly inconceivable that a complaint merely external should be able to render mercurial or other preparations outwardly used; there can be little doubt that such cases, whenever they occur, would be effectually removed by a proper application of a dilute solution of mercury externally. We must ever entertain a suspicion to express our doubts whether a real and genuine phthisis, considered as a primary disease, has ever appeared. Notwithstanding this, we are told by Pliny that Piercynus, the Syrian, the dictator, and others, have died of this disorder.

The insects of this genus found on quadrupeds and birds, may be considered as almost equalling the number of the animals themselves; since few of either division exist without one or more species peculiar to themselves.

PEDIGREE. See DESCENT.

PEDIMENT. See Architecture.

PEDOMETER, or Pedometer, foot-measurer, or way-wiser; a mechanical instrument, in the form of a watch, and consisting of various wheels and teeth; which, by means of a chain, or string, fastened to a man’s foot, or to the wheel of a chariot, advance a notch each step, or each revolution of the wheel; by which it numbers the paces or revolutions, and so the distance from one place to another.

Plate Pedometer, &c. figs. 1, 2, 3, explains one of Spencer and Perkins’s pedometers. The barley or wheat, which was driven in the pocket ascends the number of steps made by the wearer. The external appearance, fig. 1, is somewhat like that of a watch; in the place of the watch-chain is a brass lever, A, and a silver wire, B, which wove into a hook; the other has a hole a through it, as shown in fig. 2, and has a cleft cut in it through the hole; through this hole a wire passes, which is fixed between the two studs A & B; figs. 1 and 2, so as to turn round freely; it also goes through the two arms of the piece B, fig. 2, and is made fast to them so that they turn with it the arm x, which is higher or lower than the other, and has a narrow opening cut in it, into which is inserted a piece of steel D by a pin through its top; the end of the lever A has two small screws in it so as to close up the hole a, and pinch the wire which passed through the hole tight. When the lever A is moved forwards and forwards, it turns the wire by friction, and moves the piece B up or down till it is stopped by its leaf d coming either against the under side of the tooth, or against the back of the case, as shown in figs. 4. When the piece B turns round the pin. When the piece B is moved up or down, it pushes or pulls the piece D in or out of the case; the end of this is in two branches e; the latter ends in the plain point of v, the former in the pointed end of the other. This piece B is made to turn round one tooth; at the same time the point f slips over the sloping side of the opposite tooth, and when the piece D is pushed forward, it also turns round in the same direction as while the hook c slips over the tooth ready for the next movement. The ratchet m has a pinion of 6 teeth on its under side, which tacks into a wheel of 6 teeth on the point of the ratchet (which projects through the dial), is fastened the long hand f, fig. 1. As the wheel m makes one revolution for ten strokes of the lever A, and its pinion has one-tenth of the number of teeth in the wheel, or 60, it is evident that 100 strokes of the lever will be required for one revolution of the wheel n, and hand i. The wheel a has a pinion of six leaves on it, which gives motion to a wheel o of 60 teeth, which turns r of 60 teeth, on whose arbor the hand t, fig. 1, is fastened: the wheel o has a pinion of 6 leaves on the under side of it, which moves a wheel y of 72 teeth, which carries the hand s,fig. 1; by this arrangement, it is evident, that for 100 strokes of the lever A; its dial is divided into 10 each, answering to 100, or 1 revolution of the hand z. The index x will turn round once for 1200 strokes of the lever; and the parts of each of which denotes one revolution of the hand t, or 100 strokes of the lever; the hands are not fastened to their spindle, but can be turned round to set them all to O when it is going to be used. The best method of placing the machine, is with a case upon the thigh, the lever A brought towards the bottom of the waistband, and if possible, the joints of the lever over the joints of the thigh; that the lever being over the belly is at rest, while the motion of the thigh moves the case part of the machine at every step. Set all the hands to O; and when 100 places are walked, the lever A will have made one revolution, and the hand will move to the figure 1, and so on as before described.

Persons of middle stature are found to make about 1000 paces in a mile; but it is best to walk in a mile at several times, observing each time by the several hands, the number of paces each time, and the average of these will serve to calculate by.

PEEK, in the sea-language, is a word used in various senses. Thus the anchor is said to be a-peek, when the ship being about to weigh, comes over her anchor in such a manner that the cable hangs perpendicularly between the hawse and the anchor. To heave a-peek, is to bring the peck so that the anchor may hang a-peek. A ship is said to ride a-peek, when lying with her main and fore-yards hoisted up, one end of the yards is brought down the shrouds, and the other raised up on end; which is chiefly done when she lies in rivers, lest other ships falling foul of the yards should break them. Riding a broad peck, denotes that the yards are only raised to half the height. Peek is also used for a room in the hold, extending from the hatches forward to the stem; in this room men of war keep their powder, and merchants men their victuals.

PEER, in our common law, are those who are innumerable in an inquest upon any man, for the convicting or clearing him of any offence, for which he is called in question; and the reason is, because the course and custom of every man in such a case by his equals, or peers.

Peers of the realm, are the nobility of the kingdom, and lords of parliament; who are divided into dukes, marquises, earls, viscounts, and barons; and the reason why they are called peers is, because notwithstanding there is a distinction of dignities in our nobility, yet in all public actions they are equal, as in their votes of parliament, and in passing upon the trial of any nobleman.

It seems clearly, that the right of peerage was originally tenanted by men, annexed to such estates, allowed to be peers of the realm, and were summoned to parliament to do suit and service to their sovereign; and, when the land was alienated, the dignity passed with its appurtenance. Thus the bishops still sit in the house of lords, in right of succession to certain ancient baronies annexed, or supposed to be annexed, to their episcopal lands. But afterwards, as alienations grew frequent, the dignity of peerage was confined to the lineage of the party alienated; and, instead of territorial, became personal. A certain tenure by barony became no longer necessary to constitute a lord of parliament; but the record of the writ of summons to him, or his ancestors, was admitted as a sufficient evidence of the tenure.

Peers are now created either by writ, or patent; for those who claim by prescription must suppose either a writ or patent made to their ancestors, though by length of time it may be lost. If a writ or the king’s letter, is a summons to attend the house of peers, by the style and title of that barony which the king is pleased to confer; by that patent is a royal grant to a subject, of any dignity and degree of peerage. The creation by writ is the more ancient way; but a man is not emboiled, unless he actually takes his seat in the house of lords; and therefore the most usual, because the king’s letter of patent is a royal grant of the dignity by patent, which ensures to a man and his heirs, according to the limitations thereof, though he never himself makes use of it.
In criminal cases, a nobleman is tried by his peers. Peers shall have the benefit of clergy for the first offence of felony without being burned in the hand.

PELICANUS, a Christian sect who appeared before the latter part of the fourth, or the beginning of the fifth century. Pelagius, the author of this sect, was born in Wales, and his name was Morgan, which in the Welsh language signifies Pelagi, when he had his Latin name Pelagius. St. Austin gives him the character of a very pious man, and a Christian of no vulgar rank: according to the same father, he travelled to Rome, where he associated himself with persons of the greatest learning and figure, and wrote his commentaries on St. Paul’s epistles, and his letters to Melanion and Demetrius; but being charged with heresy, he left Rome, and went into Africa, and thence to Jerusalem, where he settled. He died somewhere in the East, but where is uncertain. He was charged with maintaining the following doctrines: 1. That Adam was by nature mortal, and whether he had sinned or not, would certainly have died. 2. That the consequences of Adam’s sin were confined to his own person. 3. That new-born infants are consequently under sentence of death before the fall. 4. That the law qualified men for the kingdom of heaven, and was founded upon equal promises with the gospel. 5. That the general resurrection of the dead does not follow a resurrection of our Saviour’s resurrection. 6. That the grace of God is given according to our merits. 7. That this grace is not granted for the performance of every moral act; the liberty of the will, and information in points of doctrine, &c. Pelagius’s sentiments were condemned by several councils in Africa, and by a synod at Antioch. There was also a sect of semi-pelagians; who, with the orthodox, allowed of original sin; but denied that the liberty of the will could be so far impaired thereby, that men could not of themselves do something which might induce God to afford his grace to one more than another; and as to election, they held, that it depended on our perseverance: God choosing only such to eternal life, as continued steadfast in the faith.

PELECOIDES, in geometry, a figure in form of a hatchet; such is the figure of the pelecoides, (see Plate Miscel. fig. 182,) contained under the two inverted quadrangular arcs AB and AD, and the semicircle BCD. The area of the pelecoides is demonstrated to be equal to the square AC, and that again to the parallelogram EP. It is equal to the square AC, because it wants of the square on the left hand the two segments AB and AC, which are equal to the two segments BC and CD, by which it exceeds on the right hand.

PELICAN, in chemistry, a kind of double glass vessel, used in distilling liquors by cir- culation; it consists of a cucurbit and alembic head, with two tubes bending into the cucurbit again.

PELICANUS, in ornithology, a genus belonging to the order of anseres. The bill is straight, without teeth, and crooked at the point; the face is naked; and the feet are palmar. See Plate Nat. Hist. fig. 321. Mr. Latham enumerates no less than 30 different species of this genus, besides varieties. The most remarkable seem to be those that follow:

3 A
may hold its prey with more security; it has no nostrils, but in its place a long furrow, that reaches almost to the end of the bill; the whole is of a dirty white, tinged with ash-colour.

From the centre of the mouth is a narrow slit of black bare skin, that extends to the third part of the head; beneath the chin is another, that, like the pouche of the pelican, is dilatable, and of size sufficient to contain from five to eight entire berrings; which in the breeding season it carries at once to its mate or its young.

The young birds, during the first year, differ greatly in colour from the old ones; being generally dusky brown, with a few triangular white spots; and at that time resemble in colour the speckled diver. Each bird, if left undisturbed, would only lay one egg in the year; but if that is taken away, they will lay another; if that is also taken, then a third, but never more that season. The egg is white, and rather less than that of the common goose; the nest is large, and formed of any thing the bird can find, and is placed in trees, rocks, sea-cliffs, grass, sea-plants, shavings, &c. These birds frequent the island of Alisa, in the frith of Clyde; the rocks adjacent to St. Kilda; the Stalks of Staffinveery, near the Orkneys; the islands off the coast of Kerry, Ireland; and the Bass in the frith of Forth: the multitudes that inhabit these islands are prodigious.

4. The aull, or booby, is somewhat less than a man; the colours of the beak are brown and white; but varied so in different individuals, that they cannot be described by them. Their wings are very long; their legs and feet pale yellow, shaped like those of the phalacrocorax, but shod with sharp claws; they frequent islands, where they breed all months in the year, laying one, two, or three eggs on the bare rock. While young, they are covered with a white down, and continue so till they are almost ready to fly. They feed on fish like the rest of this genus; but have a very troublesome enemy in the man-of-war bird, which lives on the spoils obtained from other sea-birds, particularly the booby. As soon as this dangerous enemy perceives that the booby has taken a fish, he flies furiously at him, upon which the former dives to avoid the blow; but as he cannot swallow his prey below water, he is soon obliged to come up again with the fish in his bill as before, when he suffers a new assault; nor does his enemy cease to persecute him till he lets go the fish, which the other immediately carries off.

5. The aquilus, or man-of-war bird, is in the body about the size of a large fowl; in length three feet, and in breadth fourteen. The bill is slender, seven inches long; and much curved at the point; the colour is dark reddish brown, the under mandible hags a large membraneous bag attached some way down the throat, as in the pelican, and applied to the same uses; the colour of this is a fine purple red, sprinkled on the sides with a few scattered feathers; the whole plumage is brownzack black, except the wing-coverts, which have a russet tinge; the tail is long and much forked; the outer feathers are eight inches or more in length, the middle ones from seven to eight; the legs are small; all the toes are webbed together, and the webs are deeply indented; the colour of them is dusky red.

The frigate-pelican, or man-of-war bird, as it is by some called, is chiefly, if not wholly, met with between the tropics, and ever out at sea, being only seen on the wing. Sometimes it soars so high in the air as to be seen by vessels that are even at the top of a mast, but does not descend to the surface of the sea, where, hovering at some distance, the moment he spies a fish, he darts down on it with the utmost rapidity, and seldom without success, lying upon it, and driving it by its long bill, which becomes so soft and pliant, that the Spanish would sometimes adorn it with gold and embroidery, to make work-bags of.

PELLICLE, among physicians, &c. denotes a thin film, or fragment of a membrane.

When any liquor is evaporated in a gentle heat, till a pellicle arises at top, it is called an evaporation to a pellicle; wherein there is just liquor enough left, to keep the salts in fusion.

PELTARIA, a genus of the silicosa order, in the tetradynesthesia class of plants; and in the natural method ranking under the 39th order, siliquosea. The silicusa is entire, and nearly orbicular, compressed plane, and not opening. There are two species, herbs of the Cape.

PELVIS, in anatomy, the lower part of the cavity of the abdomen, thus called from its resemblance to a basin, or ever, in Latin called pelvis.

PEN, fountain, is a pen made of silver, brass, &c. contrived to contain a considerable quantity of ink, and let it flow out by gentle degrees, so as to supply the writer a long time without being under the necessity of taking fresh ink. The fountain-pen is composed of several pieces, as in the plate, where the middle piece F carries the pen, which is screwed into the inside of a little pipe, which again is soldered to another pipe of the same bigness as the lid G, in which lid is soldered a male screw, for screwing on the cover, as also for stopping a little hole at the place, and hindering the ink from running away. At the other end of the piece F is a little pipe, the outside of which the top-cover H may be screwed; in the cover there goes a port-crayon, which is to be screwed into the last-mentioned pipe, in order to stop the end of the pipe, into which the ink is to be poured by a funnel. To use the pen, the cover G must be taken off, and the pen a little shaken, to make the ink run more freely.
Kircher, and others, observed the same thing; though it is said, without any intimation of what had been done by Riccioli.

To this last named Huygens, who first demonstrated the principles and properties of pendulums, and probably the first who applied them to clocks. He demonstrated, that if the centre of motion was perfectly fixed and immovable, and all manner of friction, and resistance of the air, &c. removed, then a pendulum, once set in motion, would for ever continue to vibrate without any decrease of motion, and that all its vibrations would be perfectly isochronal, or performed in the same time. Hence the pendulum has universally been considered as the best chronometer or measurer of time. And as all pendulums of the same length perform their vibrations in the same time, without regard to their different weights, it has been suggested, by means of them, to establish a universal standard for all countries.

Pendulums are either simple or compound; and each of these may be considered either in theory, or as in practical mechanics among artisans.

A simple pendulum, in theory, consists of a single weight suspended for experiments, or as the number 59254 added to the square of the number 59254, is equal to AB.

2. Let CD be a semicylind, having its base EC parallel to the horizon, and its vertex B downwards; and let CD be the other half of the semicylindrical curve BC, and consequently the body or pendulum-weight coinciding with the point B. If now the body is let go from B, it will descend by its own gravity, and in descending it will unwind the string from off the arch BC, as at the position CD, and the ball G will describe a semi-cylindrical curve BHA, equal and similar to BGC, when it has arrived at the lowest point A; after which, it will continue its motion, and ascend, by another equal and similar semicylindrical AKD, to the same height D, as if CD were the string, now wrapping itself upon the other arch CD. From D it will descend again, and pass along the other semi-cylindrical curve BDA, to the point B and thus perform continual successive vibrations between B and D, in the curve of a cycloid, as it before oscillated in the curve of a circle, in the former case.

This contrivance to make the pendulum oscillate in the curve of a cycloid, is the invention of the celebrated Huygens, to make the pendulum perform all its vibrations in equal times, whether the arch, or extent of the vibration, is great or small; which is not the case in a circle, where the larger arcs take a longer time to run through than the smaller ones do, as is well known both from theory and practice.

The chief properties of the cycloidal pendulum then, as demonstrated by Huygens, are the following: 1st. That the time of an oscillation in all arcs, and in the same time, is equal to the semicircle of the same quantity, viz. whether the body begins to descend from the point B, and describes the semicircle BA; or that it begins at A, and describes the arc HA; or that it begins at any other point; as it will still descend to the lowest point A in exactly the same time. And it is further proved, that the time of a whole vibration through any double or quadruple curve, is in proportion to the time in which a heavy body will freely fall, by the force of gravity through a space equal to 4AC, half the length of the pendulum, as the circumstances...
of a circle is to its diameter. So that, if $r = \frac{167}{3}$ feet denotes the space a heavy body falls in the first second of time, $p = 3.1416$ the circumference of a circle whose diameter is 1, and $r = AC$ the length of the pendulum; then, because, by the nature of descents by gravity, $\sqrt{r} = \sqrt{\frac{1}{2}r} = \sqrt{\frac{1}{2} \cdot \frac{1}{2}r}$, that is, the time in which a body will fall through $\frac{1}{2}r$, or half the length of the pendulum; therefore, by the above proportion, as $1 : \frac{1}{2} = \frac{1}{2}r : p$, which is the time of an entire oscillation in the cycloid.

And this conclusion is abundantly confirmed by experience. For example: if we consider the time of a vibration as 1 second, to find the length of the pendulum that will so oscillate in 1 second; this will give the equation $p \sqrt{\frac{1}{2}r} = 1$; which reduced, gives $r = \frac{2p}{1} = \frac{2 \cdot 3.1416^2}{1} = 38.11$ inches, or 3 7/16 inches, for the length of the pendulum; which is in the best experiments shew to be about 39 1/8 inches.

3. Hence also, we have a method of determining, from the experiment the length of a pendulum, the space a heavy body will fall perpendicularly through in a given time; for, since $p \sqrt{\frac{1}{2}r} = 1$, therefore, by reduction, $g = \frac{2p}{r}$ is the space a body will fall through in the first second of time, when $r$ denotes the length of the second's pendulum; and as constant experience shews that this length is nearly 267 inches, in the latitude of London, in this case $g$, or $\frac{2p}{r}$, becomes $\frac{1}{2} \times 3.1416 \times 394 = 193.07$ feet, very nearly, for the space a body will fall in the first second of time, in the latitude of London: a fact which has been abundantly confirmed by experiments made there. And in the same manner, Mr. Huygens found the same space fallen through at Paris, to be 1 3/5 French feet.

The whole doctrine of pendulums oscillating between two semicircles, both in theory and practice, was delivered by that author, in his Horologium Oscillatorium, novo Demonstratione. De Motu Pendulorum. And every thing that regards the motion of pendulums has since been elucidated in different ways, and particularly by Newton, who has given an admirable theory on the subject, in his Principia, where he has extended to epicycloids the properties demonstrated by Huygens of the cycloids.

4. As the cycloid may be considered as coinciding in A, with any small arc of a circle described from the centre C, passing through A, where it is known the two curves have the same radius and curvature; therefore the time in the small arc of such a circle, will be nearly equal to the time in the cycloid; so that the times in very small circular arcs are equal; because these small arcs may be considered as portions of the cycloid, as well as of the circle. And this is one great reason why the pendulums of clocks are made to oscillate in as small arcs as possible, viz. that their oscillations may be the nearer to a constant equality.

This may also be deduced from a comparison of the times of vibration in the circle, and in the cycloid, as laid down in the following articles. It has there been shewn, that the times of vibration in the circle and cycloid are thus, viz. time in the circle nearly $p \sqrt{\frac{1}{2}r} \times (1 - \frac{1}{8} \frac{1}{8})$.

PENDULUM.

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<td>85</td>
<td>39.001</td>
<td>67.159</td>
</tr>
<tr>
<td>90</td>
<td>39.001</td>
<td>67.168</td>
</tr>
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6. If two pendulums vibrate in similar arcs, the times of vibration are in the sub-duplicate ratio of their lengths. And the lengths of pendulums vibrating in similar arcs, are in the duplicate ratio of the times of a vibration directly, or in the reciprocal duplicate ratio of the number of oscillations made in any one and the same time. For, the time of vibration being as $p \sqrt{\frac{1}{2}r}$, where $p$ and $g$ are constant or given, therefore $t$ as $\sqrt{\frac{1}{2}r}$, and $r$ as $t^4$. Hence therefore the length of a half-second pendulum will be $39\frac{1}{16}$ inches, and the length of the quarter-second pendulum will be $39\frac{1}{16} \times 4 = 5.81$ inches; and the length of the second pendulum will be $39\frac{1}{16} \times 16 = 94.45$ inches; and so of others.

7. The foregoing laws, &c. of the motion of pendulums, cannot strictly hold good, unless the thread that sustains the ball is void of weight, and the gravity of the whole ball is collected into a point. In practice, therefore, a very fine thread, and a small ball, but of a very heavy matter, are to be used. But a thick thread, and a bulky ball, disturb the motion very much; for in that case, the simple pendulum becomes a compound one; it being much 'the same thing, as if several weights were applied to the same inelastic rod in several places.

8. Mr. Kritt, in the new Petersburgh Memoirs, vol. 6 and 7, has given the result of many experiments upon pendulums, made in different parts of Russia, with deductions from them, from whence he derives this theory: if $t$ is the length of a pendulum that swings seconds in any given latitude $l$, and in a temperature of 10 degrees of Reaumur's thermometer, then will the length of that pendulum, for that latitude, be thus expressed, viz. $l = (539178 + 29121 + \sin l) 7$ lines of a French foot. And this expression agrees very nearly, not only with $\frac{1}{4}$ the experiments made on the pendula in the forementioned Memoirs, but also with those of Mr. Graham, and those of Mr. Lyons in 79' 50' north latitude, where he found its length to be 441:38 lines.
cold, from those that have such provision. Also simple pendulum, and detached pendulum, are terms sometimes used to denote such pendulums as are not connected with any clock, or clockwork.

Pendulum, compound, in mechanics, is a pendulum whose rod is composed of two or more wires or bars of metal. These, by undergoing different degrees of expansion and contraction, when exposed to the same heat or cold, have the expansion and contraction made to act in such a manner as to preserve constantly the same distance between the point of suspension and centre of oscillation, although exposed to very different and various causes.

There are a great variety of constructions for this purpose; but they may be all reduced to the gizehtron, the mericurial, and the lever pendulum.

It may readily be observed, by the way, that the vulgar method of remedying the inconvenience arising from the extension and contraction of the rods of common pendulums, is by supplying the bob, or small ball, with a screw at the lower end, which, when the pendulum is at any time made longer or shorter, as the ball is screwed downwards or upwards, and thus the time of its vibration is kept continually the same.

The gridiron pendulum was the invention of Mr. John Harrison, a very ingenious artist, and celebrated for his invention of the watch for finding the difference of longitude. He was, indeed, one of the first to observe, that other timekeepers and watches, since that time; for all which he received the parliamentary reward of between 20,000 and 30,000 pounds.

It consists of five rods of steel, and four brass, the smaller in an alternate order, the middle rod being of steel, by which the pendulum-ball is suspended; these rods of brass and steel, thus placed in an alternate order, are so connected with each other at their ends, that while the expansion of the steel rods has a tendency to lengthen the pendulum, the expansion of the brass rods, acting upwards, tends to shorten it. And thus, when the length of the brass and steel rods is duly regulated, their expansions and contractions will exactly balance and correct each other, and so preserve the pendulum invariably of the same length. The simplicity of this ingenious contrivance is much in its favour; and the difficulty of adjustment seems the only objection to it. See Longitude.

Mr. Harrison, in his first machine for measuring time at sea, applied this combination of wires of brass and steel, to prevent any alterations by heat or cold; and in the machines or clocks he has made for this purpose, a like method of guarding against the irregularities arising from this cause is used.

The mercurial pendulum was the invention of the ingenious Mr. Graham, in consequence of several experiments relating to the materials of which pendulums might be formed, in 1715. Its rod is made of brass, and branched towards its lower end, so as to embrace a cylindrical glass vessel 13 or 14 inches long, and about two inches diameter; which being filled about twelve inches deep with mercury, forms the weight or ball of the pendulum. If upon trial the expansion of the rod is found too great for that of the mercury, more mercury must be pour'd into the vessel; if the expansion of the mercury exceeds that of the rod, so as to occasion the clock to go fast with heat, some mercury must be taken out of the vessel, so as to shorten the column. And thus by the aid of an expansion and contraction of the quicksilver in the glass be made exactly to balance the expansion and contraction of the pendulum-rod, so as to preserve the distance of the centre of oscillation from the point of suspension invariably the same.

Mr. Graham made a clock of this sort, and compared it with one of the best of the common sort, for three years together; when he found the errors of his own not about one-eighth part of those of the latter.

Mr. John Ellicott also, in the year 1738, constructed a pendulum on the same principle, but differing from Mr. Graham's in many particulars. The rod of Mr. Ellicott's pendulum was composed of two bars only; the one of brass, and the other of steel. It had two levers, each sustaining its half of the ball or weight; with a spring under the lower part of the ball to relieve the levers from a considerable part of its weight, and so to make their motion uniform and easy. The one lever in Mr. Graham's construction was above the ball; whereas both the levers in Mr. Ellicott's were within the ball, and each lever had an adjusting screw, to lengthen or shorten the lever, so as to render the adjustment the more perfect.

Notwithstanding the great ingenuity displayed by these very eminent artists on this construction, it must farther be observed, in the history of improvements of this nature, that Mr. Cumming, another eminent artist, has given, in his Essays on the Principles of Clock and Watch Work, a ample description, with plates, of a construction of a pendulum with levers, in which it seems he has united the properties of Mr. Graham's and Mr. Ellicott's, without being liable to any of the defects of either. The rod of this pendulum is composed of one flat bar of brass, and two of steel; and each lever is within the ball of the pendulum; and, among many other ingenious contrivances for the more accurate adjusting of this pendulum to mean time, it is provided with a small screw in the lower half for weight, and one entire revolution of which on its screw will only alter the rate of the clock's going one second per day; and its circumference is divided into 30, one of which divisions will therefore alter its rate of going one second in a month.

Pendulum-clock, is a clock having its motion regulated by the vibration of a pendulum.

It is controverted between Galileo and Huygens, which of the two first applied the pendulum to a clock.

After Huygens had discovered, that the vibration made in arcs of a cycloid, however unequal they might be in extent, were all equal in time; he soon perceived, that a pendulum applied to a clock, so as to make it describe arcs of a cycloid, would rectify the otherwise unavoidable irregularities of the motion; and since, though the several causes of those irregularities should be all made equal in time, the pendulum to make greater or smaller vibrations, yet, by virtue of the cycloid, it would still make them perfectly equal in point of time; and the motion of the clock governed by it, would therefore be preserved perfectly equal. But the difficulty was, how to make the pendulum describe arcs of a cycloid, for generally a pendulum, being tied to a fixed point, can only describe circular arcs about it.

Here Mr. Huygens contrived to fix the iron rod or wire, which bears the ball or weight at the top, to a silk thread, placed between two cycloidal chocks, or two little arcs of a cycloid, made of metal. Hence the motion of vibration, applying successively from one of those arcs to the other, the thread, which is extremely flexible, would describe the figure of them, and by that means cause the ball or weight at the bottom to describe a just cycloidal arc.

This is doubtless one of the most ingenious and useful inventions many ages since produced; by means of which it has been asserted there have been clocks that would not vary a single second in several days; and the same invention also gave rise to the whole doctrine of involutes and evolutes, with the radius and degree of curvature, &c.

It is true, the pendulum is still liable to its irregularities, how minute soever they may be. The silk thread by which it is suspended, shortened in moist weather, and lengths in dry; by which means the length of the whole pendulum, and consequently the times of the vibrations, are somewhat varied.

To obviate this inconvenience, M. De la Hire, instead of a silk thread, used a little fine spring; which was not indeed subject to shorten and lengthen, from those causes; yet he found, by experience, that it was very easy to regulate the pendulum by an arc of silk thread, and then made its vibrations faster than in warm; to which also we may add its expansion and contraction by heat and cold.

He therefore had recourse to a stiff wire or rod, and by one end to the ages above-mentioned, by this means he renounced the advantages of the cycloid; but he found, as he says, by experience, that the vibrations in circular arcs are performed in times as equal, provided they are rectified, as those, as those in cycloids. But the experiments of sir Jonas Moore, and others, have demonstrated the contrary.

The ordnance causes of the irregularities of pendulums Dr. Derham ascribes to the alterations in the gravity and temperature of the air, which increase and diminish the weight of the ball, and by that means make the vibrations greater and less; an accession of weight in the ball being found by experiment to accelerate the motion of the pendulum; for a weight of six pounds added to the ball, Dr. Derham found made his clock gain thirteen seconds every day.

A general remedy against the inconveniences of pendulums, is to make them long, the ball heavy, and to vibrate but in small arcs. These are the usual means employed in England; the cycloidal chocks being generally neglected.

Pendulum-clocks resting against the same wall have been found to influence each other's motion. See the Philos. Trans. numb. 453, sects. 5 and 6, where Mr. Ellicott has given a curious and exact account of this phenomenon.
...and goes eight days without winding up; shewing the hour, minute, and second. The numbers in such a piece are thus calculated: First count up the seconds in twelve hours, which are the beats in one turn of the great wheel; and they will be found to be 43200 = 12 × 60 × 60. The swing-wheel must be 30, to swing 60 seconds in one of its revolutions. Hence, if we let the half of 43200, viz. 21600, be divided by 30, and the quotient will be 720, must be separated into quotients. The first of these must be 12, for the great wheel, which moves round once in 12 hours, or six minutes; and the swing wheel once in a minute, to shew the seconds. See Clockwork.

PENEA, in botany, a genus of the monotypic order, in the Iridaceae class of plants; and in the natural order of the Irideae, comprising one species, Canna indica. This species is of which the order is doubtful. The Cannaceae is diphyllous; the corolla campanulate; the style quadrangular; the capsule tetragonal; the seed round and ochreous. 
PENEOPE, a genus of birds of the order of gallinaceous. The characters of which are: the neck is bare at the base; the head is covered with feathers; the neck is quite bare; the tail consists of twelve principal feathers; and the feet are for the most part bare. Linnaeus, in the Systema Naturae, enumerates six species: 1. Penelope melagris satyrus, or horned pheasant. Latham calls it the horned turkey. This species is larger than a fowl, and smaller than a turkey. The color of the bill is brown; the nostrils, forehead, and space round the eyes are covered with slender black hairy feathers; the top of the head and each eye there is a fleshly calous blue substance like a horn, which bends backward. On the part of the neck and throat there is a loose flap, of a fine blue color, marked with orange spots, the lower part of which is bent with a few hairs; down the middle it is somewhat longer than on the sides, being wrinkled. The breast and upper part of the back are of a full red color. The neck and breast are inclined to yellow: the other parts of the plumage and tail are of a russet brown, marked all over with white spots encompassed with black. The legs are somewhat white, and furnished with a spur behind each. It is a native of Bengal.

2. The penelope melagris cristata, is about the size of a fowl, being about two feet six inches long. The bill is two inches long; and of a black color; the sides of the head are covered with a marked purple blue skin, in which the eyes are placed; beneath the throat for an inch and a half, the skin is bare, of a fine red color, and covered only with a few hairs. The top of the head is furnished with long feathers, which the bird can erect as a crest at pleasure; the general color of the plumage is brownish black, glossed over with copper in some lights; but the wing-coverings, back, and violet gloss. They inhabit Brazil and Guiana, where they are often made tame. They frequently make a noise not unlike the word jum. Their flesh is much esteemed.

3. Penelope crax canuncens, called by Latham, &c. yagou. It is bigger than the common fowl. The bill is black; the head feathers are long, pointed, and form a crest, which can be erected at pleasure. It has a naked membrane, or kind of wattle, of a dull black color. The blue skin comes forward on the bill, but is not liable to change color like that of the turkey. The plumage has not much variation; it is chiefly brown, with some white markings on the neck, breast, wing-coverings, and belly. This species inhabits Cayenne, but is a very rare bird, being met with only in the inner parts, or about the Amazons' country. Those seen at Cayenne are nothing like ours, for it is a familiar bird, and will sit in that state, and mix with other poultry. It makes the nest on the ground, and hatches the young there, but it is attended by a turkey. It is brown, or black, and has a hissing noise. The head is partly black and partly white, and is adorned with a short crest. The space about the eyes, which are black, is white; the feet are red. It inhabits Guiana.

4. The pipile, or as it is called, crax pippil, is black in the belly, and the back brown stained with black. The flesh on the neck is of a green colour. It is about the largest of the piperidae, and has a hissing noise. The head is partly black and partly white, and is adorned with a short crest. The space about the eyes, which are black, is white; the feet are red. It inhabits Guiana.

5. The marial is about the size of a fowl, and shaped somewhat like it. Its space round the eyes is bare, and of a pale red; the chin, throat, and forepart of the neck, are scarcer feathered with feathers; but the throat itself is bare, the membrane elongated to half an inch or more; both this and the skin round the eyes change colour, and the red becomes deeper and thicker; when the bird is irritated, all the head feathers are long, so as to appear like a crest when raised up, which the bird often does when agitated; at which time it also expresses those of the whole body, and so discharges its voice as to be scarcely known. The general color of the plumage is of a greenish black. This species is common in the woods of Guiana, at a distance from the sea. The female makes her nest among rocks of a low bushy tree, as near the trunk as possible, and lays three or four eggs. When the young are hatchet, they descend with the mother after ten or twelve days. The mother acts as other fowls, scratching on the ground like a hen, and brooding the young, which quit their nurse the moment they can shift for themselves. They have two broods in a year; one in December or January, the other in May or June. The best time of finding these birds is morning or evening, being then in thick trees whose fruits they feed on, and are discovered by some of them falling to the ground. The young birds are easily tamed, and solum forsake the places where they have been brought up; they need not be housed as they prefer the roaming on tall trees to any other place. Their flesh is much esteemed.

6. The volutering p-petrel. The bill of this bird is of a greenish color: the back is brown, the middle green, and the belly of a whitish brown. It calls out the crying curassow. It is about the bigness of a crow.

PENGUIN, in ornithology. See Alca.

PENNANTIC, a genus of the poly-}

dactylous order. There is no calyx; the corolla is not keeled; stamina five; petalium three-sided, two-celled. There is one species, a herb of New Zealand.

PENNATULA, or Sea-pen, a genus of zoophytes, which, though it swims about freely in the sea, approaches near to the corals. This genus has a bone along the middle of the inside, which is its chief support; and this bone receives the supply of its osseous matter by the same polype-mouths that furnish it with nourishment. Linnaeus reckons seven species. It is certainly an animal, and as such is free or locomotive. Its body generally expands into processes on the upper part, and these branches are furnished with rows of tubular denticles; they have a polype-head proceeding from each tube.

The sea-pen is not a coralline, but distinguished from it by this specific difference; corals, corallines, alcyonaria, and all that order of beings, adhere firmly by their bases to submariue substances, but the sea-pen either swims about in the water or floats upon the surface.

Its general appearance greatly resembles that of a quill-feather of a bird's wing; it is about four inches long, and of a reddish color; along the back is a groove from the quill part to the extremity of the feathered part, as there is in a pen: the feathered part consists of fins proceeding from the stem. The fins move the animal backward and forward in the water, and are furnished with suckers or mouths armed with filamentous, beak-like processes.

Dr. Boader of Prague had an opportunity of observing one of these animals alive in the water, and he gives the following account of what he saw: "A portion of the stem contracted, and became of a strong purple colour, so as to have the appearance of a ligature round it; this apparent ligature, or zone, moved upwards and downwards successively through the whole length of the stem, as well the feathered as the naked part; it began at the bottom, and ascended as b-fore; but as it ascended, the body of the feathered or plumated part, it became paler." When this zone is much constricted, the trunk above it swells, and acquires the form of an onion; the constriction of the trunk gives the colour to the zone, for the intermediate parts are paler in proportion as the zone becomes deeper.

The end of the naked trunk is sometimes curved like a hook; and at its extremity is a smooth, or a sputum, or a thin skin, which grows deeper while the purple zone moves upward, and shallower as it is coming down. The fins have four motions, upward and downward, and backward and forward, from right to left, and
from left to right. The fleshy filaments, or claws, more in all direct one, and to a cylindrical part from which the proceed are sometimes protruded from the fins, and sometimes hidden with them.

Upon dissecting this animal the following phenomena were discovered: When the trunk was opened lengthwise, a softish liquid flowed out of it, as liquid as to hang down an inch. The whole trunk of the steen was found to be hollow, the outward membrane being very strong, and about the tenth part of an inch thick; within this membrane appeared another much thinner; and between these two membranes, in the pinnated part of the trunk, innumerable little yellowish eggs, about the size of a white poppy-seed, were seen floating in a whitish liquid; three parts of the cavity within the inner membrane is filled by a kind of yellowish bone; this bone is about two inches and a half long, and one twentieth of an inch thick; in the middle it is square, but towards the ends it grows round and very taper, that end being the more next to the pinnated part of the trunk. This bone is covered in its whole length with a clear yellowish skin, which at each end is brought out into a large round knob; one is inserted in the top of the pinnated trunk, and the other in the top of the naked trunk; by the help of the penisagma the end of the bone is either bent into an arch, or disposed in any other manner. The fins are composed of two skins; the outward one is strong and leathery, and covered over with an infinite number of crimson streaks; the inner skin is thin and transparent; the suckers are also in the same manner composed of two skins, but the outward skin is something softer. Both the fins and suckers are isosceles, so that the cavity of the suckers may communicate with those of the fins, as the cavity of the fins does with that of the trunk. Dr. Shaw, in the History of Algiers, says, that these animals are so luminous in the water, that in the night the fishermen discover islands swimming about in the depths of the deep sea by the light they give. From this extraordinary quality, Linnaeus calls this species of the scarpena penulata phosphorescent, and remarks, after giving the synonyms of other authors, habitat in ochtano fandian illumines.

There are other kinds of seas-pen, or species of this animal, which have not a resemblance to a pen.

PENNY, formerly a silver, but now a copper coin.

The penny was the first silver coin struck in England by our Saxon ancestors, being the 210th part of their pound, and its true weight was about 232 grains Troy.

In Etheldred’s time, the penny was the 20th part of the Troy ounce, and equal in weight to our threepence; which value it retained till the time of Edward the Third.

Till the time of king Edward the First, the penny was struck with a cross so deeply sunk in it, that it might, on occasion, be easily broken, and parted into two halves, these called halfpence; or into four, thence called fourthings, or farthings. But that prince coined it without the cross; instead of which he struck round halfpence and farthings; though there are said to be instances of such round halfpence having been made in the reign of Henry the First, if not also in those of the two Williams.

Edward the First also reduced the weight of the penny to a standard; ordering that it should weigh 32 grains of wheat, taken out of the middle of the ear. This penny was cut in the same way as that of the 32nd part; by the 5th of Edward the Seventh, it was diminished to the 20th part of the Troy ounce, by his command the 32nd part was cut out of it; by the 5th of the 4th of Edward the Eighth, and afterwards the 4th; but by the 2nd of Elizabeth, the penny was reduced to the 20th part of the Troy ounce, and its weight was fixed by an act of parliament, which is still in force.

PENNY-WEIGHT, a Troy weight, being the 20th part of an ounce, containing 24 grains, used in the United States, and the English colonies. The grains are also divided into ten or twenty of the most common proportions, by which divisions the sliders are to be fixed.

The construction of one of the sliders is shewn in fig. 3; where M is a piece of brass, to one corner of which a tube B was soldered, having an opening of the same width as the bar is cut in this, and a cover N is screwed on with two screws; this cover has a screw with a mill-head through it, by which the slider is fixed. A piece of brass C is soldered to the bar, between the bar and the under side of the cover, and whose elasticity prevents the slider moving too freely when the screw is slack, and defends the bar from being scratched by the ends of the screw as it is fixed.

Fig. 6, describes the method of making the joints of the rods: P is the end of one bar, which has a steel spindle s screwed fast to it; the other bar o has a cock c, screwed on, whose upper end is coped with a brass circle ABCDE; this is, the square of the side DE, is equal to the sum of the squares of the sides AB and AC.

The area of a pentagon, like that of any other polygon, may be obtained by resolving it into triangles. See the articles Triangle and Polygon.

Pappus has also demonstrated, that twelve regular pentagons contain more than twenty grains of wheat in their circle.

The dodacohedron, which is the fourth regular solid, consists of twelve pentagons.

In fortification, pentagon denotes a fort having five sides.

PENTAGRAM, or Parallelogram, an instrument whereby design is of any kind may be copied in what proportion you please, without being skilled in drawing.

A pentagram is composed of 4 bars, A B C D, Plate Pedometre, &c. fig. 4, usually of brass; the bar A is jointed to B at b about his middle, and at a it is connected with E; the bar B is the same length as A; and at d it is jointed to the bar D, whose end is connected with the end of E; these form two parallelograms; thus, da = D, and db = E.

To the other end of the bar A, a tube F is soldered, through which a pointed brass rod e, which has the same length as the tube, B has a slider G upon it, which has a tube similar to F; another slider I of the same kind is mounted on the bar D. These sliders have screws, by which they can be fixed at any distance. Under each of the joints of the base, a small tube is fixed, in the bottom of which is a small castor as H, which makes the instrument run easily on the table. When the instrument is used, the two sliders GI must be set exactly in a line with the tube F; when it is required to make a copy of a drawing of the same size, the sliders must be set so that from F to I is the same distance as from I to G; the tube I must then have a wire put through it, whose lowest end is fast screwed to a heavy leaden weight, L; this must have three sharp points in the under side, so that when it is set on the table it may not be liable to move. A paper or drawing is laid under the tube F, and the point of the tracer drawn over the lines of it, the point of the pencil at G will describe a similar figure. If the drawing is to be reduced to half-size, one-tenth must be put to the slider G, and the pencil into I, without moving either slider; then the distance from the tracer to the fixed point or weight L, is twice the distance of the pencil to the slider GI. The same process is to be followed for setting the sliders for any proportion is, as the distance between the tracer e and the fixed point I, is to the distance between the pencil G and the slider e, so is the length of any line described by the tracer to the length of the tube line at the same time described by the pencil. To avoid the trouble of measuring these distances each time, the bars B and D are divided into ten or twenty of the most common proportions, by which divisions the sliders are to be fixed.

The construction of one of the sliders is shewn in fig. 3; where M is a piece of brass, to one corner of which a tube B was soldered, having an opening of the same width as the bar is cut in this, and a cover N is screwed on with two screws; this cover has a screw with a mill-head through it, by which the slider is fixed. A piece of brass C is soldered to the bar, between the bar and the under side of the cover, and whose elasticity prevents the slider moving too freely when the screw is slack, and defends the bar from being scratched by the ends of the screw as it is fixed.

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PENTAPETES, a genus of the dicotyledonous order, in the monandria class of plants, and in the natural method ranking under the 37th order, columniferae. The calyx is five-leafed; it has either five petals or none; the capsule is five-pointed and quinquelocular. There is one species.

PENTSTEMON, a genus of the dicotyledonous class and order. The calyx is five-leafed; there are either five petals or none; the capsule is five-pointed and quinquelocular. There is one species.

PERAMBULATOR, in astronomy, a partial shade observed between the perfect shadow and the full light in an eclipse.

When any distance is to be measured by this machine, the operator takes hold of the wheel, and wheels it along in as straight a line as he can. The circumference of the wheel being thirty-six inches (or half a pole), and the two wheels in the piece being equal, the screw d (fig. 2) will turn once in each turn of the great wheel, or twice for every pole the machine is wheeled. This screw then bore a plate h, which is laid on the machine at the present day. The axis of the wheel a, turning once for twenty-four turns of the great wheel, makes the wheel g require for each revolution eighty turns of the great wheel, or for the machine to be wheeled ten chains (or turns of the short hand) $= 40$ poles (as the circle of its hand is divided) $= 1$ furlong; and at each revolution of this wheel, the hammer m will strike the bell k. The pinion of eight on the arrow of the wheel k is, working on the wheel, and its turns K of seventy-two; the result of which will be, that the hand on the spindle of $k$ will require for each revolution 7680 turns of the great wheel; or for the machine to be wheeled $3840$ poles = $900$ chains or turns of the short hand, $= 96$ furlongs or turns of the hand F and strokes on the bell, $= 12$ miles as the dial is divided.

The use of this instrument is obvious from its construction. Its proper office is in the surveying of roads and large distances, where a great deal of expedition, and not much accuracy, is required. It is evident, that driving it along, and observing the hands, has the same effect as dragging the chain, and taking account of the chains and links.

Its advantages are, its handiness and expedition; its contrivance is such, that it may be fitted to the wheel of a coach, and by a slight effort it performs its office, and measures the road without any trouble.

PERCA, Perch, a genus of fishes of the order thalacii; the generic character is, teeth sharp, incurved; gill-coverings trivittilous, scaly, serrated; dorsal fin spiny on the fore part; scales (in most species) hard and rough.

1. Perca flavescens, common perch. The perch is an inhabitant of clear rivers and lakes throughout almost all parts of Europe, arriving sometimes to a very large size, and to the weight of eight, nine, or ten pounds; its general size, however, is far smaller, usually measuring from four to six inches in length, and weighing from two to four pounds. The colour of the perch is brownish-olive, sometimes accompanied by a slight tinge of purple on the sides, and commonly marked by five or six more or less moderately broad, blackish, transverse, semilunar bands; the dorsal fin is of a pale violet-brown, marked at the back of the spiny part by a roundish black spot accompanied by a smaller one; the rest of the fins, with the tail, are red.

The perch usually spawns in the early part of the spring, depositing in a kind of elongated bands of gluten, throughout which are disposed the eggs in a sort of reticular direction. It is of a gregarious disposition, and is found of frequenting deep holes in rivers which flow with a gentle current; it is extremely voracious, and bites eagerly at a bait; it is tenacious of life, and may be carried to the distance of sixty miles without strain, and yet survive the journey. It is one of those fishes which were held in repute at the tables of the antient Romans, and is in general esteem at the present day, being considered as firm and delicate. In some of the northern regions a species of isinglass is prepared from the skin.

2. Perca luciopeca, sande perch. General length from one to two feet, but said to arrive to arrive to a shape longer than in the preceding species, having something of the habit of a pike, the head being rather produced, and the mouth furnished with large teeth; general colour silver-grey, deepest on the back, and with a purplish tinge of blue on the head and gill-covers; sides of the back marked by pretty numerous, slightly dentate, blackish bands; dorsal fin, operculae, and pectoral fins, bluish-black. Native of clear rivers and lakes in the middle parts of Europe, and highly esteemed for the table; in general manners said to resemble the common perch, but to be far less tenacious of life.

3. Perca cernua, ruffe perch. Length about six inches; shape more slender than that of the common perch; head rather large, and somewhat flattened; teeth small; colour subniveous, with numerous dusky spots disposed over the body, dorsal, pectoral fins, and tail; abdomen white; native of many parts of Europe; chiefly frequenting clear rivers, assembling in large shoals, and keeping in the deepest part of the water. There are about forty species of this genus. See Plate Nat. Hist. figs. 323, 324.

PERCH, in land-measuring, a rod or pole of 10 feet in length, of which 40 in length, and 4 in breadth make an acre of ground. But, by the customs of several counties, there is a difference in this measure. In Staffordshire it is 24 feet; and in the forest of Sherwood 25 feet, the foot being there 18 inches long; and in Herefordshire a perch of ditching is 21 feet, the perch measuring 101 feet, and a pole of denshified ground is 12 feet, &c.

PERCUSSION, in mechanics, the impression
Percussion is either a force or a stroke, when the impulse is given in a line perpendicular to the point of contact; and oblique, when it is given in a line oblique to the point of contact.

The ratio which an oblique stroke bears to a perpendicular one, is as the sine of the angle of incidence to the radius. Thus, let ab (Plate Miscel. fig. 183) be the side of any body on which the force falls, with the direction da; draw de at right angles to db, a perpendicular let fall from d to the body to be moved, and make ad the radius of a circle; it is plain that the oblique force da, by the laws of composition or resolution, will be resolved into the two forces dc and db; of which de, being parallel to ab, has no energy or force to move that body; and consequently db expresses all the power of the stroke or shock on the body to be moved. But db is the right sine of the angle of incidence dab; wherefore the oblique force da, to one falling perpendicularly, is as the sine of the angle of incidence to the radius.

Percussion is the action of the mass or quantity of motion, or of the momentum, or quantity of motion multiplied by the velocity, represented by the product arising from the mass or quantity of matter moved, multiplied by the velocity of its motion; and that without any regard to the time or duration of action; for its action is considered totally independent of time, or but as for an instant, or an infinitely small time.

This consideration will enable us to resolve a question which has been greatly canvassed among philosophers and mathematicians, viz. what is the relation between the force of percussion and mere pressure or weight? For they consider, that the former force is infinitely, or incalculably, or in any other term, than the latter. For, let M denote any mass, body, or weight, having no motion or velocity, but simply its pressure; then will that pressure or force be denoted by M itself, if it is considered as acting for some certain finite assignable time; but, considered as a force of percussion, that is, as acting but for an infinitely small time, its velocity being 0, or nothing, its percussive force will be 0xM, that is 0, or nothing; and is therefore less than any the smallest percussive force whatever. Again, let us consider the two forces, viz. of percussion and pressure, with respect to the effects they produce; with respect to the intensity of any force is very well measured and estimated by the effect it produces in a given time; but the effect of the pressure M, in 0 time, or an infinitely small time, is nothing at all; that is, it will not, in an infinitely small time, produce, for example, any motion; either in itself, or in any other body; its intensity, therefore, as its effect, is infinitely less than any the that force of percussion. It is true, indeed, that we see motion and other considerable effects produced by mere pressure, and to counter-

act which it will require the opposition of some considerable percussive force; but then it must be observed, that the former has been an infinitely longer time in producing its effect; and it is no wonder in mathematics that an infinite number of infinitely small quantities makes up a finite one. It has therefore only been for want of considering the circumstances when and where any question could have arisen on this head. Hence the two forces are related to each other, only as a surface to a solid or body; by the angle of the surface through an infinite number of points, or through a finite right line, a solid or body is generated; and by the action of the pressure for an infinite number of moments, or for some finite time, a quantity equal to a given weight, or force is generated; but the surface itself is infinitely less than any solid, and the pressure infinitely less than any percussive force.

This point may be easily illustrated by some familiar instances. If a blow of a mallet, upon the head of a nail, will drive the nail into a board; when, if we wish to conceive any weight so great as will produce a like effect, i.e. that will sink the nail as far into the board, at least unless it is left to act for a very considerable time; and even after the greatest weight has been applied, as a pressure on the head of the nail, and has sunk it as far as it can as to sense, by remaining for a long time there without producing any sensible further motion, the weight being removed from the head of the nail, and instead of it, let it be struck a small blow with a hammer, and the nail will immediately sink farther into the wood. Again, it is also well known, that a sufficient weight, will drive a wedge in below the greatest ship whatever, lying aground, and so overcome her weight, and lift her up. Lastly, let us consider a man with a club to strike a small ball, upon which, at a certain distance, another ball, we may suppose, has been thrown; and let it travel to the same, or nearly the same place, in the same time, it being supposed that it is uniform, and that there is no friction. If this be the case, the first will be struck off by the second, and in the same instant, and in the same place.

The laws of percussion therefore to be considered, are of two kinds: those for elastic, and those for non-elastic bodies.

The only general principle for determining the motions of the bodies by percussion, and which belongs equally to both the sorts of bodies, i.e. both the elastic and non-elastic, is this: viz. that there exists in the bodies the same general law of motion, estimated in any of the same direction, both before and after the shock. And this principle is the immediate result of the third law of motion or, that reaction is equal to action, and in a contrary direction; from whence it happens, that whatever motion is communicated to one body by the action of another, exactly the same motion does this latter lose in the same direction, or rest at all, the same does the former communicate to the latter in the contrary direction.

From this general principle too it results, that no alteration takes place in the common centre of gravity of bodies by their actions upon another; but that the same common centre of gravity perseveres in the same state, whether of rest or of uniform motion, both before and after the shock of bodies.

Now, from either of these two laws, viz. that of the preservation of the same quantity of motion, in one and the same direction, and that of the preservation of the same state of the centre of gravity both before and after the shock, all the circumstances of the motions of both the kinds of bodies after collision may be made out; in conjunction with their own peculiar and separate constitutions, namely, that of the one sort being elastic, and the other non-elastic.

The effects of these different constitutions, here alluded to, are these: that non-elastic bodies, on their shock, will adhere together, and either remain at rest, or else move together as one mass with a common velocity; or if elastic, they will separate after the shock, with the very same relative velocity with which they met and shocked. The former of these consequences is evident, viz. that non-elastic bodies keep together as one mass after they meet; because there exists no power to separate them, and without a cause there can be none. And the latter consequences results immediately from the very definition and essence of elasticity itself, being a power always equal to the force of compression or shock; and which restoring force therefore, acting the contrary way, will generate the same relative velocity between the bodies, or the same quantity of motion, as before the shock, and the same motion also of their common centre of gravity.

To apply now the general principle to the determination of the motions of bodies after their shock: let Bb and Dd be two bodies, and V and v their respective velocities, either before or after the direction AD; which quantities V and v will be both positive if the bodies both move towards D, but one of them negative if the other is negative, if the body D moves towards A, and v will be = 0 if the body D is at rest. Hence then the difference between the velocities of the bodies is Vv, just as much as the difference between the two forces Dv and Vd, which was the whole quantity of motion in the direction AD, and which momentum must also be preserved after the shock.
PERENNIAL, in botany, is applied to those plants whose roots will abide many years, whether they retain their leaves in winter or not; those which retain their leaves are called evergreens; but such as cast their leaves, are called deciduous.

PERGALEA, a genus of the pentandria digyna order, in the angiospermous flowers. Contorted nectaries, surrounding the genitacles with five-sagittate cups; corolla subvalved. There are five species, twining plants of the Cape, &c.

PERICARP. See Anatomy.

PERICARPUS, among botanists, a covering or case for the seeds of plants. See Botany.

PERICHORON. See Anatomy.

PERILLOCHIUM. See PERILOCHIUM.

PERIPERIQUE. See Astrolony.

PERIPERMEN. See Anatomy.

PERIUR. See Astronomy.

PERILUS, a genus of the class and order didynamia gymnosperma. The calyx uppermost; segment very short; stamens distinct; styles two, connected. There is one species, an annual of the East Indies.

PERIMETER, in geometry, the bound or limit of a body. The perimeters of surfaces or figures are lines, those of bodies are surfaces. In circular figures, instead of perimeter, we say circumference, or periphery, class and order.

PERLINUM, or PERINEUM. See Anatomy.

PERIOD, in astronomy, the time taken up by a star or planet in making a revolution round the sun, or the duration of its course till it returns to the same point of its orbit. See Astronomy.

PERIOD. See Chronology.

PERIOD, in grammar, denotes a small compass of discourse, containing a perfect sentence, and distinguished at the end by a point, or full stop, thus (.) and its members or divisions marked by commas, colons, &c.

PERIODIC. See Geography.

PERIODOSTEUM. See Anatomy.

PERIPIRY, in geometry, the circumference of a circle, ellipse, or any other regular curvilinear figure. See Circle, &c.

PERITONIC sulfur, a genus of the digyna order, in the pentandria class of plants; and in the natural method ranking under the 30th order, contorta. The necrarium surrounds the genitacles, and sends out five filaments. There are 12 species, some of which are natives of warm climates: one, however, is sufficiently hardy for this climate. The periploca is a climbing plant, that will wind itself with its ligaceous branches about whatever tree, hedge, pale, or pole, is near it, and will arise, by the assistance of such support, to the height of above 30 feet; and where no tree or support is at hand to wind about, it will kindle and entangle itself together in a most complicated manner. The flowers of these branches, which are most woody, are covered with a dark-brown bark, whilst the younger shoots are more mottled with the old; the flower-buds of brown and grey, and the ends of the youngest shoots are often of a light green. The leaves are the greatest ornament to this plant, for they are large, and of a shining appearance on their upper surface, and cause a variety by exhibiting their under surface of a hoary cast. Their figure is oblong, or rather more inclined to the shape of a spear, as their ends are pointed, and they stand opposite, by pairs, on short footstalks.

PERM, in botany, is applied to those plants whose roots will abide many years, whether they retain their leaves in winter or not; those which retain their leaves are called evergreens; but such as cast their leaves, are called deciduous.

PERINEUM, or PERINEUM. See Anatomy.

PERIOD, in botany, is applied to those plants whose roots will abide many years, whether they retain their leaves in winter or not; those which retain their leaves are called evergreens; but such as cast their leaves, are called deciduous.
These are the number of years purchase to be given for a perpetual annuity, on the sup-
position that it is receivable yearly; but as annuities are payable only at the end of each
able half-yearly, and the interest of money is likewise usually paid half-yearly, the per-
petuity under these circumstances will be greater or less than the above, as the periods
at which the annuity and interest occur are ordered more or less frequent than those at which the rate
of interest is supposed payable. Example at 4
per cent. interest:

<table>
<thead>
<tr>
<th>Interest</th>
<th>Annuity payable</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yearly</td>
<td>$25,000.00</td>
</tr>
<tr>
<td>Yearly</td>
<td>$25,475.38</td>
</tr>
<tr>
<td>Yearly</td>
<td>$25,845.20</td>
</tr>
<tr>
<td>Yearly</td>
<td>$25,979.61</td>
</tr>
</tbody>
</table>

A perpetuity is, where all that have
interest join in the conveyance, yet they cannot
be bar or pass the estate; for, if by concurre-
ence of all having interest, the estate may be bar-
red, it is no perpetuity. 1 Chan. Ca. 213.

PERCEPTION, in grammar, a term applied to
such nouns or pronouns, as being either pre-
or understood, are the nominatives in all
infections of a verb; or it is the agent or
patient in all finite and personal verbs.

PERSONAL GOODS. See Chattels. PER-
SONATE, is the representing a person
by a fictitious or assumed character, so as
to pass for the person so described. Person-
ating bail, is by stat. 21 Jac. i. c. 26, a
capital felony. By various other statutes, per-
sonating seamen entitled to wages, price,
mony, &c. are made persons.

PERSONIA, a genus of the class and
order tetrads: monogony. There is no
calix; petals four; glands four, at the base
of the germ; stigma blunt; drupe one-
seed.

PERSPECTIVE, is the art of drawing the
picture or representation of any visible ob-
ject on a plane surface, in such manner as it
should appear on some transparent surface,
terposed between the object and the eye of
an observer. Hence it is the foundation of
ting painting, and is so far necessary in reg-
gulating the practical designs of an artist, that,
without a knowledge of the principles thereof,
he works at random, in not keeping to the
nicety of measures and proportions. It has
greatness for its foundation, and, consequently,
its true perfection. It consists in determin-
ing all the points in a picture, which points connected,
produce lines, and lines (straight and cur-
vilinear) constitute the first principles of a
projected picture, or the grand outline and structure which
the picture is to dress and shade. Hence it is perceivable that the mathematician
directs the outlines, but does not finish the
piece; and, on the other hand, the painter
cannot make a sure beginning without the
mathematician’s rules.

We do not mean to say that these rules are
to be applied to the minute inflections or
curvatures of every leafy subject of a land-
scape, or to all the smaller hollows and pro-
minences of objects, or the muscular round-
ness and softness of living creatures; for these,
as well as some other of the minutiae of art,
are to be determined by the eye, and drawn
by a steady hand. A landscape-painter may
study nature in the innmost recesses of a forest,
and there store his mind with models of trees,
shrubbery, and foliage, and by such means he
may become qualified to make a random pic-
ture of an individual shrub, or a group of
trees; but if he would go further and rep-
resent a true proportion of an avenue of these
subjects, he must study the perspective di-
rections of that avenue, and where it is to be
planted, and so on as well as their relative positions, or his proposed
picture will become an amorphous. He
may give a tolerable direct view of one side
of a building, but he cannot do more; if he
would give the representation of more than
one side he must have recourse to the prin-
ciples of perspective.

The practical rules of perspective are in
great measure applied to the delineation of
architectural bodies, and other right-lined
figures; and a knowledge of the general laws
of this science is to some extent necessary to
the judgment of the manner in which lines shall run, where
they should tend, and where termi-
minate, so as to produce the desired effect.

Perspective is employed both in representing
the ichnographies and the scenographies
of objects; and the former is frequently
found to be a necessary foundation of the
latter.

We mean not to enter into an elaborate
history of perspective, and say who it was that
first discovered the properties of lines, which,
when posited in certain order, would aid the
representation of solid bodies, but rather pro-
cede immediately to the practical (with
the premises that all the practical geometry ne-
cessary in this art has been elucidated in our
preceding volume under that head, to which
we refer the student.

The drawing-board, covered with a sheet of
paper, may be termed the perspective plane,
whereon the objects are to be delineat-
ed. See Plane Perspective, fig. 1.

Parallel to the bottom of this plane let a
pencil-line be drawn, mark it AB, and call it
the ground-line.

At about a third part, or somewhat more,
of the height of the intended picture, or prin-
cipal figure in the picture, draw (with the
help of a T square) a pencil-line parallel to the
ground-line, mark it NO, and call it the
horizontal line.

The height of this line will be variable, as the ground on which the ob-
server stands may be higher or lower from the
base of the principal figure; but, in general,
when the draughtsman can choose his station,
the height we have prescribed will be found
the most convenient.

On that part of the ground-line which the
eye is supposed opposite to in drawing
any picture, draw another pencil-line perpen-
dicular thereto, as at C, crossing the horizontal
line at D. This point D is called the point
of sight, being the spot immediately opposite
to, both in lateral and perpendicular
position.

The ground-line, and its perpendicular, may
be divided into scales of equal parts, whereof
CD may be supposed five feet, the height of
the eye.

The distance of the eye from the principal
object must be set off in the horizontal line,
both ways from the point of sight D. The
choosing a proper distance is so essential a
requirement, that, without a due observance
thereof, a faithful representation of a pic-
turesque object cannot be attained.

The most favourable point of distance seems
to be that which is a meana between the dia-
gonals of an upper quarter of the picture
(AD), and the perpendicular, as at G, and
the mean of the distance will be equal to
GZ, which will be somewhat about four
times the height of the eye. This dis-
}ance must be set off on the horizontal line

3 12
PERSPECTIVE.

also, as before mentioned, on one or both sides of the point of sight.

These requisites being laid down on the drawing-board, we may proceed to examine the rules of finding the true positions of points and lines on the picture, from their ichnography, drawn out of, and below, the base line.

Suppose the pentagon ABCDE (fig. 2) were to be placed so as to occupy the rules of the perspective on the transparent plane VP, placed perpendicularly on the horizontal plane HR; dotted lines are imagined to pass from the eye E to each point of the pentagon, as CA, CB, CD, &c., which are supposed in their passage through the plane VP, to leave their traces or vestigia in the points a, b, d, &c. on the plane, and thereby to delineate the pentagon abde, which, as it strikes the eye by the same rays that the original pentagon ABCDE does, will be a true perspective representation of it.

The business of perspective, therefore, is to lay down geometrical rules for finding the points of the plane, and the picture, as well as for the true parts or vestigia of objects.

Thus, we have a mechanical method of delineating any object very accurately.

Perspective is either employed in representing the ichnographies, or ground-plots of objects, for the purpose of being true representations of the objects themselves.

But before we give any examples of either, it will be proper to explain some general terms used in this science, and, first, the horizontal line is that supposed to be drawn parallel to the horizon through the eye of the spectator; or rather it is a line which separates the heaven from the earth, and is therefore the representation of the lower limit of terrestrial objects.

Thus, A, B, C, fig. 3, are two pillars below the horizontal line CD, by reason the eye is elevated above them; in fig. 4, they are said to be equal with it; and in fig. 5, raised above it. Thus, according to the different points in view, the objects will be either higher or lower than the horizontal line.

The point of sight, A, fig. 6, is that which makes the central ray on the horizontal line; or, it is the point which is in a line perpendicular with the horizon, or horizontal line; EE is the absciss of the square, of which D, D, are the sides, F, F, the diagonal lines, which go to the points of distance C, C.

Accidental points, are those where the objects end: these may be cut negligently, because neither drawn to the point of sight, nor to those of distance, but meeting each other in the horizontal line. For example, two pieces of square timber, G and H, fig. 7, make the points L, I, J, on the horizontal line; but go not to the point of sight K, nor to the points of distance C, C; these accidental points serve likewise for cases, doors, windows, tables, chairs, &c.

The line of direct view, or of the front, is when we have the object directly before us; in which case, it shews only the foreside; and, if below the horizon, a little of the top, but nothing of the under side, unless the object be polygonous.

The point of oblique view, is when we see an object aside of us, and as it were aslant, or with the corner of the eye; the eye, however, being all the while opposite to the point of sight, in which case, we see the object laterally, and it presents to us two sides or faces. The practice is the same in the side-points, as in the front-points; a point of sight, points of distance, &c. being laid down in the same manner.

We shall now give some examples, by which it will appear that the whole practice of perspective is built upon the foundation already laid down. Thus, to find the perspective representation of the line ABCDE, we have to draw SE, the line perpendicular to the plane of the paper, 8, between the eye and the triangle draw the line DE, which is called the fundamental line; from D draw 2 V, representing the perpendicular distance of the eye above the fundamental line, be it what it will; and through V draw, at right angles to 2 V, HH parallel to DE: then will the plane DHH represent the transparent plane, on which the perspective representation is to be made. Next, to find the perspective points of the angles of the triangle, let fall perpendiculars A, C, F, B3, from the angles to the fundamental DE: set off these perpendiculars upon the fundamental line, and you will have the points of distance, C, C, from 1, 2, draw lines parallel to the principal point V; and from the points A, B, and C, on the fundamental line, draw the right lines A, B, C, which is called the spectator’s line, to be so far removed from the figure or painting, as it is distant from the principal point V.

The points a, b, d, &c. where the visual lines V, V1, V2, V3 intersect the lines of distance AC, AB, CD, will give the appearance of the objects as seen by the spectator, by which means several commodious methods will occur to every artist. Again, if the scenographic appearance of any solid was to be represented, suppose of a triangular prism, whose base is the triangle mum, fig. 6, you need only find the upper surface of it, in the same manner as you found the lower, or base; and then joining the corresponding points by right lines, you will have the points of distance, which is the solid in perspective. So that the work is the same as before; only you take a new fundamental line, as much higher than the former, as is the altitude of that solid whose scenographic appearance is to be represented.

But there is still a more commodious way, which is this: having found, as above, the base or ichnographic plane mum, let perpendiculars be erected to the fundamental line from the three angular points, which will express the altitudes of those points. But because these altitudes, though equal in the body or solid itself, will appear unequal in the scenographic view, the farther from appearing less than those nearer the eye, their true proportions may be thus determined. Any where in the fundamental line, let AB be erected perpendicular, and equal to the true altitudes of the different altitudes, let them be transferred into the perpendicular AB; and from the points A and B, and from all the points of intermediate altitudes, if there are any, draw right lines parallel to the principal point V; these parallels, &c. will constitute a triangle with AB, within which all the points of altitude will be contained. Through the points a, b, &c. erect perpendiculars to those parallels; and the points where they intersect the lines AV, BV, as in a, b, c, &c. will determine the apparent height of the solid in that scenographic position to the eye.

Parallel perspective is where the picture is supposed to be so situated, as to be parallel to the side of the principal object in the picture, as a building for instance. Then the lines on those sides of the building that are parallel to each other, continue parallel on the picture, and do not vanish into any point; while the lines at right angles to the former, vanish into the centre of the picture. This will be exemplified in fig. 10.

The picture being supposed to stand parallel to the side of the house AICD, the lines AB, DC, which in nature are parallel to each, must be made parallel in the perspective representation. But the lines BE, CF, which in nature are at right angles to AB and DC, and consequently also to the picture, tend towards a point; and this point G, towards which they tend, is the centre of the picture.

Oblique perspective, is when the plane of the picture is supposed to be at an angle to the sides of the objects represented, in which case the representations of the lines upon those sides will not be parallel among themselves, but will tend towards their vanishing point, which is the point of perspective.

A bird’s eye view, is a view supposed to be taken in the air, looking down upon the object, and differs from the usual way of drawing perspective views, in supposing the horizontal line to be raised much higher.

When an object is to be drawn in perspective, its parts must be measured, so that we may be able to lay them down from a scale of equal parts.

Having determined whether it is to be parallel or oblique perspective, the first thing to be drawn is the horizontal line, which is to be put parallel to the bottom of the drawing, and as high above it as the height of a man’s head, or five feet six inches, as HG, fig. 10, which is five feet six inches above the bottom of the house. Next, determine on the centre of the picture G, which must be placed so as to leave convenient room for the representation. Fix on C the nearest corner of the building, and draw CG, to the centre of the picture, CG now considers the line which represents the bottom of the end of the house; but this is an indefinite representation, of which we do not yet know the exact length. The method of determining this is as follows: Continue the line DC to L, and make CL equal to the width of the house. From G, the centre of the picture, lay off GK equal to the distance of the picture, the choosing of which must be regulated by taste. Draw IK, cutting CG in P; then CP is GF, the width of the house in perspective, which was equal to CI. To find the middle of this end of the house, you cannot divide it by your compasses, because the half farthest will appear to be above the middle CI, into two equal parts in L, and draw LK, it will cut CI into two equal parts perspectively. Or it may be found more simply thus: having drawn the lines BB and DD, to the centre of the picture, draw the diagonals EC, EF, crossing each other in M, and raise the per-
PERSPECTIVE.

To find the height of the gable, lay its actual height above BE, upon the corner line BC continued, as BO, and draw OG; this cross the perpendicular MN, gives N the point of the distance-point K.

Draw two perpendiculars, which will give the perspective width of the chimney. To obtain its thickness, lay off PQ equal to its thickness, and draw QG; then, drawing from a the line ab, you obtain the exact width of the chimney. From b draw bc, and from d draw de. The other end of the gable may be drawn by two different methods. The first is by supposing the front of the house transparent, and drawing the other end as if seen through it, in the same manner as the end we have described, by laying its width, and drawing from these points to the distance-point K. By raising the perpendicular in the middle, you will meet the ridge-line from the other gable in d. The other method is as follows: Through the centre of the picture draw a line parallel to PQ to G, and draw G from these points to the distance-point K. By raising the perpendicular in the middle, you will meet the ridge-line from the other gable in d. Then continue the line of the roof Bd till it meets ST in S. From A draw AS, which will give the other gable, and S will be the vanishing-point of the other side. If G is parallel to Bd and Ad; if NE is continued in like manner, it will give T for its vanishing-point. The doors and windows on the side ABCD are laid down from a scale, because these lines are drawn parallel to the others, and therefore does not vary from its geometrical delineation, except showing the thickness of the reveals, or edges of the doors and windows.

There being any windows in the side BEFG, they would be drawn in perspective by the same method that was used for finding the width of the house and the middle of the end, viz. by laying off the actual dimensions from point C upwards, and down wards, and perpendicular to the horizontal line. Then take the line of the roof Bd till it meets ST in S. From A draw AS, which will give the other gable, and S will be the vanishing-point of the other side. If G is parallel to Bd and Ad; if NE is continued in like manner, it will give T for its vanishing-point. The doors and windows on the side ABCD are laid down from a scale, because these lines are drawn parallel to the others, and therefore does not vary from its geometrical delineation, except showing the thickness of the reveals, or edges of the doors and windows.

This practice is further explained by the following rule:

To divide a line in perspective which is parallel to the horizon, and which tends to a vanishing-point, into any number of equal parts, or to divide it into any required proportion.

Let AB be the line going to its vanishing-point C, fig. 12; and first let it be required to divide that line into six equal parts. Let CD be parallel to AB, and AE the ground-line, drawn parallel to it. Lay off, at pleasure, CD for the distance of the picture, if C is the centre of the picture. Draw a line from D, which AB is divided: draw DBE, cutting the ground-line in E. Then AE represents the actual dimensions of the line AB, which is seen in perspective. (Here it may be observed, that this gives a rule also for finding the real length of any line which tends to a vanishing-point.) Divide AE into the same number of equal parts into which you propose to divide the given line AB; as A1, 1 2 3, &c. Then from these equal divisions draw lines to D, cutting the line AB in a, b, c, d, &c. which will represent the required number of equal parts, but diminishing in size as they are farther removed from the eye. If it is wished to divide the line AB into any number of unequal parts, or to lay off doors, windows, &c. upon it, the line AF, found as before, must be divided in the required proportion, and lines drawn from those to D will give the required points, &c. from which perpendiculars may be drawn for the doors, windows, &c.

To draw a circle in perspective.

The perspective representation of every circle is a regular ellipse, when the eye is without the circle; which may be demonstrated by considering that the rays from the circumference of the circle to the eye, form an oblique cone. But it is well known to those who are acquainted with conic sections, that every section of a cone, whether right or oblique, is a true ellipse, except in one case only, which is, when the section is taken sub-parallel to the elements, and which happens so rarely in drawings that it may be disregarded altogether, and the section of a cone, or the perspective of a circle, in all cases considered as a perfect ellipse.

The minima number of drawing an ellipse is, to draw the transverse and conjugate axes; the curve may then be completed by a transversal, or by hand. But as it is very difficult to find the transverse and conjugate axes of the ellipse, which are the perfect perspective representations of circles, recourse is generally had to another method of obtaining the curve. The circle is circumscribed by a square, as KLMN, in fig. 13, and the diagonals and the centre, and parallel to the sides, are drawn; also the lines ad, cd, are drawn parallel to the sides, through the points where the circle is cut by the diagonals; this square, with all these lines drawn across it, is now put in perspective as follows: Draw AB for the horizontal line, and fix B for the centre of the picture, and AB for the distance of the picture. Make DC equal to the diameter, and draw CB, CD; draw CA to the distance-point A, cutting off DG, equal to the depth of the circle; then draw G' parallel to DC, which completes the perspective of the circle; also draw the center, and transfer the divisions Ma, eN, and from these points x and o, draw lines to the vanishing-point B, cutting the diagonals of the square. The points in this calculated square in perspective, which correspond to those in the square KLMN, where the circle passes through, must now be observed, and a curve traced through them with a steady hand, and breadth required. Even in this process, it is of considerable use to know that the curve you are tracing is a regular ellipse: for though you cannot easily ascertain the axes exactly, yet you may very nearly find the lengths of the curves whatever body the curve which has been drawn is that of a regular ellipse or not.

Upon the same principle exactly, the row of arches, fig. 14, is drawn. The width of the arches and piers is obtained in the same manner as was shewn in fig. 12, viz. by laying their dimensions upon the ground-line AB, and drawing lines to the distance-point D. The curves of the arches are then found by drawing the lines CD, and D' run down to those in half the square, fig. 13, in the same manner as described above for the circle. Fig. 15 shows the appearance of circles drawn upon a cylinder, when HI is the horizontal line. The circle drawn on the cylinder at that place, is seen exactly edgeways, and appears only as a straight line; that next above it is seen a little underneath; the next still more; and so on, as they rise higher, and their distance from the eye increases. The transverse diameter, but whose conjugate diameters continually increase in length, as they rise above the horizontal line. On the contrary, you see the under sides of the circles drawn below the horizontal line; but they observe the same law, being so many ellipses, whose conjugate diameters vary in the same proportion. A little reflection on this subject will enable the student who draws to avoid many ridiculous mistakes which are sometimes committed; such as shewing the two ends of a cask, or the top and bottom of a cylinder, at the same time.

The method of drawing a building, or other object, in oblique perspective. AB is the horizontal line, and CD the ground-line, parallel to it as before. Here neither of the sides of the house is parallel to the picture; but each goes to its vanishing-point. To do this, extend the compasses from A to B, and draw to any point F for the centre of the picture; then, to find the other side, lay off FC equal to the distance of the other side, which, as before, depends upon taste only: draw DG, and GA perpendicular to BG; cutting the horizontal line in A, the other vanishing-point. Draw now EA for the other side. To cut off the several widths of the building, and of the house, which as yet are only drawn to an indefinite extent, two distance-points must be laid down, viz. one for each vanishing-point. To do this, extend the compasses from B to G, and lay the distance taken in it from B to H, which will give H for the distance-point of B, and which is to cut off all the divisions on the side EB. Also extend the compasses from A to F, and lay the distance of the point of A, and is used for transferring all divisions upon the side EA from the ground-line GE. These points and lines being adjusted, the process is not much different from that which goes to its points or equal divisions on each side of the building, as doors, windows, diminish as they recede in the same way as on the side BEFC, fig. 10. Lay the real length of the side EL, taken from the same scale used for laying down the horizontal line, and lay down on the ground-line, from E to G, and draw CI, cutting off EL for the perspective length of the building. For the other side of the house, lay it down in the same manner, from E to D, and draw DH, cutting off EN for the perspective width. Raise the perpendiculars EM, IK, and NO, for the three angles of the house, and lay the height of the building, which comes to the ground-line, as EM, and draw MK and MO to their several vanishing-points. Also lay all the heights of the doors and windows, and other divisions, upon EM, IK, and NO, and draw them to the vanishing-points A and B. To lay down the widths of the doors and windows, put their actual widths upon CE, and draw from them to the distance-point D. The curves of the arches are then found by drawing the lines AB, and D' run down to those in half the square, fig. 13, in the same manner as described above for the circle.
which cuts off all divisions upon the side LE, and then raise the perpendiculars. The gable-end is found exactly in the same manner as has been described, only taking care to use the proper distance, as set off from the point L, the manner of finding the width of the chimney is different. Lay off BA for the height of the chimney above the top of the gable, and draw a line parallel to the horizontal line; then put on equal to the actual thickness of the chimney. Then, and draw ad to the vanishing-point A; draw also ed to the distance-point I, cutting off ad in d: then having drawn ef from the nearest corner of the chimney, and which was found as in fig. 10, draw df to the vanishing-point B, cutting off ef for the exact proper width. Fig. 16 represents the method of finding the perspective of a circle in oblique projection. AB is the horizontal line, C the centre of the picture, and D, L, the distance-points. The process is exactly the same as that just described; the several divisions of the reticulated square in fig. 15, being laid upon the ground-line FG, and from these, lines are drawn to the different points A, B, C, D, E, and the perspective of the square is then drawn with all the lines across it, and the curve traced through the different points.

By drawing these examples frequently over, to get them ingrained upon the student, will make them familiar with their use; and as they include the cases which most frequently occur, he will necessarily find great benefit from the knowledge of them.

The practical part of perspective, is only the application of these rules to the actual description of objects. But, as this part is purely mathematical, its assistance towards drawing is alone what can be performed by the rules and compass, and can therefore strictly serve only for finding the images of points, of which they are composed; and, as these are infinite, it is endless to find them all by the strict rules; whence it becomes necessary after a sufficient number of them are found, to complete the image by the help of drawing, to the better effecting of which these points serve as a guide. Thus, when a circle is to be delineated, the practical rules serve to find a sufficient number of points in the circumference; which, being neatly joined by hand, will perfect the image, so that, in strictness, nothing in the image is found by mathematical rules, save the few particular points; the rest owes its being to the hand of the drawer.

Thus also, if any complicated figure is proposed, it may not be easy to apply the practical rules to the description of every minute part; but by inscribing that figure in a regular one, properly subdivided and reduced into perspective, that will serve as a help, whereby a person skilled in drawing, may with ease describe the object proposed. Upon the whole, where the boundaries of the proposed objects consist of straight lines and plain surfaces, they may be described directly by the strict rules; whereas, when they are curvilinear, either in their sides or surfaces, the practical rules can only serve for the description of such right-lined cases as may conveniently inclose the objects, and which will enable the designer to draw them within those known bounds with a sufficient degree of exactness.

It is therefore in vain to seek, by the practical rules of perspective, to describe all the little hollows and prominences of objects, the different light and shade of their parts, or their smaller windings and turnings; the infinite variety of the labours, of rocks, bushes, and leaves of trees, or the features and limbs of men and animals; much less to give them that roundness and softness, that force and spirit, that easiness and freedom of posture, that expression and force, which are requisite to a good picture. Perspective must content itself with its peculiar province of exhibiting a kind of rough draught to serve as a groundwork, and to describe a general proportion and places of the objects, according to their supposed situations; leaving the rest to be finished, beautified, and ornamented, by a hand skilful in drawing.

It is true, perspective is of most use where it is most wanted, and where a deviation from its rules would be the most observable; as in describing all regular figures, pieces of architecture, and other objects of that sort, where the particular tendency of the rules is most remarkable; the rule and compass in such cases being more much exact than any description made by hand; but still the figure, described by the perspective rules, will need many helpings and additions of a hand, and its other ornaments of pillars, and their entablatures, the strength of light and shade, the apparent roundness and protuberance of the several parts, nay, even the atmosphere, finishing to the designer's hand; but, with a regard to such objects as have no constant and certain determinate shape or size, such as clouds, hills, trees, rivers, uneven grounds, and the like, a much larger latitude allowable, provided the designer, bulk, or usual natural shape of those objects, are in some measure observed, so as not to make them appear unnatural or monstrous. See Drawing.

But, although the strict practical rules of perspective are in a great measure confined to the description of right-lined figures, yet the known general laws of that science is of great and necessary use to inform the judgment, after what manner the images of any proposed lines should run, which way they should tend, and where terminate; and thereby to give it the better to determine what appearance any objects ought to put on, according to their different situations and distances; it accustoms the eye to judge with greater certainty of the relations between real objects and their perspective descriptions, and the hand to draw the same accordingly, and directs the judgment readily to discover any considerable error therein which might otherwise escape notice. Besides that, when the ground, or general plan, and the principal parts of a picture, are first laid down according to the rules, every thing else will more naturally fall in with them, and every remarkable deviation from the just rules will be the more readily perceived, and the easier avoided or rectified; so that although it may be infinitely tedious or absolutely impracticable, to describe every minute part of a picture by the mechanical rules, yet that employing them, where they can be the most commodiously used, will give the picture in general such a look, as will guide the artist in drawing the other parts without any obvious incosistency.

We shall, therefore, give such rules as are of most general use in the practice of perspective. 1. Let every line which in the object or geometrical figure is straight, perpendicular or parallel to its base, be drawn orthographically from the visual point. 2. Let the straight lines, which in the object return at right angles from the fore-side right, be drawn scenographically from the visual point. 3. Let all straight lines, which in the object return at right angles from the back, be drawn orthographically from the visual point. 4. Let the object you intend to delineate, standing on your right hand, be placed also on the right hand of the visual point; and that on the left hand, on the left hand of the visual point, and that which is just before, in the middle of it. 5. Let those lines which are (in the object) equidistant to the returning line, be drawn in the scenographic figure, from that point found in the horizon. 6. In setting off the altitude of columns, pedastals, and the like, measure the height from the base-line upward, in the front or fore-right side; and a visual ray down to the perpendicular in each case, unless the altitude of the column or pillar, all the way behind the fore-right side, or orthographic appearance, even to the visual point. This rule you must observe in all figures, as well where there is any columns, pillars, as where there is none. 7. In delineating ovals, circles, arches, cresces, spirals, and cross arches, or any other figure in the roof of any room, first draw it scenographically; and so with perpendiculars from the most eminent part; whereby, carry it up to the ceiling; from which several points carry on the figure. 8. The centre in any scenographic regular figure, is found by drawing cross lines from opposite angles; for the point where the cross lines or lines, as the case may be, is the centre. 9. A ground-plane of squares is alike, both above and below the horizontal line; only the more it is distant above or beneath the eye, the smaller will be the squares. 10. In drawing a perspective figure, where many lines come together, you may, for the directing of your eye, draw the diagonals in red; the visual lines in black; and those which are the most perpendicular, and with the different colour from that which you intend the figure shall be of. 11. Having considered the height, distance, and position of the figure, and drawn the perspectives, with side or angle against the base, raise perpendiculars from the several angles or designed points, from the figure to the base; and transfer the length of each perpendicular, from the place where it touches the base, to the base on the side opposite to the point of distance; so will the diameters drawn to the perpendiculars in the base, by intersection with the transferred distances, give the angles of the figures, and so lines drawn from point to point will circumscribe the scenographic figure. 12. If in a landscape there are any standing waters, as rivers, ponds, and the like, place the horizon level line with the farthest sight or appearance, or where there are any houses, or the like, in the picture, consider their position, that you may find from what point in the horizontal lines to draw the front of the same. 13. In describing things at a great distance, observe the proportion both in magnitude and distance, in draught, which appears from the object to the eye. 14. In colouring and shadowing of every thing, you must do the same in your picture,
which you observe with your eye, especially in objects lying near, but, according as the distance grows greater and greater, so the colours must be hither and hither, till at last they lose themselves in a darkish sky-colour. 10. The caterpillars are best seen in a looking-glass, or other polished matter, where, if the glass is exactly flat, the object is exactly its original; but, if the glass is not flat, the object is from the original; and that more or less, according as the glass differs from an exact plane. 11. In drawing catoptric figures, the surface of the glass is to be considered, upon which you mean to have the reflected surface. 12. You must make a particular geometrical draught or projection, which on the glass must appear to be a plane full of squares; on which projection transfer what shall be drawn on a plane, divided into the same number of branches, as the points of reflection from the surface of the glass. 13. Where the surface may appear very confused, yet the reflection of it on the glass will be very regular, proportioned, and regularly composed.

M. de Haller says, that the opalescent tints in the skin, which is produced by a crystal or glass which has its surface cut into many others, whereby the rays of the object are broken. For to the flat of the crystal, or to the surface of a glass, you must break and make an angle, which also by the refracted beams is made and continued on the other side of the same flat. 15. When these faces on a crystal are returned to a plane placed directly before it, they separate themselves at a good distance on the plane, because they are all directed to various far distant places of the same.

Perspex plane, is the glass of other transparent surfaces, in (Plate Perspective, fig. 2) supposed to be placed between the eye and the object, perpendicularly to the horizon. It is sometimes called the section, table, or glass.

Perspiration. There seems to be something thrown out from the blood during its circulation in the arteries, at least through those vessels which are near the surface of the body; for there can be no doubt that the perspiration which is lost from the skin is almost entirely emitted from the skins of animals. These substances are known in general by the name of perspirable matter, or perspiration. They have a great resemblance to what is called urine, which may be said to be a mixture of the urine and perspiration, which in the human body is thrown up to the skin, and from thence emitted. The perspiration which is thrown on the skin is very visible; and the temperature of the skin is higher than that of the body. It is usually supposed that perspiration is a difficult task, because it consists of invisible, or, at least, very small quantities at a time. It has, notwithstanding, always been ascertained that water, carbon, and an oily matter, are emitted; and that an acid supposed to be the phosphoric, phosphat of lime, and even uric, are sometimes emitted through the skin.

To ascertain the substance thus emitted by perspiration is a difficult task, because it consists of invisible, or, at least, very small quantities at a time. It has, notwithstanding, always been ascertained that water, carbon, and an oily matter, are emitted; and that an acid supposed to be the phosphoric, phosphat of lime, and even uric, are sometimes emitted through the skin.

1. The most accurate experiments on this matter that have been made are those of Mr. Cruikshank. He put his hand into a glass vessel, and luted its mouth with his wrist by means of a bladder. The interior surface of the vessel became gradually dim, and drops of water trickled down. By keeping his hand in this manner for an hour, he collected thirty grains of a liquid, which possessed all the properties of pure water. On repeating the same experiment at nine in the evening (thermometer 62°), he collected only 12 grains. The mean of these is 21 grains. But as the hand more exposed than the rest of the body, it is reasonable to suppose that the perspiration from it is greater than that from the hand. Let us therefore take 30 grains per hour as the mean; and let us suppose, with Mr. Cruikshank, that the hand is 1/50th of the surface of the body. The perspiration in an hour would amount to 1850 grains, and in 24 hours to 43,200 grains, or 7 pounds 6 ounces troy. This is almost double the quantity ascertained by Lavosier and Seguin. Hence we may conclude that the matter from the hand is more than from the other parts of the body, and that the hand is the most perspirable part of the body.
main in contact with the skin did not increase. Consequently the appearance of the carbonic acid gas must be owing either to the emission of carbon, which forms carbonic acid gas by combining with the oxygen gas of the air, or to the absorption of oxygen gas, and the subsequent emission of carbonic acid gas; precisely in the same manner, and for the same reason, that these substances are emitted by the lungs. This is the more probable opinion; but the experiments hitherto made do not enable us to decide.

3. Besides water and carbon, or carbic acid gas, the skin emits also a particular odorous substance. That every animal has a peculiar smell, is well known: the dog can discover his master, and even trace him to a distance by the scent. A dog, chained some hours after his master had set out on a journey of some hundred miles, followed his footsteps by the smell, and found him on the third day in the midst of a crowd. But it is needless to multiply instances of this fact; the dog is well known to every one. Now this smell must be owing to some peculiar matter which is constantly emitted; and this matter must differ somewhat either in quantity or some other property, as we see that the dog who distinguishes the individual by means of it. Mr. Cruikshank has made it probable that this matter is an oily substance; or at least that there is an oily substance emitted. To this the skin was repeatedly exposed, night and day for a month, the same part of the skin being exposed to the air during the hottest part of the summer. At the end of this time he always found an oily substance accumulated in considerable masses on the top of the inner surface of the vessel, in the form of black tears. When rubbed on paper, it makes it transparent, and hardens on it like grease. It burns with a white flame, and leaves behind it a clear ash.

4. Berthollet has observed the perspiration of acid; and he has concluded that the acid which is present is the phosphoric: but that has not been proved. Forcroy and Vanquelin have ascertained that the sweat which collects upon the skins of horses consists chiefly of phosphat of lime, and tereia is even sometimes mixed with it. It is well known that it is difficult to give a satisfactory definition of this substance; but if hitherto it has not been analysed, though it probably differs from the transpiration.

It has been supposed that the skin has the property of absorbing moisture from the air; but this opinion has not been confirmed by experiments, but rather the contrary.

The chief arguments in favour of the absorption of the skin, have been drawn from the quantity of moisture discharged by urine being, in some cases, not only greater than the whole drink of the patient, but even the whole of his drink and food. But it ought to be remembered that, in diabetes, the disease here considered, the weight of the body is continually diminishing, and therefore part of it must be constantly thrown off. Besides, it is scarcely possible in that disease to get an accurate account of the food swallowed by the patient. In those cases where very accurate accounts have been kept, and where deception was not so much practised, the urine was found to exceed the quantity of water in the excreta almost as much as the weight of the body, related with much accuracy by Dr. Gerard. The patient was bathed regularly during the early part of the disease in warm water, and afterwards in cold water: he was weighed before and after bathing, and no sensible difference was ever found in his weight. Consequently, in that case, the quantity absorbed, if any, must have been very small. In the case of Miss St. Aubigne, he was weighed in the state of fasting, and in that of Vanquelin, the patient was weighed after each course of medicine. It is well known that thirst is much alleviated by cold bathing. By this plan captain Bligh kept his men cool and in good health during their very extraordinary voyage across the South Sea. This has been considered as owing to the absorption of water by the skin. But Dr. Currie had a patient who was wasting fast for want of nourishment, a tumour in the oesophagus preventing the possibility of taking food, and whose thirst was always alleviated by bathing; yet no sensible increase of weight, but rather the contrary, was perceived after bathing. It does not appear then, that either of these cases was water absorbed. The allaying of thirst by the cold bathing may indeed exactly be accounted for, by the lessening of the temperature, and the prevention of perspiration.

Further, Seguin has shown that the skin does not absorb water during bathing, by a still clearer experiment: he dissolved in some mercurial salt in water, and found that the mercury produced no effect upon a person that bathed in the water, provided no part of the cuticle; but upon rubbing off a portion of the cuticle, the mercury was absorbed, and the effects of the mercury became evident upon the body. Hence it follows irresistibly, that water, at least in the state of water, is not absorbed by the skin when the body is plunged into it, unless the cuticle is first removed.

This may perhaps be considered as a complete proof that no such thing as absorption is performed by the skin; and that therefore the appearance of carbolic acid gas, which takes place when air is confined around the skin, must be owing to the emission of carbon. But it ought to be considered, that although the skin cannot absorb water, this is no proof that it cannot absorb other substances; particularly that it cannot absorb oxygen gas, which is very different from water. It is well known that water will not pass through the skin of the more or less modified, or wood. Yet Dr. Priestley found that venous blood acquired the colour of arterial blood from oxygen gas, as readily when these substances were separated by a bladder, as when they were in actual contact. He found, too, that when gases were confined in bladders, they gradually lost their properties. It is clear from these facts, that oxygen gas can pervade bladders; and if it can pervade them, why may it not also pervade the cuticle? Nay, further, we know from the experiments of Cruikshank, that the vapour perspired passes through leather, even when presented to water, at least for a certain time. It is possible, then, that water, when in the state of vapour, or when dissolved in air, may be absorbed, although water, while in the state of water, may be incapable of pervading the cuticle. The experiments, therefore, which have hitherto been made upon the absorption of the skin, are insufficient to prove that air and vapour cannot penetrate the cuticle, provided there are any facts to render the contrary supposition probable.

Now that there are such facts, cannot he denied. We shall not indeed produce the experiments of Van Mons as a fact of that kind, because it is liable to objections, and at best is very indirect. Having a patient whose lungs, from the wound in the throat, was incapable for several days of taking any nourishment, he kept him alive during that time, by applying to the skin in different parts of the body, several times a day, a little corn strongly ignited. A fact mentioned by Dr. Watson is much more important, and much more decisive. A lad at Newmarket, who had been almost starved in order to bring him down to such a weight as would qualify him for running a horse-race, was weighed in the morning of the race-day; he was weighed again an hour after, and was found to have gained 30 ounces of weight, yet in the interval he had only taken half a glass of wine. Here absorption must have taken place, either by the skin, or lungs, or both. The difficulties in either case are the same; and whatever renders absorption probable, will equally strengthen the probability that absorption takes place by the other. See Physiology.

PERULA, a genus of the class and order dioecia polyandra. There is one species, a tree of New Grenada.

PETALON, among botanists, an appellation given to the flower-leaves, or opposition to the folia, or common leaves of the plant. See Botany.

PETALOPSIS, a genus of the decandria monogynia class and order: the calyx is glabrous, five-toothed; petels five; stamina on margin of calyx; berry one-celled, seeds one or four. There are two species, trees of Jamaica and Guiana.

PETARD, in the art of war, a metaline engine, somewhat resembling a high-crowned hat. The petard may be considered as a piece of ordnance; it is made of copper mixed with brass, or of lead with tin; its charge is from five to six pounds of powder, which reaches to the skin three fingers' breadth of the mouth; the vanilla is covered to the top, and stopped with a wooden tongmout, the mouth being strongly bound up with cloth tied very tight with ropes. It is covered up with a wooden plug, that has a cavity to receive the mouth of the petard and fastened down with ropes.

Its use is in a clandestine attack to break down gates, bridges, barriers, &c. to which it is hung; and this it does by means of the wooden plug. It is also used in counter-mines to break through the enemy's galleries, and give their mines vent. The invention of petards is ascribed to the French Huguenots, in 1579, who with them took Cassel, d'Albergers, &c. as PETECHIAL. See Medicine.

PETER-PENCE, an antient tax of a penny on each house, paid to the pope. It was called Peter-pence, because collected on the day of St. Peter ad vincula, and sent to Rome; whence it was also called Rome-scot, and Rome-penny.

PETESESIA, a genus of the tetrandria monogyana class and order: the corolla is one-petalled, funnel-form, stigma bifid, berry many-seeded. There are three species, shrubs of South America and the West Indies.
PETRIE, in botany, the slender stalk that supports the leaves of a plant.

PETRIE PRINCIPLES, in logic, the taking a thing for true, and drawing conclusions from it as such, when it is really false, or at least wants to be proved, before any inferences can be deduced from it.

PETITION, the right of the people to petition to the king, or to either house of parliament, for any alteration in church or state, shall be signed by above twenty persons, unless the matter thereof is approved by three judges of the peace, or the major part of the grand jury in the county; and in London by the lord mayor, aldermen, and common council; nor shall any petition be presented by more than ten persons at a time.

PETRIE, CHANCERY, a request in writing, directed to the lord chancellor or master of the rolls, shewing some matter or cause, whereupon the petitioner prays somewhat to be granted him.

PETRIE ORNAMENT, a form of the tetragynia order, in the hexandria class of plants, and in the natural method ranking under the 12th order, holoeccae. The calyx is tetraphyllous; there is no corolla; and but one seed, which ripes at the top. There are two species (Guinea hov-weed), herbs of the West Indies.

PETREA, in botany, a genus of the cladinia angiosperma class of plants, with a more or less altered from their original state, according to the different substances they have been buried among in the earth; some of them being of a hard, and others of a soft nature; some being so highly impregnated with crystalline, sparify, pyritic, or other extraneous matter, as to appear more masses of stone, or lumps of the same, than any true vegetable, which are either greater or less divided, and sometimes colour-red, imbricate themselves into its pores, and fill them up. These fluids are afterwards moulded and condensed. The solid part of the wood is decomposed and reduced into powder, which is expelled without the mass by aqueous filtrations. In this manner, the pieces which were formerly occupied by the wood are now left empty in the form of pores. These pores have no apparent difference either of the size or of the shape; but it occasions, both at the surface and in the inside, a change of substance, and the ligneous texture is inverted; that is to say, that which has been the natural wood, becomes solid in that which is petrified; and that which was solid or full in the first state, becomes porous in the second. In this way, says M. Mosard, petrified wood is much less valuable than stones, and which has grown in pure natural wood, becomes solid in that which is petrified; and that which was solid or full in the first state, becomes porous in the second. In this way, says M. Mosard, petrified wood is much less valuable than stones, and which has grown in pure natural wood, becomes solid in that which is petrified; and that which was solid or full in the first state, becomes porous in the second. In this way, says M. Mosard, petrified wood is much less valuable than stones, and which has grown in pure natural wood, becomes solid in that which is petrified; and that which was solid or full in the first state, becomes porous in the second. In this way, says M. Mosard, petrified wood is much less valuable than stones, and which has grown in pure natural wood, becomes solid in that which is petrified; and that which was solid or full in the first state, becomes porous in the second. In this way, says M. Mosard, petrified wood is much less valuable than stones, and which has grown in pure natural wood, becomes solid in that which is petrified; and that which was solid or full in the first state, becomes porous in the second. In this way, says M. Mosard, petrified wood is much less valuable than stones, and which has grown in pure natural wood, becomes solid in that which is petrified; and that which was solid or full in the first state, becomes porous in the second.

PETRIE, in natural history, denotes the conversion of wood, bones, and other substances, principally animal or vegetable, into stone. These bodies are more or less altered from their original state, according to the different substances they have been buried among in the earth; some of them having, after a long time, changed into stone, being so highly impregnated with crystalline, sparify, pyritic, or other extraneous matter, as to appear more masses of stone, or lumps of the same, than any true vegetable, which are either greater or less divided, and sometimes colour-red, imbricate themselves into its pores, and fill them up. These fluids are afterwards moulded and condensed. The solid part of the wood is decomposed and reduced into powder, which is expelled without the mass by aqueous filtrations. In this manner, the pieces which were formerly occupied by the wood are now left empty in the form of pores. These pores have no apparent difference either of the size or of the shape; but it occasions, both at the surface and in the inside, a change of substance, and the ligneous texture is inverted; that is to say, that which has been the natural wood, becomes solid in that which is petrified; and that which was solid or full in the first state, becomes porous in the second. In this way, says M. Mosard, petrified wood is much less valuable than stones, and which has grown in pure natural wood, becomes solid in that which is petrified; and that which was solid or full in the first state, becomes porous in the second.
The woody fibres being decomposed, turn their leaves into stony-veiled, and there remains in the whole piece nothing but little stony cylinders. In this condition as the woody fibres disappear, the surrounding moisture, mixed with earth in the state of dissolution, does not fail to penetrate the piece of wood, and to remain in its new cavities. The new deposit assumes exactly the form of decomposed fibres; it envelops in its turn the little cylinders which were formed in their cavities, and by incorporating with them. We may suppose, therefore, that in proportion as it decomposes, there is a growth of the deposit part against the lapidific fluid: from this reaction a colour arises which stains more or less the new deposit; and this colour will make it easily distinguishable from that which has been laid in the inside of the vessel. In all petrified wood this shade is generally perceptible.

We have then, says M. Monge, four distinct epochs in the process by which nature composed this second deposit into stones: and, to speak more distinctly, by which she substituted a stony deposit in its place: 1. Perfect vegetable wood, that is to say, wood composed of solid and of empty parts, of ligneous fibres, and of vessels. 2. Wood having the pores obstructed and choked up by an earthly deposit, while its solid parts remain unaltered. 3. The solid parts attacked and decomposed, forming new cavities between the stony cylinders, which remain in the same state, and which support the whole mass. 4. These new cavities filled with new deposits, which incorporate with the cylinders, and compose new and general masses of the mass, representing exactly the piece of wood.

Among the petrifications of vegetables called dendrolithes, are found parts of shrubs, stems, roots, portions of the trunk, some fruits, &c. We must not, however, confound these operations of mooses, ferns, and leaves, nor incrustations, with petrifications.

Among the petrifications of animals, we find shells, crustaceous animals, polyarctics, some worms, the bony parts of fishes and of amphibious animals, or no rceived insects, rarely birds and quadrupeds, together with the bony portions of the human body. The corneous anisomers are petrified serpents; and with regard to figured and accidental bodies, these are llama naturae.

In order, says M. Bertrand, in his Dictionnaire des fossiles, that a body should become petrified, it is necessary that it is, 1. Capable of preservation under ground. 2. That it is sheltered from the air and running water (the ruins of Herculanenum prove that bodies which have no connection with free air preserve themselves untouched and entire). 3. That it is secured from corrosive extractions. 4. That it is in a place where there are vapours or liquids, laden either with metallic or stony particles in a state of dissolution, and which, without destroying the body, penetrate it, impregnate it, and unite with it in proportion as its parts are dissipate by evaporation.

It is a question of great importance among naturalists, to know the time which nature employs in petrifying bodies of an ordinary size. It was the wish of the late emperor, duke of Lorraine, that some means should be taken for determining this question. M. le chevalier de Bailli, director of the cabinet of natural history of his imperial majesty, and some other naturalists, had, several years before, the happy idea of throwing some light upon it. His imperial majesty being informed by the unanimous observations of mod-rni historians and geographers, that certain pillars which are commonly found at the mouth of the river Belgrade, are remains of the bridge which Trajan constructed over that river, presumed that these pillars have been preserved for so many ages must be petrified, and that they served him in some information with regard to the time which nature employs in changing wood into stone. The emperor then, thinking this hope well founded, and wishing to satisfy his curiosity, ordered his ambassador at the court of Constantinople to ask permission to take up from the Danube one of the pillars of Trajan's bridge. The petition was granted, and one of the pillars was accordingly taken up; from which it appeared that the petrification of a hard stone as thick as a finger in the space of 1500 years. There were, however, certain waters in which the transmission is more readily accomplished. Petrifications are formed more slowly in earths that are porous and in a slight degree moist than in water itself.

When the foundations of the city of Quebec in Canada were dug up, a petrified savage was found among the last beds to which they proceeded. Although there was no idea at the time that this man had been buried under the ruins, it is however true, that his quiver and arrows were still well preserved. In digging a basement in Regis- burnire in 1744, a human skull was found among stags' horns. It is impossible to say how many ages this casque had lain there. In 1695 the entire skeleton of an elephant was dug up near Tonna, in Thuruggia. Some time before this epoch the petrified skeleton of a crocodile was found in the mines of that country. We might cite another fact equally curious but at the beginning of the last century. John Munte, curate of Siergarp in Scania, and several of his parishioners, wishing to procure turf from a drained marshy soil, found, some feet below ground, an entire cart with the skeletons of the hores and carter. It is presumed that there had formerly been a lake in that place, and that the carter attempting to pass over the ice, had by that means probably perished. In fine, wood partly fossil, and partly calcified, has been found at a great depth, in the abbey of Fontenay. It is but very lately that fossil wood was discovered at the depth of 75 feet in a well betwixt Liss and Vauvres, near Paris. This wood was in sand betwixt a bed of clay and pyrites, and water was found four feet lower than the pyrites. M. de Laumont, inspecting the place, found at the bottom of the lead-mine at Pontpean, near Rennes, a fossil, perhaps the only one of its kind. In that fissure, sea-shells, rounded pebbles, and an entire bee, have been found 240 feet deep. This beeck was laid horizontally in the direction of the fissure. Its bark was converted into pyrites, the sap-wood into jet, and the centre into coal.

A great many pieces of petrified wood are found in different counties of France and Savoy, in Cobourg in Saxony, and in the mountains of Misioo, trees of a considerable thickness have been taken from the earth, which were entirely changed into a very hard petrified wood, and the branches and their roots. In sawing them, the annual circles of their growth have been distinguished. Pieces have been taken up on which it was distinctly seen that they had been gnawed by worms; and, by their marks, the wood has been gnawed by certain kind of woodpecker, and their roots. In the same way, pieces have been found which were petrified at one end, while the other still remained in the state of wood fit for being burned. It appears then that petrified wood is a great deal less rare in nature than is commonly imagined.

Mr. Kirwan observes on the subject of petrifications, 1. Those of shells are found on or near the surface of the earth; those of fish, deeper; and those of wood deeper still. Shells in substance are found in vast quantities, and at considerable depths. 2. The substances most susceptible of petrification are those which most resist the putrefactive action of the air, that is to say, the hardest kinds of wood, &c.; while the softer parts of animals, which easily putrefy, are seldom met with in a petrified state. 3. They are most commonly found in strata of marl, chalk, lime-stone, or clay; seldom in sandstone, still more seldom in gypsum; and never in granite, basalt, or school. Sometimes they are found in pyrites, and ores of iron, copper, and silver, consisting almost always of that kind of earth or other mineral which surrounds them; sometimes of tiles, agate, or carnelian. 4. They are found in climates where the animals themselves could not have existed. 5. Those found in slate or clay are compressed and flattened.

The different species of petrifications, according to Cronstedt, are,

1. Terra larvata; extraneous bodies changed into a limy substance, or calcareous changes. These are, 1. Loose or friable. They consist, in the form of a chalky nature, in form of vegetables or animals; the second filled with solid limestone in the same form. Some are found entirely changed into a calcareous spar.

On these petrifications Cronstedt observes, that shells and corals are composed of limy matter even when still inhabited by their ani-

mals, but they are classed among the petrifications as soon as the calcareous particles have obtained a new arrangement; for example, when they have become sparry, filled with calcareous earth either harden ed or loose, or when they lie in the strata of the earth. "These (says he) form the greatest part of the dust, and of which are so indiscriminately made, often without any regard to the principal and only use they can be of, viz. that of enriching zoology. Mineralogists are satisfied with seeing the possibility of the changes the limestone undergoes in regard to its particles; and also with receiving some insight into the alteration which the earth has been subject to from the state of the strata which are now found in it." The calcareous lime being in the particles 

of a limy or chalky nature, answer extremely well as a manure; but the indurated kind serve only for making grottoes. Gypseous
petrifications are extremely rare; however, Chardin informs us that he had seen a lizard inclosed in a petrified tree at Adrianople, which is said to be in the collection of the count de Tessin. 3. Coralloids of the white flint (milipora) found in Sweden. 4. Wood of yellow flint found in Italy, Turkey near Adrianopole, and produced by the waters of Lough-ineish in Ireland.

IV. Larvae argilecée; where the bodies appear to be changed into clay. These are found either loose and friable, or incrustated. Of the former kind is a piece of porcelain clay met with in a certain collection, with all the marks of the root of a tree upon it. Of the latter kind is the oestocolla, which is said to be the roots of the poplar-tree changed, and not to consist of any calculous substance. A sort of fossil ivory, with all the properties of clay, is said likewise to be found in some places.

IV. Larvae insalite; where the substances are impregnated with great quantities of salt. Human bodies have been twice found impregnated with salt at the springs of the most saline of the springs of Fajallom, in the province of Dalarn in Sweden. One of them was kept for several years in a glass-case, but at last began to moulder and fall to pieces. Turf and roots of trees are likewise found in a similar state, impregnated with vitriol. They do not flame, but look like a coal in a strong fire; neither do they decay in the air.

V. Bodies penetrated by mineral inflammable substances. 1. By bit-coal, such as wood; whence some have imagined coal to have been originally produced from wood. Some of these substances are fully saturated with the coal matter; others not. Of the former Cronstedt reckons jet; among the latter the substance called munza vegetables, which is of a loose texture, resembling amber, and may be used as such. These penetrated by asbestos are rock-coal. The only example of this is given by our author is a kind of turf in the province of Skone in Sweden. The Egyptian mummmies, he observes, cannot have any place among this species, as they are impregnated artificially with ashpall and vitriol, in a manner similar to what happens naturally with the wood and coal matter in the last species. 3. Those impregnated with sulphur, which has dissolved iron, or with pyrites. Human bodies, bivalve and univalve shells, and insects, have been all found in this state; and the last are found in the alum state at Andraun, in the province of Skone in Sweden.

V. Nature metalifera; where the bodies are impregnated with metals. These are, 1. Coated with native silver, which is found on the surface of shells in England. 2. Where the metal is mineralised with copper and sulphur. Of this kind is the false tritl or grey silver-ore, in the form of ears of corn, and supposed to be vegetables, found in argillaceous slate at Frankenberg and Tahlitteren in Hesse. 3. Largue cupriceae; where the bodies are impregnated with copper. Some species possess the turquois or Turkey stones, improperly so called; being ivory and bones of the elephant, or other animals, impregnated with copper. At Siccar-point there are bones of animals dug up, which, during calcination, assume a blue colour; but according to Cronstedt, it is not probable that these owe their colour to the impregnation of the bone with copper. Of these our author gives two examples. One is, where the copper is unintercalated with sulphur and iron, forming an iron marcasitic ore. With this stone shells, flat, and the base a bed of the iron and oak in Norway. Other petrifications of this kind are found in the form of fish in different parts of Germany. The other kind is where the copper is impregnated with sulphur, and iron in the form and shape of extraneous bodies. These are either loose or incrustated. Of the loose kind are some roots of found at the lake Lungemla in Finland. The impregnated kinds are even exemplified in some wood found at Obissan in Bohemia. 5. where this is impregnated in the pyriticaceous larve described above.

VII. Where the bodies are tending to decomposition, or in a way of decomposition. Among these, our author enumerates mould and turf, &c.

PETROCARA, a genus of the class and order heptandrii monogynii. The calyx is five-cleft, tubercle; corolla five-petalled; stamens fifteen; style long, perfectly smooth, and five-celled. There are two species, trees of Guiana.

PETROLEUM. See Bitumen.

PETROMYZON, the lamprey, a genus of fishes belonging to the class of the Polyphylem. It has seven spiracula at the side of the neck, no gills, a fistula on the top of the head, and no breast or belly fins. There are eight species, distinguished by peculiarities in their back fins. 1. The marinus, or sea-lamprey, is sometimes found so large as to weigh four or five pounds. It greatly resembles the eel in shape, but its body is larger, and its stout and short, namely, the termination. The opening of the throat is very wide; each jaw is furnished with a single row of very small teeth; in the middle of the palate are situated one or two other teeth, which are longer, stronger, and moveable towards the inside of the throat.

The lamprey is an inhabitant of the ocean, ascending rivers chiefly during the latter part of winter and the early months of spring; and after a residence of a few months in fresh water, again returning to the sea: it is viviparous, and the young are observed to be of slow growth; contrary to the assertions of Dr. Wright, who has supposed the lamprey to be a short-lived fish. When in motion this fish is observed to swim with considerable vigour and rapidity, but it is more commonly seen attached by the mouth to some large sea-ooze, and the body hanging at rest, or obeying the motion of the current: so strong is the power of adhesion exerted by this animal, that a stone of the weight of more than twelve pounds may be raised without forcing the fish to forego its hold. The general habits of the lamprey seem pretty much to resemble those of the eel, and it is supposed to live principally on worms and young fish. Like the eel it is remarkably tenacious of life; if the several parts, when cut in pieces, will long continue to move; and the head will strongly attach itself for several hours to a stone, though by far the greater part of the body is cut away from it.

Among the cartilaginous fishes none is so destitute of all appearance of real bone as the lamprey, in which the spine itself is not other than some soft cartilage, without any processes or protuberances whatsoever. Among other particulars in its anatomy, it is remarkable that the heart, instead of being inclosed in a soft pericardium, as in other animals, is guarded by a strong fibrous sheath, one: the liver, which is of an oblong form, is of a fine grass-green colour, somewhat deeper in the female fish, and may be used for the purpose of a pigment.

Lamprey, arising from instinctive inspection, and total ignorance of the nature of the animal, is said sometimes to prevail, viz. that the lamprey is furnished with nine eyes on each side; this mistake appears to have excited unusual indignation in Sir T. Brown.

As an article of food, the lamprey has for many ages maintained its credit as an exquisite dainty; and has uniformly done its part to furnish entertainment to the eaters. The death of King Henry the First, it is well known, is attributed to a too luxuriant indulgence in this his favorite dish. It still continues to be so esteemed; for we are told by Mr. Pennant that the city of Gloucester continues to send yearly, at Christmas, a present of a rich lamprey-pie to the king. It sometimes happens that lampreys are so scarce, that they are taken in such quantities as to demand the price of a single fish. They are most in season during March, April, and May, and are observed to be much more firm when fresh-arrived from sea than when they have been a considerable time in fresh water. They are found in several of the British rivers, but which is most celebrated for them is the Severn. In the months of some of the larger European rivers they are sometimes in such plenty, that it is impossible to use them in their fresh state; they are therefore grilled and moderately salted, and afterwards barreled up for sale, with the addition of vinegar and spices.

PETROMYZON FLUVIALIS, lamprey. This species, according to Dr. Bloch, an inhabitant of the sea, and ascends in spring-time most of the European rivers, in which it is found much more frequently and plentifully than the great lamprey. With us it is found in great quantities in the Thames, the Severn, and the Dee. It is often caught with the larger lamprey, and is by some preferred to it, as being fuller-tasting. Mr. Pennant informs us that vast quantities are taken by Mortlake, and sold to the Dutch, as baits for their cod and turbot fisheries. According to this author about four hundred and fifty thousand have been taken in the Thames alone in five shillings per thousand, and about a hundred thousand have been occasionally sent to Harwich for the same purpose. The Dutch, it is added, have the secret of preserving them till the time of the turbot-fishery. Great quantities, says Dr. Bloch, are taken in the march of Brandeburgh, and in Pomerania, Silesia, and Prussia; and after freezing, are
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packed in barrels by layers, between each of which is a layer of hay-leaves, and spices, sprinkled over with vinegar. In this state they are sent into many other parts of the German empire. In the river Baunier in Courland, great quantities are taken from Shooter's fish weir next; they are much larger than those found elsewhere, and are packed in snow, and sent to any distance; and when put into cold water recover themselves. This species spawns in March and April, and is a prolific fish. It is tenacious of life, that it will live many days out of water.

3. Petromyzon planeri, Planer's lamprey; length from five or six to ten inches; general resemblance that of the lampreys; native of the rivers of Thuringia and other parts of the German empire. Like most of the genus, tenacious of life, living for a space of an hour when immersed in spirits or wine, and in the mud of the stream the whole time. When thus killed in spirits, the mouth remains open, but when the fish dies in water it is shut.

4. Petromyzon branchialis, minute lamprey; length of the European rivers; in England more frequent in the Isis than elsewhere. Instead of coning itself under stones, this species lodges itself among the mud, and is not observed to adhere to any other body like the genus; it is used as a bait for other fish. It seems to have been first distinctly described as an English species by Dr. Plot, in his History of Oxfordshire.

5. Petromyzon sanguineus, blood lamprey. It seems in many points so nearly to resemble the common lamprey as to leave some suspicion of its being the young of that species; yet Mons. Noel seems convinced of its being specifically different. It is said to be found only at those times in which the shallows (clupea alosa) is in the river. These fishes it persecutes, by fastening beneath their bellies, and seizing them with the sucker-like feets; this body being constantly full of that fluid alone: they sometimes attack salmon in a similar way, but from the greater thickness of the skin in those fishes, are able to obtain but a small quantity of blood from them.

PETUNE, in natural history, one of the two substances whereby the porcelain or China-ware is made. The petune is a coarse kind of lint or pebbles, the surface of which is not so smooth when broken as that of our common flint. See Stoneware.

PEUCEDANUM, or Sulphurwort, a genus of the digita family, in the pentadactyl class of plants, and in the natural method ranking under the 4th order, umbeliate. The fruit is lobated, straited on both sides, and surrounded by a membrane; the involucre are very short. There are 10 species, many of which have very remarkable and in many cases, especially concerning the officinal, or common bog-saxifrage, growing naturally in the English salt marshes. The roots, when bruised, have a strong foetid scent like sulphur, and an acrid, bitterish, nauseous taste. Found in the spring; they yield a considerable quantity of yellow juice, which dries into a gummy gum, and retains the strong smell of the root. The expressed juice was used by the ancients in leprosy disorders.

PEWTER, a factitious metal, used in making domestic utensils, as plates, dishes, &c. See Zinc.

PHEA, cup-mushroom, a genus of the natural order of fungi, in the cryptogamia class of plants. The fungus is campalized and sessile. Linnaeus enumerates 11 species; Dr. Withering, 40 British species.

PIELE, a genus of the chiroptera order, in the diaphania class of plants; and in the natural method ranking under the 33rd order, papilionaceae. The legimnen is semillolum. There are 11 species.

PILET, a genus of the class and order synangia polygramma superius. The callyx is subbydious, many-leaved; florets homangiphorous; recept, clausly, seeds vispid.

There is one species; a tree of Virginia.

PI理想, a genus of birds belonging to the order anseres, the characters of which are: The bill is sharp, straight, and pointed, the nostrils are oblong, and the hinder toe is turned forward. There are two species, viz.

1. The domesticus, or red-footed pinguin, has a thick, arched, red bill; the head, limb, part of the neck, and back, of a deepish purplish hue, and sometimes white; brown hair, and the tips of the feathers; white; instead of a tail, a few black bristles; and red legs. It is found on Pinguin island, near the Cape of Good Hope, is common all over the South sea, and is about the size of a goose.

2. The eutherus, or tropic bird, is about the size of a partridge, and has very long wings. The bill is red, with an angle under the lower jaw. The eyes are enfolded with black, which ends in a point towards the back of the head. Three or four of the larger quill-teathers towards their ends are black, tipped with white; all the rest of the bird is white, except on the chest, which is variegated with curved lines of black. The legs and feet are of a vermilion red. The toes are webbed. The tail consists of two long straight narrow feathers, almost of equal breadth, and much less than a half; the ground-colour is a very fine deep orange-brown, and in the middle of each wing is a large subtriangular transparent spot or patch, resembling the appearance of a piece of Muscovado sugar; the under parts are a little blacker, and the ground-colour is succeeded by a black border, and across all the wings run lighter and darker bars, exhibiting a very fine assortment of varying shades; the upper wings are slightly curved downwards at their tips, and the abdomen, and the lower wings are edged with a border of black spots on a pale buff-coloured ground; the antehen are widely parted with a quadrate series of fibres, exhibiting a highly elegant appearance. This insect is native of both the Indies, and occasionally varies both in size and colours.

Pheanta lucana is an American species, of Lucanus tam, and extremely beautiful; its colour is a most elegant pea-green, with a small yellowish eye-shaped spot with a transparent centre in the middle of each wing, and the lower wings are produced at the bottom into a long and broad tail or continuation; the ridge of the upper wings is broad, and a fine purple-blue-colour; the head and thorax yellowish white, and the body milk-white.

Of the European species of this division beyond comparison the finest is the phacena junonia (ph. pavonia Lin.), a native of many

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have been met with in plenty on the islands of St. Helena, Ascension, Mauritius, New Holland, and various places in the South Seas; but in no place so numerous as at Penamron island, where these birds, as well as the frigate, were in such plenty, that the trees were absolutely loaded with them, and so great was the number of them, that they were taken off the hands with the hand. At Osaka, and in the Friendly isles, the natives give them the names of bingao and toolakea. Some ornithologists reckon two other species (perhaps varieties) of this kind.

PHALENA, moth, a genus of insects of the order lepidoptera; the generic character is: antennae setaceous, gradually lessening from base to tip; wings (when sitting) generally divided (flight nocturnal). This genus, like that of papilio, containing a vast number of species, is divided into assortments, according to the different habits of the animals. These assortments are as follows, viz.

1. Attract the males and females, and find them, when at rest, are spread out horizontally.

2. Bombyces, in which the wings are incumbent, and the antenna pectinulated.

3. Pyralides, with wings converging into a dorsal and slightly furcated figure.

4. Tane, with wings convoluted into a cylinder.

5. Ptericole, with wings divided into distinct plumes.

These distributions, like those of the genus papilio, are not strictly accurate, and must therefore be regarded with a proper degree of volition: 2.

In the first division or attract ranks the most splendid, and largest, of all the phacena yet known, viz. the phacena atlas, an insect so large that the extent of its wings measures about one and a half; the ground-colour is a very fine deep orange-brown, and in the middle of each wing is a large subtriangular transparent spot or patch, resembling the appearance of a piece of Muscovado sugar; the under parts are a little blacker, and the ground-colour is succeeded by a black border, and across all the wings run lighter and darker bars, exhibiting a very fine assortment of varying shades; the upper wings are slightly curved downwards at their tips, and the abdomen, and the lower wings are edged with a border of black spots on a pale buff-coloured ground; the antehen are widely parted with a quadrate series of fibres, exhibiting a highly elegant appearance. This insect is native of both the Indies, and occasionally varies both in size and colours.

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Of the European species of this division beyond comparison the finest is the phacena junonia (ph. pavonia Lin.), a native of many
Phaeton.

Parts of Germany, Italy, France, &c., but not yet observed in England. It measures about six inches in extent of wings, and is varied by a most beautiful assortment of the most sober colours, consisting of different shades of deep and light grey, black, brown, &c. On the middle of each wing is an eye-shaped spot, having the disk black, shaded on one side with blue veined with white, and the whole included by a circle of black. Lastly, all the wings are bordered by a deep edging of very pale brown, with a white line immediately adjoining to the darker part of the wing; these spots are very distinct.

The caterpillar, which feeds on the apple, pear, &c., is hardly less beautiful than the insect itself; it is of a fine apple or yellowish-green colour, with each segment of the body differently shaded; its prominence of a bright blue colour, with black radiated edges, and surrounded by long black filaments, each of which terminates in an elaborate tip. This larva, when ready for its chrysalis, is raised on a web with a pointed extremity, and transforms itself into a large short-chysalis, out of which afterwards emerges the moth.

The phaena pavonia or smaller peacock-moth of England, and is commonly called the emperor moth. In every respect, except size, it so greatly resembles the former, that Linnaeus chose to consider it as a permanent variety only of the same species. The larva and pupa are also of the same appearance with those of the preceding, but on a much smaller scale.

The bombyces constitute a very numerous tribe of the phalanae; those of the brown-tail, tiger-moth may serve as an example. This species is one of the larger English moths, and is of a fine pale cream-colour, with chocolate-brown bars and spots; the lower wings red, and black spots; the thorax dark brown, with a red collar round the neck; and the body red, with black bars. The caterpillar is of a deep brown, with white specks; extremely hairy, and feeds on various plants. It changes into the moth in a few days, and Phaena pavonia is June, and the moth appears in July.

Phaena fuscicula or the brown-tail moth is remarkable for the ravages which its caterpillar commits, by destroying the foliage of trees and hedges; and those there are few or perfectly bare appearance. The moth itself is about a third part less than that of a silkworm, and is of a fine satiny white, except the hinder part of the body, which is of a deep brown. The caterpillar is brown, with dark crimson hairs, a row of white spots along each side, and two red spots on the lower part of the back; it is of a gregarious nature, vast numbers residing together under one common web. It hatches early in autumn, from eggs laid by the parent moth, and immediately forms for themselves a small web, and begins feeding on the foliage of the tree or shrub on which they have hatched. They march themselves with great regularity for this purpose in rows, and at first devour only the upper pellide and the green parenchyma of the leaves, and in the evening return to their web. In about three weeks they cast their skin, and afterwards proceed to feed as before, enlarging their web from time to time, and forming it on all sides as strong and secure as possible. In this they remain the whole winter in a state of torpidity, still being enlivened by the warmth of the returning spring, they again issue from their covering, and being now grown stronger, begin to devour the whole substance of the leaves, instead of containing themselves with the upper part as in their very young state. The destruction which they sometimes cause to the verdure of the country may be judged from the fact that in the year 1762, when, according to the account of the ingenious Mr. Curtis, author of the Flora Londinensis, &c., in many parishes about London subscriptions were opened, and the poor people employed, to cut off and collect the webs at one shilling per bushel, which were burned, under the inspection of the churchwardens, overseers, or beaistles, of the respective parishes. At the first onset of this business, and, as assured in some instances, that four-score bushes were collected in one day in the parish of Clapham alone. When these caterpillars are arrived at full growth, which is usually about the beginning of June, each spins itself a separate web, in which it changes to a dark-brown chrysalis, out of which in the beginning of July proceeds the moth.

The ravages of these insects in the current year, 1806, have been scarcely less than those above recorded.

But of all the moths of the tribe bombyces, the phaena mori, or silkworm moth, is by far the most important. This is a whitish moth, with a broad stripe across each of the upper wings. The caterpillar or larva, eminently known by the title of the silkworm, is, when full grown, nearly three inches long, and of a yellowish-grey colour, employed in the preparation of the web, to cut off and collect the webs at one shilling per bushel, which were burned, under the inspection of the churchwardens, overseers, or beaistles, of the respective parishes. When full-grown, the animal entirely cease to feed, and begins to form itself a loose development of silken fibres in some convenient spot which it has chosen, and in which it proceeds to wrap itself in a much closer covering, forming an oval yellow silken case or ball, about the size of a pigeon's egg, in which it changes to a chrysalis, and after lying thus enclosed for a short while, the body of the creature assumes a lustrous or brownish body, with a brown or greyish tips; which is white, with black spots; the upper pair being still further decorated by a pair of deep-yellow bands: the body also is of a deep golden yellow, with black spots. The caterpillar is of similar colour, and the chrysalis being a silkworm moth.

In the division tetrices, so named from the faculty which their caterpillars possess of rolling or twisting the leaves of the vegetables they inhabit, into a tubular form, stands the elegant phaena prasiana, an inhabitant of the oak, and sometimes of the alder; the upper wings are of fine green, with two oblique yellow stripes; the lower wings pale or whitish. The caterpillar is of a yellowish-green, with white specks, and the end of the body orange-coloured.

In the division pyraulae stands the phaena farinalis, distinguished by the polished surface of its wings, which have a large glistening brown middle area or patch, while the remainder is marked by whitish streaks. This insect, when sitting, has an oblong triangular outline, and the abdomen is turned up at the tip.

The division called fereus comprehends those moths which have the whole of their surface, even of the wings, brown, and which, though often of very elegant colours. Of this tribe is the phaena pellidae: it is of a nearly white colour, with very numerous black spots: its caterpillar is greasy, appearing in great quantities on various sorts of fruit-trees during the decline of summer, and
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committing great ravages on the leaves: and the abdomen rounded the legs are verythese caterpillars inhabit a common web, and long, and the palpi or clampers are stronglyusually move in large group es together; toothed on the inner side by several sharpthe first pair of
their colour is a pale greyish yellow, with pointed curved processes
numerous black spots; each caterpillar, at the legs have all the appearance of a pair of anlime of its change to chrysalis, envelops it- tenna: far exceeding the rest in length, arid
self in a distinct oral web with pointed extre- being of a slender or filiform shape.
The
mities; and many of these are stationed close whole insect is of a deep chesnut-brown coto each other, hanging, in a perpendicular lour, with a yellowish cast on the abdomen.
direction, front the internal roof of the ge- Its particular history seems to be little known,
neral enclosing web; the chrysalis is blackish, but there can be no doubt of its being of a
and the moth appears in the month of Sep- predacious nature, living probably on the
smaller insects.
tember.
Phalangium caudatum is, in general, of
To this division also belong the moths emphatically so called, or cloth-moths. Of these rather smaller size than the former, and of a
the principal is the phalama vestianella, lengthened shape, with shorter limbs in prowhich, in its caterpillar state, is very destruc- portion it is principally distinguished by the
tive to woollen cloths, the substance of which long setaceous process in which -the abdomen terminates: the chela or clampers are
it devours, forming for itself a tubular case
with open extremities, and generally ap- large, and toothed on the inside towards the
proaching to the colour of the cloth on which' tips. The general colour of the animal is
This mischievous species chesnut-brown. ft is a native of the East
it is nourished.
changes into a chrysalis in April, and the Indies.
To this genus belong those well-known inmoth, which is universally known, appears!
sects called long-legged, shepherd, or harchiefly in May and June.
In the last division, called alucitse, is one vest spiders, being popularly considered as
of the most elegant of the insect tribe, though such, though differing very considerably from
not distinguished either by large size or spiders properly so named. The most comIt is a small moth, of a snowy
mon insect of this kind is the phalangium
lively colours.
whiteness, and, at first view, catches the at- opil io of Linnaeus, which, during the autumn,
tention of the observer by the very remark- may be observed in gardens, about walls,
able aspect of its wings, which are divided &c. It is remarkable for its plump, but flatinto the most beautiful distinct plumes, two fish, orbicular body; and its extremely long
im each upper, and three in each under wing, and slender legs, which are generally so carand formed on a plan resembling that of the; ried, that the body appears suspended or elelong wing-feathers of birds viz. with a strong- vated to a considerable height above the surmiddle rib or shaft, and innumerable lateral face on which the animal rests: the eyes are
This moth, which is the phalama situated on the top of the head, and resemble
fibres.
pentudactyla of Linnxus, appears chiefly in two very minute glassy globules; the colour
the month of August. Its caterpillar, which of the whole animal is a pale greyish-brown.
is yellowish-green, speckled with black, feeds This species preys on the smaller kind of inon' nettles, and changes into a blackish chry- sects in general.
Among the minute species of phalangium,
salis enveloped in a white web.
Another very remarkable species of this the most remarkable is the phalangium candivision is the phalama hexadactyla of Lin- croides of Linnaeus, a very small insect, of a
iiams; each wing consisting of six distinct reddish-brown colour, and of slow motion,
plumes. The insect is of a pale grey-brown occasionally found among papers, dried
Its shape is obtusely oval,
colour, with several transverse lines or bars plants, &c, &c.
across the feathers, and exhibiting a very cu- with a sharpened front, furnished with a pair
It chiefly
of very long and large jointed claspers, which
rious spectacle in the microscope.
makes its appearance in the month of Sep- give the insect a very remarkable appeartember. This little moth is by the English ance the body is very much depressed.
collectors somewhat improperly called the This little insect has been occasionally refertwenty-plumed moth, the plumes being in red to very different genera. It is a species
See Plate which seems to vary considerably in size
reality twenty-four in number.
those which are found in our own country
]Vat. Hist. figs. 325, 326, 327, 323.
a genus of insects of rarely exceeding the length of the tenth of an
the order aptera. The generic character is, inch, while in some parts of Europe it appears
eyes tsvo vertical, and two la- to arrive at twice that length.
It is said by
legs eight
front furnished with cheliform anten- Linnaeus, but probably on no just foundation,
teral
to introduce itself occasionally under the skin,
na: ; abdomen generally rounded.
Of all the insects in the order aptera, and to excite a painful tumour; a circumfew perhaps will be found of a form more re- stance which, considering the size of the animal, seems scarcely possible.
pulsive than that of the present genus
It preys on
See Plate Nat.
which, exclusive of its spider-like shape, is, smaller and weaker insects.
in some species, armed with weapons resem- Hist. tig. 329.
Phalangium. See Anthericum s
bling those of the genus aranea, but operating
in
recian antiquity, a
with greater malignity. The phalangia differ
very much in size, some being very minute square battalion, consisting of 8000 men, with
insects, while others are equal in magnitude their shields joined, and pikes crossing each
other, so that it was next to impossible to
to the larger kind of spiders.
The phalangium reniforme is one of the break it.
This animal is a native
PH A LAPIS, or Canary-grass, a genus
largest of the genus.
of the hotter regions of the globe, being found of the trigynia order, in the triandria class of
It lias the geplants.
The calyx is bivalved, carinated,
in Africa and South America.
neral appearance of a very large spider, with and equal in length, containing the corolla.
the thorax heart- (or rather kidney-) shaped, There are 12 species, of which the most re:

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markable are the canariensh, or manured
canary-grass; and the arundinacea, or reed
canary-grass,
dhese are both natives of Britain.
The first grows by the load-sides, and
is frequently cultivated for the sake of the
seeds, which are found to be the best food
for the canary and other small birds.
The
second grows on the banks of rivers. It is
used for thatching ricks or cottages, and endures much longer than straw. Jn Scandinavia they mow it twice a year, and their
cattle eat it.
There is a variety of this cultivated in our gardens with beautifully striped
leaves.
The stripes are generally green and
white; but sometimes they have a purplish
cast This is commonly called painted ladygrass, ladies’ tressesS, or riband-grass.

PIIALEUCIAN

VERSE, in antient poetry, a kind of verse which consists of five feet,
the first of 'which is a spondee, the second a
dactyl, and the three last trochees
the following one of Martial:

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PHALANGIUM,
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Summam nec metu as di
PHALLUS, the morel, a
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optes,

genus of the order of fungi, belonging to the cryptogamia
class of plants.
The fungus is reticulated
above arid smooth below. There are thre
e
species; the most remarkable ar
1. The esculentus, or esculent morel, is a
native of Britain, growii g in woods, graves,
meadows, pastures, &c. The substance,

when

recent, is wax-like and friable ; tire colour a whitish yellow, turning brownish in
decay; the height of the whole fungus, about
four or five inches.
The stalk is thick and

clumsy, somewhat tuberous at the base, and
hollow in the middle. The pileus is either
round or conical at a medium about the size
of an egg, often much larger; hollow within;
;

base united to the stalk; and its surface
latticed with irregular sinuses.
The magnified seeds are oval. It is much
esteemed at table both recent and dried,
being commonly used as an ingredient to
heighten the flavour of ragouts.
are
informed by Gleditsch, that morels are observed to grow in the woods of Germany in
the greatest plenty in the places where
charcoal has been made.
Hence the good
women who collect them ;o sell, receiving a
its

cellular, or

We

how to encourage their growth, have
been accustomed to make fires in certain
places of the w oods, with heath, broom, vaccinium, and other materials, in order to obtain a more plentiful crop.
This strange
method of cultivating morels being however
sometimes attended with dreadful consequences, large woods having been set on fire
and destroyed by it, the magistrate thought
fit to interpose his authority, and the prachint

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now

interdicted.

The impudicus,

stinking morel, or stink-

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PHALANX,

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horns,-

is

and found in
from the earth

also a native of Britain,

woods and on banks.

It arises

under a

veil or velva, shaped exactly like a
egg, and of the same colour, having a
long fibrous radicle at its base. This egg-

lien’s

volva is composed of two coats or membranes, .the space between which is full of a
thick, viscid, transparent matter, which,
when dry, glues the coats together, and
shines like varnish.
In the next stage of
growth, the volva suddenly bursts into several lacerated permanent segments, from
like

the centre of which arises an erect, white.


cellular, hollow stalk, about five or six inches high and one inch in diameter, of a wavy-like frilly appearance, and most solid cadaverous smell, conical at each end, the base inserted in a white, concave, membranous, turbid, spiny, and the summit capped with a hollow, circular, perhaps without a fleck of the reticulated cellular surface, its base detached from the stalk, and its summit umbilicated, the umbilicus sometimes perforated and sometimes closed. As soon as the volva bursts, the plant begins to diffuse its indolent odors, which are so powerful and widely expanded, that the fungus may be readily discovered by the scent alone, before it appears to the sight.

PHARMACY, is defined the art of preparing, compounding, and preserving medicines.

The preservation of medicines merely consists in the application of rules for collecting vegetable, animal, and mineral productions, at certain seasons, or under particular circumstances, and of ensuring them against the injuries they would suffer by exposure to light, heat, air, moisture, &c. this, therefore, is the least extensive, and peculiar department of the pharmaceutical art. It is the preparation and composition of medicines that constitute the principal objects of that science of which we are here to treat.

To prepare medicines, is to produce an artificial mixture or composition, or a union of two or more substances, by which, either an essential change is effected in their nature, or their medicinal essence is preserved, while their form undergoes a new modification. The first of these effects is invariably the result of chemical action; the latter may be produced by mechanical and chemical agency, either singly or combined.

In the composition of medicines, no chemical union is, in any case, effected; for a change of principle is involved in the term chemical combination; whereas, by compounding medicines, we mean merely the mixing of them together for the purposes of increasing their efficacy, or otherwise qualifying, their individual agency, of disguising their taste and colour, or of giving them a more convenient shape.

Pharmacy, then, is the art of preparing the medicines for the object for which they are made, and for its instruments, the means by which mechanical or chemical change is operated upon the ingredients of which the materia medica is composed. The most orderly method, therefore, of considering this subject will be, first to describe the mode in which the component principles of substances are developed, separated and combined, to enumerate such principles, or give the name to medicinal articles, and secondly, to detail the individual processes of preparation, separation, and combination, with the general uses and average doses of medicines thus combined, separated, or prepared.

PART I.

Pharmaceutical operations, and general analysis of the different substances used in medicine.

Pulverization is a process too simple and common to require definition; it consists in reducing substances to powder, by beating, or forcibly overcoming the aggregative, in order to facilitate the agency of chemical attraction. In triturating, the same effect is produced by rubbing in place of beating the materials operated upon; when this last is carried to a certain extent, and assisted by the addition of a fluid which does not act chemically on the material operated upon, the process is denominated levigation.

The above processes are facilitated by separating, from time to time, the coarser from the finer parts of the materials: hence the method of using the powder over the vessels with apertures of various diameters: hence likewise the pharmaceutical process of washing, or, as it is termed, elutriation, by which, although in a different mode, the end is to be a simple process, the powdered substance being agitated in a fluid which does not act upon it as a solvent, the larger particles immediately subside, from which the fluid suspending the smaller is poured off, and suffered to stand at rest until these last are all deposited.

Most of the metals are mechanically divided by the operation called granulation; this consists of first filing or beating the metal into a powder, and then passing it through a series of sieves with apertures of various diameters: hence likewise the pharmaceutical process of washing, or, as it is termed, elutriation, by which, although in a different mode, the end is to be a simple process, the powdered substance being agitated in a fluid which does not act upon it as a solvent, the larger particles immediately subside, from which the fluid suspending the smaller is poured off, and suffered to stand at rest until these last are all deposited.

I he above are the principal of those mechanical operations which may be regarded as auxiliary or preliminary to such as immediately proceed on chemical action, or tend to effect an essential change in bodies: of these last the primary and most important is solution.

Solution, like pulverization, appears at first sight to be a simple process; but, however, in fact, an example of chemical attraction exerted between the particles of a solid and of a fluid substance; and although the solvent or active power is in vulgar conceptions attributed to the latter, "the attraction between the solvent proceeds reciprocally, and is not more exerted by the one than by the other." Solution, however, of bodies in water, differs from most cases of chemical solution, in scarcely exhibiting an actual change in the properties of such bodies. This process therefore may be regarded as, in some measure, an exception to the general law of chemical action. Solution is aided by mechanical division; it is accelerated by agitation; and in most instances proceeds with a rapidity proportionate to the degree of temperature to which the solvent and solvent are subjected; because, by pulverization, agitation, and heat, the power by which the minute particles of individual bodies are held together is weakened, and thus mutual attraction is expedited.

Solution is also usually denominated, according to the nature either of the solvent or solvent, or the manner in which the process is effected.

When we have a combination of saline or earthy substances, the solvent used is only soluble in one, and part in another fluid, the one portion may be separated from the other by the application of its appropriate solvent; such mode of solution is denominated seduction, and the result obtained a leye.

When a fluid is applied to any vegetable or animal matter, so as to dissolve or attract only part of its principles, the operation is called onection.

When a solution is effected without artificial heat, we denominate the process maceration; if a moderate heat is employed, digestion. When boiling fluid is poured upon a substance, and the vessel containing the fluid is heated, that part not capable by this degree, or mode of heat, of being vocalized or evaporated, is thus obtained in a solid form; this process is denominated evaporation. Many substances, especially of the saline class, when thus treated, after the evaporating process has been carried to a certain extent, concrete into hard masses, transparent, and of a regular form; such concretions are termed crystals, and the process which engenders them crystallization. Crystals are abundantly formed in nature by slow and spontaneous, in place of a hasty and artificial evaporation; indeed it has recently been shown that every medicinal plant, or organic substance deserves to be regarded as a crystal. The figure which the body assumes as the result of crystallization is invariable and peculiar to itself. Hence the classification of crystals, according to their form, as into prismat, rhomboëd, &c. external circumstances, however, often interfere with this regularity.

The transparency of crystals, which essential to their existence, depends upon a certain quantity of water diffused through them, called therefore their water of crystallization; when this is expelled, by whatever means, the density, pupilicity, and figure of the crystal, are lost. When crystal, like thus destroyed, in consequence of exposure to air, they are said to effloresce. When water is absorbed by a crystal, so that it loses its crystalline, and assumes a mellow condition, it is said to deliquesce.

Precipitation is another mode by which a solid is separated from a fluid body. If to a solution is added a substance having a more powerful attraction to the fluid than the solute, matter will be deposited, and thrown down or precipitated in a solid form; or the added matter may enter into combination with the solvent itself, and produce a compound no longer soluble, which will consequently be in the same manner precipitated.

When from a given solution or mixture, the volatile rather than the fixed or solid matter is wished to be separated, the processes of distillation or sublimation are had recourse to; in the former, the matter subjected to a given degree of heat in vessels formed so as to collect the vapour, and again condense or reduce it to fluidity; by the latter, the volatile matter is likewise separated, and again condensed, but the reduction is into the state not of fluidity but of solidity.

After solution, fusion is the next in importance of pharmaceutical processes. This operation is usually performed in vessels called crucibles, which are cups formed of black lead, of earthenware, or of glass, which heat is applied generally by a furnace. Fusion is employed in order to effect chemic-
PHARMACY.

A composite analysis of the properties of substances

**Phosphorus**

Phosphorus is a non-metallic element with the chemical symbol P. It is a greyish-white, flammable substance that can be found in various forms. Phosphorus combines readily with oxygen and nitrogen, forming compounds such as phosphorus pentoxide (P₂O₅) and phosphorus pentoxide nitride (P₅N₅). It is used in the production of phosphorus compounds, including phosphoric acid, which is a key ingredient in many food products and cleaning agents.

**Azote**

Azote, also known as nitrogen, is a colourless, odourless, and tasteless gas that makes up about 78% of the Earth's atmosphere. It is essential for life as it is a component of proteins, nucleic acids, and many enzymes. Azote is also a component of the atmosphere and is used in the production of ammonia, which is used in the manufacture of fertilizers and explosives.

**Hydrogen**

Hydrogen is the lightest and most voluminous element, making up about 75% of the mass of the Universe. It is a colourless, odourless, and tasteless gas that is crucial for life as it is a component of water and many organic compounds. Hydrogen is also used in the production of hydrogen fuel, which is considered a clean and sustainable energy source.

**Sulphur**

Sulphur is a chemical element with the symbol S. It is a yellowish, odourless gas that is used in the manufacture of various compounds, including sulphuric acid, which is used in the production of fertilizers and other chemicals. Sulphur is also used in the manufacture of fireworks and matches.

**Carbon**

Carbon is a chemical element with the symbol C. It is a non-metallic element that is found in various forms, including graphite, diamond, and fullerenes. Carbon is used in the production of various compounds, including carbon dioxide, which is a greenhouse gas, and hydrocarbons, which are used in the production of fuels.

**Oxygen**

Oxygen is a chemical element with the symbol O. It is a colourless, odourless, and tasteless gas that is essential for life as it is a component of water and many organic compounds. Oxygen is also used in the production of various compounds, including oxides, which are used in the manufacture of pigments and other chemicals.

**Azote, like oxygen, when pure and unincombining, always exists in a gaseous form:** it constitutes the remaining three-fourths of the atmosphere. It is lighter than atmospheric air; it is unable to support respiration or combustion; and in the strictest sense it is not inflammable. Combined with oxygen, in the forms of combination, as in water, or in the form of oxygen, as in the atmosphere, it is distinguished from analogous gases by its being the acidifying principle.

**Oxygen constitutes nearly one-fourth of atmospheric air; united in a certain proportion with hydrogen, it forms water; and with certain inflammable substances, acids. Indeed the element derives its name from being the acidifying principle. Oxygen, however, unites with many substances without rendering them acid; such are the compounds which this element forms with the metals, as well as with a large number of both vegetable and animal productions.**

**Azote, like oxygen, when pure and unincombining, always exists in a gaseous form:** it constitutes the remaining three-fourths of the atmosphere. It is lighter than atmospheric air; it is unable to support respiration or combustion; and in the strictest sense it is not inflammable. Combined with oxygen, in the forms of combination, as in water, or in the form of oxygen, as in the atmosphere, it is distinguished from analogous gases by its being the acidifying principle.
fixed by mere exposure to heat; sometimes the atmospheric air is admitted in conjunction with heat; fermentation is often employed to separate the constituent principles of materials treated in this manner. In one analysis, by which oxygen is communicated to the substance operated upon; and by the resulting compound, the nature of the acidible base is indicated.

Gum is one of the most abundant among the proximate principles of vegetable substances; it is glutinous, insipid, without odour, and soluble in water, constituting a viscous solution, denominated mucilage. It is insoluble in alcohol, ether, or oil. It does not absorb oxygen from the atmosphere; it is neither volatile nor fusible. At a temperature beyond the boiling point, but beneath that of ignition, gum is decomposed, and affords an aperient acid, ammonia, carbonic acid, and carbonated hydrogencarbon; the residuum is charcoal with a certain quantity of lime.

The ultimate principles of gum are oxygen, hydrogen, carbon, azote, and lime. The medicinal qualities of gum are trivial. In pharmacy it is employed principally as a medium of fusion of various substances with water.

Resin. This is another proximate principle existing in abundance in vegetable products. It is generally, but not always, united with gum. Resin is not soluble in water, but, unlike gum, is soluble in alcohol, ether, or oil. It can also dissolve oxygencarbon, when heated to ignition and burns; and is fusible by heat nearly that of boiling water. When volatilized, however, it is invariably decomposed; its products are water, arentic acid, a burnt or healing spirit, and a charred residuum. Its ultimate principles are carbon, hydrogen, oxygen, and azote.

Resins are much more active on the living system than gums. The virtues of many medicinal substances depend exclusively on their resinous part. The extractive matter is another vegetable principle, which until lately was confounded with the gum and resin. It is equally soluble in water and alcohol. It is likewise, at a certain temperature, absorbs oxygen. It affords, upon being exposed to heat, empyreumatic acid and oil, and some ammonia. Its elements are carbon, hydrogen, oxygen, and azote.

This vegetable principle it is difficult to obtain pure and unmixed.

Oil. This is of two kinds, expressed or unctuous, and volatile or essential. These have some qualities in common, and others characteristic of each. Expressed oils are viscid, almost without taste or odour: they congeal by cold, and are insoluble either in water or alcohol. With alkalies they form soap. At a temperature of 212°, they are decomposed, and afford water and carbonic acid. Their ultimate principles are carbon, with a small proportion of hydrogen.

These oils are generally found in the seeds and fruits of vegetables, from which they are separated by mechanical pressure, or by boiling. Some of them have medicinal virtues, but they are commonly employed merely as lubricants. Volatile or essential oils are quickly dissipated by the heat of boiling water, without suffering decomposition. They are more soluble in alcohol than in water. They slowly absorb oxygen, and are at length changed into resinos matter. They contain more hydrogen than the fixed oils.

Essential oil exists in abundance in the aromatic plants, and appears to constitute the aromatic, emanent with some essential oils have supposed this last to be a peculiar and exclusive principle. It is usually extracted from the vegetable by distillation. As medicines, these oils are highly stimulant. The natural combination of essential oil and resin, which exists in some plants, constitutes balsam, which in some cases has also a peculiar acid in its composition.

Camphor. This is a distinct vegetable principle. It is insoluble in water, but is soluble in alcohol, oil, and ether. It evaporates even at the ordinary temperature of the atmosphere. When distilled, it is decomposed, and affords a pungent volatile oil, amounting to nearly one-third of its weight, while carbonic and hydrocarbonic acid gases escape, and a quantity of charcoal remains. Camphor then appears to contain a greater proportion of carbon and perhaps of oxygen than the essential oils. The medicinal powers of camphor are very considerable.

Wax is a solid, tenacious, and inflammable principle, holding nearly the same relation to expressed, that camphor does to essential oil.

Fecula is an important principle in vegetals. It is, when existing separately, mild and insipid. It is not soluble in cold water. With boiling water, it forms a jelly. It is insoluble in alcohol; but is decomposed by certain processes into sugar. Fecula is composed of oxygen, carbon, and hydrogen. It is by far the most nutritious principle in vegetable matters.

Gluten. A thick fibrous substance found in the farina of some plants. It is insipid, elastic, insoluble in water, and but sparingly soluble in alcohol. Its prominent principle is to be azote.

Albumen, or egg-white, is named from its resemblance to a principle in animal matter. This is soluble in cold water, and coagulated by heat or alcohol. It affords much ammonia on exposure to heat. Albumen generally found united with gum and extract. It is soluble in water, and in alcohol. It is converted by fermentation into alcohol; and this last, by a second-stage of fermentation, becomes acetic acid. So-called matter consists of oxygen, carbon, and hydrogen.

The saline principle in vegetables is named their essential salt. Essential salts are either acids or bases.

The native vegetable acids which have been detected, are seven, viz., the malic, which is contained in apples, and other fruits, previous to their maturity. It is converted into the oxalic acid by the agency of nitric acid.

The oxalic. This has the largest proportion of oxygen, of any native vegetable acid. It is soluble, and capable of crystallization. Its distinguishing property is its very strong attraction for lime.

The citric. This attracts the earths in general more forcibly than the alkalies.

The tartaric, which is extremely soluble in water, and crystallizable. It has been imagined to contain a larger portion of hydrogen than any other of the acids.

The acetous. This acid is more usually the produce of fermentation. It is likewise found native in the sap of the vine; &c. It yields upon decomposition a small portion of ammonia.

Volatile fatty acid is found in several balsams and gum-resins. This is soluble in boiling water, and upon cooling separates in white flakes.

The gallic is the last of the native vegetable acids. This has generally been supposed to constitute the principle of astringents in vegetables. It exists abundantly in gall-nuts, and other vegetable astringents. Its distinguishing property is its forcible attraction to the oxides of iron, with which it forms a precipitate of a very deep black. The gallic acid contains a large quantity of carbon, with some oxygen, and a very small quantity of hydrogen.

The tannin, or tanning principle, has hitherto primarily connected with the gallic acid. This principle is characteristic of the peculiarity of combining with animal jelly, and forms with a hard insoluble substance. Tannin is found in considerable quantity in vegetable astringents, and is usually united with the gallic acid.

Besides the above vegetable acids, several compounds exist in some vegetables, formed by the union of sulphuric, nitric, muratic, carbonic, and phosphoric acids, with the alkalis and carbons.

The lignonous part, or fibre, of the vegetable, is enumerated among its proximate principles. This is in a manner the basis for the attachment of its other principles. It is insipid and insoluble. With nitric acid it affords the malic and oxalic acids. It appears to be principally formed of carbon, combined with oxygen and hydrogen.

From the above enumeration of the proximate principles in vegetables, the utility of those pharmaceutical processes to which they are subjected, may with facility be perceived. These need not again be described.

The next paper will conclude the present section by a general notice of the principles of such animal substances as are medicinally employed. The number of articles which have entered into the materia medica from the animal kingdom is comparatively small. Animal have the same general chemical characters with vegetable products. The principal difference is constituted of the former to undergo the putrefactive process, and by their affording a larger quantity of ammonia or volatile alkali when decomposed by heat; these peculiarities appear to be principally derived, as above noticed, by the presence of azote in a much larger proportion in animal than in vegetable matter. This in decomposition unites with the hydrogens which animal substances likewise contain in abundance, and thus constitutes the ammonia. Animal substances contain likewise sulphur and phosphorus; and for the most part the carbon which enters into their composition is much inferior in quantity to what is found in vegetables.

The vegetable gluten and albumen we have already described as resembling the animal. Animal fat bears a considerable resemblance to vegetable oil. Gelatine is like mucilage or fecula. Milk contains a principle similar to the succinatic matter in the vegeta-
This powder is the basis of the common carbonate. It is sprinkled on the skin in the cutaneous inflammations of children.

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If rendered friable, the spurt retains its bitterness and astringency, the drying process has been properly conducted. It is in this state that it is chiefly used in medicine. Dose from one to three grains.

Pulverum extractio, extraction of pulps, Ed. Pulverum preparatio, Lond.

Boil those fruits which afford pulp, if unripe or if ripe and dry, with a little water; then express the pulp through a hairsieve, and as it does so, add an earthen vessel, stirring it frequently lest it burns, until it assumes the consistence of honey. The cassia fruit pulp is to be boiled in a bruiséd pod, and the water evaporated to a due consistence. When fruits are ripe and fresh, the pulp may be squeezed through a sieve without previous boiling.

The following preparations are only found in the London Pharmacopoeia:

Anemoni purificatio, purification of gum amomum.

Boil the ammonium in water until it is soft, and by a press strain it through a hempen bag, let the resinosum matter have time to subside. Evaporate the water, mixing towards the end of the evaporation the resinosum and gum-aromatica; and other similar gum-resins may be purified in the same way. Any gum also which melts easily, such as galbanum, may be purified by putting it into an ox-bladder and keeping it in boiling water, till it becomes so soft that it may be pressed through strong thin linen cloth, and freed from its impurities.

Styraci purificatio, purification of Storax.

Having dissolved Storax in alcohol, strain the liquor, and distil it with a gentle heat to a proper consistence.

Corni cervi utrio, burning of heart-burn.

Burn pieces of heart-burn until they become white, then rub them to a very fine powder.

Millepede preparatio, preparation of milipedes.

Suspend these, inclosed in a thin linen bag, over proof spirit heated in a close vessel, that they may be killed by the vapour, and rendered friable.

Spongix utio, burning of sponge.

With sponge cut into small pieces; and when freed from strong matter, burn it in a close iron vessel until it becomes black and friable; then rub it into a fine powder.

Conservae, conserves.

The conserves that are retained in the Ph. Ed. are the conserva corticis exterioris recentis fructus citri aurantii, rutula a brausa; conserve of the outer rind of the orange, are preserved by a grater, Ed. Conserva aurantia hispanoauranti hispamuri phlomis corticis exterioris, Lond. Conserva fruticis rose caninae matris, a seminibus coramque rubri solacium purgas, conserve of the fruit of dog-briars carefully freed from the seeds and reduced, Ed. Conserva cynosbati, Lond.

Conservae gallicae nodumum explicatum, conserve of the unknown petals of the red rose, Ed. Conserva rose rubrae, Lond.

In each of these the vegetable is to be beat into a pulp, and during the beating three
In addition to the above, the London college retain conserve altheae maritimi, conserve of sea-woodmoss. Conserva lujica, conserve of wood-sorrel. Conserva aris, conserve of arum. Conserva pruni sylvestris, conserve of pears. Conserva siltora, conserve of squills.

**Succis, juices.**

Succus cohlearis officinalis compositus, compound juice of scurry-grass, Ed. Succus cohlearis compositus, Lond. Take of juice of scurry-grass, juice of water-cresses expressed from recently gathered herbs, juice of the orange-flower, of each two pounds; spirit of mastic half a pound; mix and let them stand until the impurities have subsided, then pour off the liquor. This preparation is scarcely in use. 

Succis inspissati, inspissated juices or extracts.

Succus spissatus aconiti napellii, inspissated juice of aconite or wolfsbane, Ed. Braise the fresh leaves, and press the juice strongly through a hempen bag; which reduced, by evaporation in open vessels heated by boiling water saturated with muriat of soda, to the consistence of thick honey. After the mass has cooled, it is to be kept in glazed earthen vessels, and moistened with alcohol. A remedy chiefly employed in obstinate cases of chronic rheumatism. Dose from five to six or more grains.

In the same manner are to be prepared the four following:

Succus spissatus atropis belladonnae, inspissated juice of deadly nightshade, Ed. This has been used in convulsive disorders and in schirrus. Dose one grain, gradually increased.


Succus spissatus hyoscyami nigri, inspissated juice of black henbane, Ed. Dose one grain, increased.

Succus spissatus lacteae virorum, inspissated juice of strong-scented lettuce, Ed. *Principally used in Germany for dropsey. Dose four or five grains, largely increased.*

Succis spissatus sambuci nigrae, inspissated juice of black elder, Ed. Succis spiss. sambuci, Lond. Five pounds of elder-berry juice, and one pound of sugar, are to be gently boiled to the consistence of thick honey. This also keeps very well, an eligible preparation. It has been employed as a laxative, in the dose of half an ounce or more.

Succus spissatus monardae elaterii, inspissated juice of wild cucumber, Ed. Lati. compon. Lond. Cut the ripe fruit of the wild cucumber, and press the expressed juice through a very fine hair sieve. Boil it a little, and set it aside for some hours, that the thick parts may subside. Pour off the thinner parts, and then separate the remainder by straining. The thicker part which remains is to be covered with a linen cloth, and dried by a gentle heat.

This preparation has been employed as a purgative cathartic. Dose one or two grains.

The additional preparations in the Ph. Lond. are, succus spissatus ribis nigri, inspissated juice of black currant; and succus spissatus limonis, inspissated juice of lemon.

**Oleum**.

**Cassia**, Ed. Oleum angulare communis, Ed. Oleum angulare communis, Lond. Take any quantity of fresh almonds, bruise them in a stone mortar, enclose the mass in a hempen bag, and express the oil by a press without heat.

In the same manner the oleum linii usitatis-similis, oil of linseed, Ed.; ole. censea linii, Lond. is to be expressed.

To the above, the London college add, ole. ricini, castor-oil; and ole. simpeos, oil of mustard. The former of these, however, is usually prepared by decoction, and is made in the West Indies.

**Emulsiones**, emulsions.

Emulsion angulatae communes, edule, Ed. Emulsion angulatae communes, Ed. Take of sweet almonds (blanched) an ounce; water two pounds and a half; beat the almonds in a stone mortar, and gradually add the water, then strain.

This emulsion is employed freely as a demulcent.

Emulsion gammii minosi nitroce, Arabic emulsion. This is prepared in the same manner, adding while beating the almonds two ounces of gum-arabic mucilage. Employed with the same intention as the above.

Emulsion camphora, camphor emulsion. Camphor one scruple, blanched sweet almonds two drachms, refined sugar one drachm, water six ounces; to be mixed in the same manner as the almond emulsion.

Dose two ounces.

**Infusia**, infusions.

Infusum cinchona officinalis, infusion of Peruvian bark.

Take of Peruvian bark powdered one ounce; water one pound; macerate for four-and-twenty hours, and then strain.

This contains only a small portion of the active principle of the bark. Dose two ounces.

Infusum digitalis purpurea, infusion of foxglove.

Take of the dried leaves of foxglove one drachm; boiling water eight ounces; spirit of cinnamon one ounce. Macerate for four hours, and strain. Dose in dropsey half an ounce, and a dram, twice a day, gradually increased.

Infusum gentiane lucre compositum, compound infusion of gentian, Ed. Infus. gentiane comp. Lond. Take of gentian root half an ounce; dried orange-peel one drachm; coriander-seeds half a drachm; diluted alcohol four ounces; water one pound. Pour on first the alcohol, and after three hours the water; then macerate for twelve hours without heat, and strain.

An useful medicine in dyspepsia. Dose two ounces.

Infusum mirum catechu, infusion of catechu.

Take of extract of catechu two drachms and a half; cinnamon half a drachm; boiling water seven ounces; simple syrup one ounce. Macerate the extract and cinnamon with the water in a close vessel for two hours; then strain, and add the syrup. Principally employed in diarrhoea. Dose one ounce.

Infusum rhei palmati, infusion of rhubarb.

Take of rhubarb root half an ounce; boiling water eight ounces; spirit of cinnamon one ounce. Macerate the root with the water in an earthen vessel (which is not glazed with lead) for twelve hours; then, having poured on the acid, strain the liquor and add the sugar.

Principally used as a mild astringent gargle.

Infusum tamarindae indicae cum cassis semp. infusion of tamarind and currants.

Take of the prepared fruit of the tamarind one ounce; currants half an ounce; rhubarb root twelve ounces; and a small quantity of alcohol. Macerate the ingredients for twenty-four hours in a small vessel not glazed with lead, which is to be shaken frequently, and after four hours standing, the liquor is to be strained.

This is a mild and pleasant purgative. The whole of the above quantity may be taken at a time.

N. B. The infusion succus simplicis of the Ph. Lond. is prepared from senna one ounce and a half; ginger one drachm; boiling water one pint; macerated for an hour and strained.

The infusion emmenega tartaricae, prepared from senna one ounce; coriander-seeds half a drachm; refined sugar two ounces. Macerate the senna in a small vessel not glazed with lead for twelve hours; then, having poured on the acid, strain the liquor and add the sugar.

Principally used as a tonic and astringent gargle.

Infusum tympanum indicae cum senna, infusion of tamarind and senna.

Take of the prepared fruit of the tamarind one ounce; senna-leaves one drachm; coriander-seeds half a drachm; refined sugar half an ounce; boiling water eight ounces. Macerate the ingredients for twelve hours, and then strain. The crystals and vegetable mass are to be dissolved in the water by boiling, and the liquor while hot poured on the senna and coriander, the maceration being continued for an hour in a covered vessel, and when cold strained. Dose of each from two to eight ounces.

**Potio digitalis**, Chalk potion, Ed. Potio digitalis, Lond. Take of prepared carbonate of lime one ounce; refined sugar half an ounce; mucilage of gum arabic two ounces. Rub them together, and gradually add two pounds and a half of water, and spirit of cinnamon two ounces.

An antacid. Dose one or two ounces.

The four following mixtures are found only in the Ph. Lond.

**Mistura camphorata**, camphorated mixture.

Take of camphor one drachm; a small quantity of rectified spirit of wine; refined sugar one ounce; macerate for two hours, and strain. Dose one drachm.
Mistura boiling distilled powdered refined water.

Take of musk two scruples; powdered gum arabic, refined sugar, of each a drachm; rose-water six ounces. Rub the musk with the sugar, then with the gum, and gradually add the rose-water. Dose an ounce.

Mistura mucosa, mixtus muscorum.

Take of gum tragacanth, mastic of gum tragacanth, Ed. Mucilago tragacanth- ther, Lond.

Take of tragacanth gum powdered an ounce; boiling water eight ounces. Macerate for twenty-four hours, and rub carefully the gum so that it may be dissolved; then strain it through linen.

Used chiefly in making troches.

Mucilago munos rubicea, mastic of gum arabie, Ed. Mucilago gymnii arabis, Lond.

Take of powdered gum arabic one part; boiling water one part. Digest with frequent shaking until the gum is dissolved; then strain through linen.

Employed principally as a demulcent, and as a vehicle for suspending oils, &c.

Mucilago seminum cyclodii malii, Lond. mucilage of quince-seed.

Take of quince-seed one drachm; distilled water eight ounces. Boil with a gentle heat for ten minutes, and strain through linen.

This is seldom employed in medicine.

Aqua calcis, lime-water, Ed. Aq. calcis, Lond.

Take of lime recently prepared half a pound. Place it in an earthen vessel, and sprinkle it with four ounces of water, keeping the vessel covered while the lime becomes hot and pulverizes; then pour on twelve pounds of water, and by agitation mix it with the lime. This agitation is to be repeated after the lime has subsided, which is to be done about ten times, keeping the vessel closed to prevent the accession of air. Now let the water be strained through paper, interposing glass rods between the filter and the funnel, that it may pass through as quickly as possible. It is to be kept in bottles well stoppered.

Take of sugar is used as a tonic and astringent. Dose from one to two pounds daily.

Decocta, decoctions.

Take of altareth- root dried four ounces; raisins freed from their seeds two ounces; water two pounds. Boil down to five pounds; strain; put aside the strained liquor until the impurities have subsided, and pour off the clear liquor.

As a demulcent to be drunk ad libitum.

Decoctum anthemidis nobilis, decoction of camomile.

Take of dried camomile flowers an ounce; caraway-seeds half an ounce; water five pounds. Boil for a quarter of an hour, and strain.

The decoction pro enemate, and decoction pro profugis, of the London Ph. are similar to the above.

Decoctum cinchona officinalis, decoction of Peruvian bark, Ed. Decoctum cinchona, Lond.

Take of Peruvian bark in powder one ounce; water a pound and a half. Boil for ten minutes in a closed vessel, and while still hot strain. Dose two ounces.

Decoctum daphnes mezerei, decoction of mezereon, Ed.

Take of the mezereon-bark two drachmas; of bruised liquorice-root half an ounce; water three pounds. Boil with a gentle heat down to two pounds, and strain.

This decoction has chiefly been given in cases of erysipelas, either with or without mercury. Dose six or eight ounces.

Decoctum geofferæ inermis, decoction of cabbage-tree bark, Ed.

Take of the cabbage-tree bark in powder an ounce; water two pounds. Boil gently to one pound, and strain.

This is sometimes given as an anthelmintic. Dose two ounces.

Decoctum guaiaci officinalis compositum, compound decoction of guaiacum.

Take of the shavings of guaiacum-wood three ounces; raisins two ounces; sassafras-root, liquorice-root, of each an ounce; water ten pounds. Boil the water with the guaiac and raisins with a gentle heat to five pounds, and towards the end of the decoction add the roots; then strain without expression.

It is chiefly given in rheumatism. Dose two or three pints daily.

Decoctum orae distillata, decoction of barley, Ed. Decoct. hordei, Lond.

Take of pearl-barley two ounces; water five pounds. First wash off with cold water the flour adhering to the barley; then boil the barley for a short time with about half a pound of water, to extract the colouring matter. Put the barley thus purified into five pounds of boiling water. Boil this to one half, and strain.

A common disease in fever. In the Ph. Lond. a compound decoction is ordered with figs, raisins, and liquorice.

Decoctum polygalæ seegeræ, decoction of seneca.

Take of seneca-root one ounce; water two pounds. Boil to sixteen ounces, and strain.

Dose one or two ounces.

Decoctum snákias sarsaparilla, decoction of sarsaparilla, Ed. Decoct. sarsaparilla, Lon.

Take of cut sarsaparilla six ounces; water eight pounds. Digest for two hours in a heat of about 193°; then take out the root and bruise it, return it to the liquor, and boil it with a gentle fire to two pounds. Then express and strain.

Sarsaparilla in this form is employed in combination with other medications.

The decoctions of the London, which are not in the Ed. Ph. are the following:

Decoctum coraniervi, decoction of harts-horn.

Take of burnt and prepared harts-horn two ounces; gum arabic, of each a drachm; distilled water three pounds. Boil, stirring constantly, down to two pounds, and strain.

This is a useless preparation.

Decoctum heliothor, decoction of wine.

Take of white heliothor root in powder one ounce; distilled water two pints; rectified spirit of wine two ounces. Boil the water with the root to one pint, and when the liquor is cold, strain it and add the spirit.

This is principally employed as a wash in psoriasis.

Decoctum sarsaparillæ compositum, compound decoction of sarsaparilla.

Take of sarsaparilla root sit and bruised six ounces; bark of sassafras root, shavings of cinnabar wood, liquorice root bruised, of each one ounce; mezereon three drachmas; distilled water ten pints. Macerate for six hours with a gentle heat; boil to five pints; towards the end of the boiling add the mezereon, and then strain.

This is an improvement upon the Lisbon diet-drink. Dose four or six ounces, three or four times a day.

Decoctum ulmi, decoction of elm.

Take of the elm bark, fresh bruised, four ounces; distilled water four pints. Boil to two pints, and strain.

This has been used in cutaneous affections.

Syrups, syrups.

Syrups simplex, common syrup.

Take of refined sugar, powdered, fifteen parts; water eight parts. Dissolve the sugar with a gentle heat, and boil it a short time, so as to form syrup.

Syrups acidi aceti, acidulous syrup.

Take of acetic acid two pounds and a half; refined sugar three pounds and a half. Boil so as to form syrup.

Syrups althaeæ officinalis, syrup of althæa, Ed. Syr. althææ, Lond.

Take of fresh althæa root cut, one pound; water ten pounds; refined sugar four pounds. Boil the water with the root to one-half, and strain it by strong pressure. Put aside the strained liquor, that the impurities may subside; and to the purified liquor add the sugar; then boil, so as to form a syrup.

This is a superfluously preparation.

Syrups amonii zinziheris, syrup of ginger, Ed. Syrups zinziheris, Lond.

Take of ginger root beaten three ounces; boiling water four pounds; refined sugar four pounds. Boil the water with the root to one-half, and strain it by strong pressure. Put aside the strained liquor, that the impurities may subside; and to the purified liquor add the sugar, so as to make a syrup.

This is a pleasant and useful syrup.

Syrups citri auranti, syrup of orange-peel, Ed. Syr. cortis auranti, Lond.

Take of the fresh outer rind of the orange six ounces; boiling water three pounds;
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refined sugar four pounds. Macerate the root in the water for twelve hours; then to the strained liquor add the pounded sugar; and thus form a syrup, by applying a gentle heat. This syrup, like the former, is grateful and aromatic.

Syropus cithis medicus, syrup of lemon, Ed. Syr. Limonis, Lond. Take of the juice of lemons strained, after the impurities have subsided, three parts; refined sugar five parts. Dissolve the sugar so as to form a syrup. This syrup is used to sweeten and acidulate mixtures.

Syropus colchici autumnalis, syrup of colchicum. Take of the fresh root of colchicum, sliced into small pieces, one ounce; acacia acid and sixteen ounces; purified sugar twenty-six ounces. Macerate the root in the acid for two days, occasionally agitating the vessel; then strain it with a gentle pressure; to the strained liquor add the sugar, and boil it so as to form a syrup.

This has been given in dropsy, in the dose of from half an ounce to one ounce.

Syropus dianti caryophylli, syrup of clove July-flower, Ed. Syr. Caryophylli rubi, Lond. Take of the fresh petals of this flower, freed from the peels, one pound; boiling water four pounds; refined sugar seven pounds. Macerate the petals in the water for twelve hours; then, when the liquor is strained, add the pounded sugar, which is to be dissolved with a gentle heat, so as to form a syrup.

This syrup is of a deep red colour, and pleasant flavour.

Syropus papaveris somniifici, syrup of white poppy. Papaver papaveris albi, Lond. Take of the dried capsules of the white poppy, freed from the seeds, two pounds; boiling water thirty pounds; refined sugar four pounds. Macerate the capsules in the water for twelve hours; then boil until only a third part of the liquor remains; then strain by strong pressure. Boil the strained liquor to one-half, and again strain it, and then add the boiled liquor to the syrup, and boil it a little, so as to form a syrup.

This syrup is given principally as an anodyne to children. Dose to a child a year old one drachm.

Syropus rhanni catharticci, syrup of buckthorn, Ed. Syr. spinae cervinae, Lond. Take of the clarified juice of ripe buckthorn berries two parts; refined sugar one part. Boil so as to make syrup.

This is given as a cathartic. Dose an ounce to an ounce and a half.

Syropus rosae gallici, syrup of red rose. Take the dried petals of the red roses seven ounces; boiling water five pounds; purified sugar six pounds. Macerate the petals in water for twelve hours; then boil them a little, and strain; to the strained liquor add the sugar, and again boil it, so as to make syrup.

This syrup is not in much use; it is very slightly astringent.

Syropus rose centifoliae, syrup of damask, or pale rose, Ed. Syr. rose, Lond. Take fresh petals of the pale rose one pound; boiling water four pounds; refined sugar three pounds. Macerate the petals in water for twelve hours; having strained the liquor, add the sugar, and boil so as to form syrup.

A mild pectorative given to infants, in the quantity of two or three tea-spoonfuls.

Syropus syphyllarum, syrup of spurry. Take of the vinegar of spurry two pounds; pounded refined sugar three pounds and a half. Let the sugar be dissolved in the vinegar by a gentle heat. An active expectorant. Dose one or two drachms.

Syropus toluiferus balsami, syrup of tolu balsam, Ed. Syr. tolatuni, Lond. Take of common syrup two pounds; tincture of tolu one ounce. To the syrup recently prepared and taken from the fire, add by degrees the tincture, and gently agitate them together.

This syrup is only to be valued from its flavour.

Syropus vulva odoratae, syrup of violet, Ed. Syr. viole, Lond. Take of the fresh flowers of the sweet-scented violet one pound; boiling water four pounds; purified sugar seven pounds and a half. Macerate the flowers in the water for twenty-four hours, in a covered glass or earthen vessel; then strain without expression, and add pounded sugar, so as to form syrup.

A mild laxative. Dose to infants one or two tea-spoonfuls. The London Pharmacopoeia has the syrupus succi fructus mori, syrup of mulberry-juice. Syrupus succi fructus rubi, syrup of raspberry-juice. Syrupus succi fructus rubi nigri, syrup of black currant juice. Syrupus croceus, syrup of saffron. Syrupus papaveris, syrup of red poppy. The two last are principally employed on account of their colour. The mel acetatum, oxymel colchici, mel rose, mel salicis, oxymel salicis, vary but little from their corresponding syrups.

Fring, wines.

Vinum abies soccorinae, wine of soccorinae aloes, Ed. Vic. aloes, Lond. Take of soccorinae aloes powdered an ounce; lesser cardamom a large root, of each confused, one drachm; Spanish white wine two pounds. Digest for seven days, frequently agitation, and strain.

A stimulating cathartic. Dose from one to two drachms to an ounce.

Vinum gentiana compitum, compound gentian wine.

Take of gentian root half an ounce; Peruvian bark one ounce; orange-peel dried two drachmas; canella bark one drachm; diluted alcohol four ounces; Spanish-white wine two pounds and a half. The root and barks being bruised, pour first on them the diluted alcohol, and after four-and-twenty hours add the wine. Macerate for seven days, and strain.

Dose, as a stomachic, half an ounce, or six drachms.

Vinum ipecacuanhas, ipecacuanha wine, Ed. Vic. ipecac. Lond. Take of ipecacuanha root bruised one ounce; Spanish white wine fifteen ounces. Macerate, and after seven days strain through paper. Dose as an emetic one ounce.

Vinum nicotiana tabaci, tobacco wine. Take of tobacco leaves one ounce; Spanish white wine one pound. Macerate, and after seven days strain through paper.

Dose, as a diuretic, thirty drops increased.

Vinum rhei palmati, rhubarb wine. Take of the rhubarb root cut two ounces; canella bark one drachm; diluted alcohol two ounces; Spanish white wine fifteen ounces. Macerate for seven days, and strain through paper.

Dose from half an ounce to one ounce.

Acet., vinegars.

Acetum aromaticum, aromatic vinegar. Take of the rosemary tops dried, the dried leaves of sage, of each four ounces; lavender flowers dried two ounces; cloves two drachms; distilled acetic acid eight pounds. Macerate for seven days, and strain the expressed liquor through paper.

Principally employed as a perfumery.

Acetum aceticum camphoratum, camphorated acetic acid. Take of the stronger acetic acid six ounces; camphor half an ounce; alcohol as much as is sufficient. Rub the camphor into powder with the alcohol, which put into the acid, so as to dissolve it.

A grateful stimulant, snuffed up the nostrils.

Acetum scilla maritima, vinegar of squill, Ed. Acet. scill., Lond. Take of dried squill two ounces; distilled acetic acid two pounds and a half; alcohol three ounces. Macerate the squill with the vinegar for three days, then express it; add the alcohol; and when the impurities have subsided pour off the liquor.

Dose from one to two drachms.

Tincturae, tinctures.

Tinctura alicis soccorinae, tincture of aloes, Ed. Tinct. alic. Lond. Take of powdered soccorinae aloes half an ounce; extract of liquorice an ounce and a half; alcohol four ounces; water one pound. Digest with a gentle heat for seven days in a closed vessel, frequently shaking it (which is to be observed in the preparation of all tinctures. Dose one ounce, as a cathartic.

Tinctura aloes aetherei, ethereal tincture of aloes.

Take of myrrh, soccorinae aloes, of each an ounce and a half; English saffron one ounce; spirit of sulphuric aether one pound. Digest the myrrh with the spirit for four days in a closed vessel, then add the aloes and saffron. Again digest for four days; and when the faces have subsided pour off the tincture.

Dose one or two drachms.

Tinctura alicis cum myrrhis, tincture of aloes with myrrh, Ed. Tinct. alic. comp. Lond. Take of powdered myrrh two ounces; alcohol one pound and a half; water half a pound. Mix the alcohol with the water, then add the myrrh. Digest for four days, and when the mixture has acquired a tincture of aloes, and one ounce of English saffron; again digest for three days, and pour off the pure tincture.
Tinctura ammoni repletis, tincture of cardamom, Ed. Tinct. cardamomum, Lond.

Take of cardamom seeds four ounces; diluted alcohol two pounds and a half. Digest for seven days, and strain through paper.

This is a grateful aromatic. In the London Ph. a compound tincture of cardamom is described, in which are introduced caraway, cinnamon, and raisins.

Tinctura aromatica serpentinaria, tincture of snake root, Ed. Tinct. serpentinum, Lond.

Take of snake root two ounces; composed one drachm; diluted alcohol two pounds and a half. Digest for seven days, and filtrate through paper.

Dose two drachms.

Tinctura assafetida, tincture of assafetida, Ed. Tinct. assafetidei, Lond.

Take of assafetida four ounces; alcohol two pounds and a half. Digest for seven days, and strain through paper.

Dose one drachm.

Tinctura benzoes composita, compound tincture of benzoin, Ed. Tinct. benzoinum, Lond.

Take of benzoin three ounces; Peruvian balsam two ounces; ketapic aloes half an ounce; alcohol two pounds. Digest for seven days, and strain.

This tincture is in vulgar use to recent wounds.

Tinctura camphorae, tincture of camphor, Ed. Spiritus camphoratus, Lond.

Take of camphor one ounce; alcohol one pound. Mix so as the camphor may be dissolved.

A stimulating emollient.

Liquor camphoratus, camphor liniment, Lond.

Take of camphor two ounces; water of ammona six ounces; spirit of lavender sixteen ounces. Mix the spirit, and water of ammona; and distil from a glass retort, with a cold condenser, sixteen ounces.

This liniment is more powerful than the preceding.

Tinctura cassia senna composta, tincture of senna, Ed. Tinct. senae, Lond.

Take cassia leaves two ounces; jalap root one ounce; coriander seeds half an ounce; diluted alcohol three pounds and a half. Digest for seven days, and to the tincture silvred through paper add four ounces of refined sugar.

Dose an ounce.

Tinctura castorei, tincture of castor, Ed. and Lond.

Take of Russian castor an ounce and a half; alcohol one pound. Digest for seven days, and strain through paper.

In the London Ph. diluted alcohol is employed. Dose one drachm.

Tinctura castorei composita, compound tincture of castor.

Take of Russian castor an ounce; assafetida half an ounce; ammoniated alcohol one pound. Digest for seven days, and filter through paper.

Dose one drachm.

Tinctura cinchonae officinalis, tincture of Peruvian bark, Ed. Tinct. cinchonii, Lond.

Take of Peruvian bark powdered four ounces; diluted alcohol two pounds and a half. Digest for seven days, and filter through paper.

Dose two drachms.

Tinctura cinchonae composita, compound tincture of Peruvian bark, Lond.

Take of Peruvian bark powdered two ounces and a half; dried orange peel one ounce and a half; Virginian snake root three drachms; saffon one drachm; composed in powder two scruples; proof spirit twenty ounces. Digest for four days, and strain.

This is the external tincture. Dose two or three drachms.

Tinctura cinchonae ammoniata, ammoniated tincture of bark, Lond.

Take of powdered Peruvian bark four ounces; compound spirit of ammonia two pounds. Digest in a close vessel for ten days, and strain.

This is an improper preparation.

Tinctura colombo, tincture of colombo, Ed. Tinct. coimbriae, Lond.

Take of colombo root, beaten into powder, two ounces; diluted alcohol two pounds. Digest for seven days, and filtrate through paper.

Dose two or three drachms.

Tinctura convolvuli jalapi, tincture of jalap, Ed. Tinct. jalapum, Lond.

Take of jalap in powder three ounces; diluted alcohol fifteen ounces. Digest for seven days, and filtrate through paper.

Tinctura croci, tincture of saffron.

Take of English saffron an ounce; diluted alcohol fifteen ounces. Digest for seven days, and filtrate through paper.

This tincture is useful in some other diseases, but not of colour.

Tinctura digitalis purpurea, tincture of foxglove.

Take of the leaves of foxglove dried an ounce; diluted alcohol eight ounces. Digest for seven days, and strain through paper.

A most active and useful medicine. Dose ten grains, gradually increased.

Tinctura gentiana composta, compound tincture of gentian, Edin. and Lond.

Take of the dried root two ounces; orange peel one ounce; canella bark half an ounce; cochineal half a drachm; diluted alcohol two pounds and a half. Digest for seven days, and filtrate through paper.

Dose two or three drachms.

Tinctura gusiaci, tincture of gusiai.

Take of gusiai resin one pound; alcohol two pounds and a half. Digest for seven days, and filtrate through paper.

Dose two or three drachms.

Tinctura guaiaci, tincture of guaiacum.

Take of guaiac resin one pound; alcohol two pounds and a half. Digest for seven days, and filtrate through paper.

Dose two or three drachms.

Tinctura guaiaci ammoniata, ammoniated tincture of guaiacum, Ed. and Lond.

Take of guaiacum resin four ounces; ammoniated alcohol a pound and a half. Digest for seven days, and filtrate through paper.

This is a useful tincture in chronic rheumatism. Dose two or three drachms.

Tinctura helichorei nigri, tincture of black helichore, Ed. and Lond.

Take of black helichore root four ounces; cochineal half a drachm; diluted alcohol two pounds and a half. Digest for seven days, and filtrate through paper.

Dose one drachm.

Tinctura hyoscyamii nigri, tincture of black henbane.

Take of black henbane leaves dried an ounce; diluted alcohol eight ounces. Digest for seven days, and strain through paper.

Tinctura kino, tincture of kino.

Take of kino two ounces; diluted alcohol one pound a half.

Dose a drachm.

Tinctura lauris cinamomi, tincture of cinamon, Ed. Tinct. cinami, Lond.

Take of cinnamon bark three ounces; diluted alcohol two pounds and a half. Digest for seven days, and strain through paper.

Tinctura lauris cinamomii composita, compound tincture of cinnamon, Ed. Tinct. cinamomi comp., Lond.

Take of the cinnamon bark and cardamom seeds, of each an ounce; long pepper two drachms; diluted alcohol two pounds and a half. Digest for seven days, and strain through paper.

Tinctura meliae vesicatorii, tincture of combatinis, Ed. Tinct. melliis, Lond.

Take of catuaqui oak drachm; diluted alcohol one pound. Digest for seven days, and strain through paper.

Dose internally from fifteen to thirty drops.

Tinctura mimosae catechu, tincture of catechu, Ed. Tinct. catechii, Lond.

Take of catechu three ounces; cinnamon two ounces; diluted alcohol two pounds and a half. Digest for seven days, and strain through paper.

Dose one drachm.

Tinctura myrrhae, tincture of myrrh, Ed. and Lond.

Take of bruised myrrh three ounces; alcohol twenty ounces; water ten ounces. Digest for seven days, and filtrate through paper.

Tinctura opii, tincture of opium, Ed. and Lond.

Take of opium two ounces; diluted alcohol two pounds. Digest for seven days, and filtrate through paper.

Dose from fifteen to twenty-five drops.

Tinctura opii ammoniata, ammoniated tincture of opium.

Take of the acid of benzoin, and English saffron, of each three drachms; opium two drachms; volatile oil of anise half a drachm; ammoniated alcohol sixteen ounces. Digest for seven days in a closed phial, and filtrate through paper.

Dose from half a drachm to a drachm.

Tinctura opii camphorata, camphorated tincture of opium, Lond.

Take of hard purified opium powdered, benzoin flowers, of each one drachm; camphor two scruples; oil of anise one drachm; proof spirit two pounds by measure. Digest for ten days, and strain.

This is the elixir paregoric. Dose one or two drachms.

Tinctura phai palmatis, tincture of rhubarb, Ed. Tinct. rhubarbi palmantis, Lond.

Take of the rhubarb root three ounces; lesser cardamom half an ounce; diluted alcohol two pounds and a half. Digest for seven days, and strain through paper.

Dose half an ounce.
Take of rhubarb root two ounces; gentian root half an ounce; distilled alcohol two pounds and a half. Digest for seven days, and strain through paper.

Dose one-half an ounce.

Tinctura rhabi cum gentiana, tincture of rhubarb and gentian.

Take of rhubarb root ten drachms; scor- toline aloes six drachms; lesser cardamom hal an ounce; distilled alcohol two pounds and a half. Digest for seven days, and strain through paper.

Dose one drachm.

Tinctura socotrina, tincture of socotrine.

Take of rhubarb root two ounces; scor- toline aloes six drachms; lesser cardamom half an ounce; distilled alcohol two pounds and a half. Digest for seven days, and strain through paper.

Dose two drachms.

Tinctura socotrina distillata, tincture of socotrine distilled.

Take of rhubarb root one ounce; tincture of cinchona one ounce; tincture of myrrh half a pound. Digest until the tincture is dissolved, and strain.

Dose half a drachm to one drachm.

Tinctura squill, tincture of squill.

Take of rhubarb root four ounces; proof spirit two pounds. Digest for eight days, and pour off the liquor.

Dose from twenty drops to a drachm.

Tinctura valeriana, tincture of valerian.

Take of wild valerian, powdered coarsely, four ounces; proof spirit two pounds. Digest with a gentle heat for eight days, and strain.

Dose from one to two drachms.

Tinctura zizan不可思, tincture of ginger.

Take of powdered ginger two ounces; proof spirit two pounds. Digest with a gentle heat for eight days, and strain.

Dose one drachm.

Extracta, extracts.

1. Extracta per aquam, extracts by water.


Take of gentian root any quantity; add to it, when cut and bruised, eight parts of distilled water. Boil it to half, and with strong pressure. Then evaporate the liquor to the consistence of thick honey by means of a bath of boiling water, saturated with muriat of soda.

In the same manner are prepared the following:


Besides these, in the London Pharmacopoeia, we have the following:

Extractum cuminum genivis, extract of cumin's tops. Sabina, of savin. Cinchona, of Peruvian bark, which last is ordered to be prepared as follows:

Take of Peruvian bark coarsely powdered one pound, distilled water twelve pounds. Boil for an hour or two, and pour off the liquor; which, while hot, will be red and pelliculid, but as it cools becomes yellow and turbid. Pour on again the same quantity of water, boil as formerly, and repeat the boiling until the liquor, when cold, remains limpid. Then mix all the liquors (strained) together, and evaporate to a proper consistence. The extract should be prepared under two forms; one soft, to form pills; the other hard, so that it may be reduced to powder.

Dose fifteen grains.

2. Extracts per aquam et alcohol, extracts by water and alcohol.

Extractum cinchonae officinalis, extract of Peruvian bark, Ed. Extract cinchona, Lond.

Take of Peruvian bark in powder one pound; alcohol four pounds. Digest for four days, and pour off the tincture. Boil the residue in five pounds of water for a quarter of an hour, and while hot strain through linen. Repeat this decoction and straining with the same quantity of water, and evaporate the liquor to the consistence of thick honey. Then mix the liquors thus insipidized, and reduce them to a proper consistence in a bath of boiling water, saturated with muriat of soda.

Dose ten or fifteen grains.

Extractum radix rhubi galipha, extract of galipha, Ed. Extr. galipha. Lond.

To be prepared in the same manner as the last.

Dose ten or twelve grains.

Besides these the following extracts are peculiar to the London Pharmacopoeia.

Extractum cascarilla, extract of cascarilla.

Dose twenty or thirty grains.

Extractum colocythisis compositorum, compound extract of colocynth.

Take of the pits of colocynth, cut small, six drachms; scorzonera aloes powdered one ounce and a half; powdered cassia, half an ounce; lesser cardamom, four ounces, from the husks, and powdered, one drachm; proof spirit one pound. Digest the colocynth with the spirit, with a gentle heat, for four days. To the expressed tincture add the cassonia and aloes. These being dissolved, draw off the spirit by distilling; then evaporate the water, and add the seeds towards the end of the evaporation. Make an extract proper for forming pills.

A cathartic of considerable power. Dose from five grains to a scruple.

Opium purificatum, purified opium.

Take of opium, cut small, one pound; proof spirit twelve pounds. Digest with a gentle heat, and frequent agitation, until the opium is dissolved; strain the liquor through paper, and distill it to a proper consistence. Purified opium should be kept in two forms: soft, so as to be fit to make pills; and hard, so as to be capable of reduction to powder.

This is an unnecessary preparation.

Aquae stillicidii, distilled waters.

Aqua distillata, distilled water, Ed. and Lond.

Let water be distilled in close vessels until about two-thirds have come over.

Aqua cortis citri auranti, water of orange-peel.

Take of fresh orange-peel two pounds; pour on these as much water, that when ten pounds shall have been drawn off a sufficient quantity shall remain to prevent curdy texture. After due maceration, let ten pounds be distilled.

In the same manner prepare the following, ten pounds being drawn off from each of the annexed quantities:

Aquae cortis fructus citri medicinis recentis, fresh lemon-peel water (with two pounds).

— cortis lauri cassia, cassia water (with one pound).
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Aqua cortexis laetri cinnamomi, cinnamun water. Aq. cinnamomi, Lond. (with one pound).

mentha piperitae florentis, peppermint water (with three pounds). Aq. mentha piperitidis, Lond.

— mentha pulegii florentis, pennyroyal water (with three pounds). Aq. mentha pulegii, Lond.

— fructus myrti pimento, pimento water (with half a pound). Aq. pimento, Lond.

— petasitis rose centifoliae, rose water (with six pounds). Aq. Rose, Lond.

Besides these we have in the Ph. Lond. Aqua anchi, dull seed water.—Aqua hemoni, fennel seed water.—Aqua menthae sylviae, sylvinm water. To each pound of distilled water let half an ounce be added of diluted alcohol.

Spiritus stillatissinis, distilled spirits.


Take of caraway seeds half a pound; pour on them nine pounds of distilled alcohol. Macerate in a closed vessel for two days; then add as much water as is required to prevent empyreuma; and distil over nine pounds.

In the same manner are to be prepared the following spirits, nine pounds being drawn from the quantities aforesaid to each.

Spiritus corticiis lauri cinnamomi, cinnamon spirit (with one pound). Sp. cin. Lond.

— menthae piperitae florentis, spirit of peppermint (with one pound and a half). Sp. menth. p. Lond.

— nucis myristicae moschatae, nutmeg spirit (with two ounces). Spirit. nuc. mosch. Lond.

— fructus myrti pimento, pimento spirit (with half a pound). Sp. pimento, Lond.

In the London Ph. the following are added: Spirits menthae sativae, — of spearmint, Sp. pulegii, — of pennyroyal.

The following are the compound spirits of the Pharmacopoeia:


Take of the grained juniper berries one pound; caraway seeds, fennel seeds, of each one ounce and a half; diluted alcohol nine pounds. Macerate for two days, and adding water sufficient to prevent empyreuma, draw over nine pounds.

Spiritus anisi compositus, compound spirit of anise, Ph. Lond.

Take of anise and of angelica seeds, of each bruised half a pound; proof spirit one gallon; water sufficient to prevent empyreuma. Distil one gallon.

Spiritus raphani compositus, spirit of horse-radish, Lond.

Take of fresh horse-radish root, dried orange-peel, of each two pounds; fresh garden scurry-grass four pounds; bruised nutmegs and cubeb, proof spirit two gallons; water sufficient to prevent empyreuma. Distil over two gallons.

The following are distilled with pure alcohol:


Take of spirit of lavender (which is prepared with two pounds of lavender flowers, and eight pounds of alcohol, seven pounds being distilled over in a water-bath) three pounds of root of lavender one pound; cinnamomum one ounce; cloves two drachms; nutmeg half an ounce; red saunders wood three drachms. Macerate for seven days, and strain.


Take of spirit of rosemary two pounds; alcohol eight pounds. Draw off seven pounds by distilling in a water-bath.

Alcohol. In the London Ph. the following process is ordered for its preparation:

Take of rectified spirit of wine one gallon; prepared kali hot one ounce. Mix the spirit with the pure kali, and then add one pound of the prepared kali while hot; agitate and digest for twenty-four hours. Pour off the spirit; now add the remainder of the prepared kali, and distil from a water-bath. The alcohol is to be kept in a closed vessel. The prepared kali should be heated to 300°. The specific gravity of alcohol distilled water is as 815 to 1000.

Olea volatile, volatile, or essential oils.


— herbe juniperi sabinae, — of sabin.

Ed. — summilitarae florentii rosarii officinalis, — of rosemary, Ed. Ol. rosm. Lond.

— spirituum lavandulae florentii spicae, — of lavender, Ed. Ol. lav. Lond.

— semen pinnipeltis amari, — of anise, Ed. Ol. ess. amari, Lond.


— fructus myrti pimento, — of pimento, Ed. —


These oils are to be prepared in the same manner as distilled waters, except that a smaller quantity is to be added of water. Seeds or roots are to be bruised or rasped. The oil comes over with the water; and according as it is lighter or heavier, it swims on the surface, or falls to the bottom. It is afterwards to be separated.

Spiritus succinii acidi succinii, oil and acid of amber, Ed. Sal. succ. Lond.

Take of amber in powder, and pure sand, of each equal parts; place them mixed in a glass retort, of which they shall fill one half. Having adapted a large receiver, distil from a sand-bath, with a gradually raised fire. First will come over a watery liquor with a little yellow oil; then yellow oil with an acid salt; afterwards a reddish and black oil. Let the liquor be poured out of the receiver, and the oil separated from the water. Let the acid salt, collected from the sides of the receiver and from the neck of the retort, be pressed between folds of bulbus paper, and freed from the adhering oil. Then let it be purified by solution in hot water and crystallization.


Distil oil of amber, mixed with water, six times its quantity, from a glass retort, until two-thirds have passed over into the receiver. Then separate the oil from the water, and preserve it in vessels effectually stopped.

Spiritus terebinthae volatile purissimi, rectified oil of turpentine, Ed. Ol. terb. rect. Lond.

Take of volatile oil of turpentine one pound; water four pounds. Distil as long as any oil passes over.

Spiritus anisatus, animal oil, Lond.

Take of oil of hartshorn one pound. Distil three times.

Spiritus petrolii, oil of mineral tar, Lond.

Distil petroleum in a sand-bath.

Spiritus armillae, oil preparations.

Oleum ammoniaci, ammoniated oil.

Take of olive oil two ounces; water of ammoniaca two drachms. Mix them.

The Limonium ammoniaci for the London Ph. is prepared with water of pure ammoniaca one ounce; olive oil two ounces.

The linin ammoniaci, Ph. Lond. is made with water of carbonated ammoniaca half an ounce; olive oil an ounce and a half.

These are all used as rubefacients.

Spiritus lini cum caco, linseed oil with lin. Take of linseed oil and line water, of each equal parts. Mix them. An application to burns.

Spiritus camphoratus, camphorated oil.

Take of olive oil two ounces; camphor half an ounce. Mix so as to dissolve the camphor.

An anodyne and stimulant embrocation.

Spiritus sulphuratus, sulphurated oil, Ed. Ol. sulph. Lond.

Take of olive oil eight ounces; sublimed sulphur one ounce. Boil with a slow fire in a large iron pot, stirring constantly, till they unite.

This preparation is discarded from practice.

In the London Pharmacopoeia a solution of oil in petroleum, petroleum sulphuratum, is ordered to be made.

Satis et salina, salts and saline preparations.

Acidum aceticum distillatum, distilled acetic acid, Ed. Acetum distill. Lond.

Distil eight pounds of acetic acid in glass vessels with a slow fire. The first two pounds that come over are to be thrown away as too watery; the four pounds which follow are the distilled vinegar: the residue gives a still stronger, but a too much burnt acid.

Spiritus aceti fortis, strong acetic acid.

Take of dried sulphate of iron one pound; acetate of lead ten ounces. Rub them together. Place them in a retort, and distil from sand, with a moderate fire, as long as acid is produced.
Acidum acetotum, acetic acid, Lond.

Take of verdigris, in coarse powder, two pounds, dry it perfectly in a bath of water saturated with salt. Then distil in a sand-bath, and distil the liquor a second time. Its specific gravity is as 1050 to 1000.

Acidum benzoicum, benzoic acid, Ed. Flores benzoe, Lond.

Take of benzoin, in powder, any quantity. Place it in an earthen pot, to the mouth of which has been adapted a paper cone; apply a gentle fire, that the acid may be subdued: if it is contaminated with oil, it is to be purified by solution in hot water and crystallization, or, as the Ph. Lond. directs, by mixing it with white clay, and again subliming.

Acidum muriaticum, muriatic acid, Ed. Acidum sulfuricum, sulfuric acid, Lond.

Take of muriat of soda two pounds; sulphuric acid sixteen ounces; water one ounce.

First expose the muriat of soda in a pot to a red heat for a short time; when cold put it into a retort. Then pour the acid mixed with the water and cold on the muriat of soda. Distil from a sand-bath, with a gentle heat, as long as acid comes over. Its specific gravity is as 1570 to 1000.

Acidum nitrosum, nitric acid, Ed. and Lond.

Take of pure nitrat of potassa powdered two pounds; sulphuric acid sixteen ounces; the nitrat of potassa being put into a glass retort, pour in the spirit of alcohol, heat, and distil from a sand-bath, with a fire gradually raised, until the iron pot is of an obscure red heat. Its specific gravity is 1550 to 1000.

Acidum nitrosum dilutum, diluted nitric acid, Ed. and Lond.

Take of nitric acid, water, equal weights. Mix them, avoiding the noxious vapours.

Acidum nitricum, nitric acid.

Take of nitric acid any quantity; put it into a retort; and having adapted a receiver, apply a very gentle heat, until the redcoloured part shall have passed over, and the acid remaining in the retort shall have become nitric.

Spiritus ætheris nitrosi, spirit of nitrous ether, Ed. and Lond.

Take of alcohol three pounds; nitrous acid one pound; pour the alcohol into a large phial, placed in a vessel filled with cold water, and add the acid gradually with constant agitation. Close lightly the phial, and set it aside for seven days in a cool place; then distil the liquor with the heat of boiling water into a receiver cooled with water or snow, as long as any spirit shall pass over.

Dose from thirty to fifty drops.

Acidum sulphuricum dilutum, diluted sulphuric acid, Ed. Acidum vitriolicum dilutum. Lond.

Take of sulphuric acid one part; water seven parts (in the Ph. Lond., eight). Mix them. Dose from fifteen to thirty drops.

Acidum sulphuricum aromatica, aromatic sulphuric acid.

Take of alcohol two pounds; sulphuric acid six ounces. Drop gradually the alcohol upon the acid. Digest the mixture with a very gentle heat for three days in a close vessel; then add cinnamon an ounce and a half; pour in the mixture. Digest again in a closed vessel for six days, and filter through paper with a glass funnel.

Dose about thirty drops.

Athær sulphuricus, sulphuric ether, Ed. Athær vitriolicus, Lond.

Take of sulphuric acid, alcohol, of each thirty-two ounces; pour the alcohol into a glass retort, capable of bearing a sudden heat; then pour on the acid in a continued stream. Mix gradually with frequent and gentle agitation, immediately distil from a sand-bath, heated previously, into a receiver kept cool by water or snow. The fire is to be so regulated, that the liquor may be made to boil as soon as possible, and continue to boil till sixteen ounces have distilled over; then remove the receiver from the sand. To the distilled liquor add two drachmats of potassa; then again distil from a high-necked retort, with a very gentle heat, into a receiver preserved from light, until ten ounces have come over. If after the first distillation sixteen ounces of alcohol are added to the acid remaining in the retort, and the distillation is repeated, ether will again appear, and this process may be repeated more than once.

Dose from thirty to sixty drops.

Athær sulphuricus cum alcoolo, sulphuric ether with alcohol.

Take of sulphuric ether one part; alcohol two parts. Mix them.

The London college order a compound spirit (sp. ætheris vitriolici comp.) to be prepared by mixing two pounds of unrectified ether with three drachmats of oil of wine.

Athær sulphuricus cum alcoolo aromatische, aromatic sulphuric ether with alcohol.

This is made from the same materials and in the same manner with the compound tincture of cinnamomum, unless that sulphuric ether with alcohol is employed instead of diluted alcohol.

These are useless preparations.

Carbonas ammoniac, carbonate of ammonia, Ed. Ammonia preparata, Lond.

Take of muriat of ammonia one pound; carbonate of lime, vaguely called chalk, dried, two pounds. Boil or rather powder, mix them, and sublimate from a retort into a receiver kept cold.

Dose from five grains to a scruple.

Aqua carbonatis ammoniac, water of carbonate of ammonia, Ed. Aqu. ammoniac, Lond.

Take of muriat of ammonia, carbonate of potassa, of each sixteen ounces; water two pounds. To the salts mixed and put into a glass retort pour on water; then distil to dryness from a sand-bath, with a fire gently raised.

Liquor volatilis, sal, et oleum corni cervi, volatile liquor, salt, and oil of horns, Lond.

Take of horns ten pounds; distil, gradually increasing the fire. A volatile liquor, salt, and oil, come over. Throat and the salt being separated, distil the liquor three times. To the salt add an equal weight of prepared chalk, and sublime three times, or until it becomes white.

The same volatile liquor, salt, and oil, may be procured from any of the parts of animals, except fat.

Aquæ ammoniæ, water of amonia, Ed. Aquæ ammoniæ puræ, Lond.

Take of muriat of ammonia sixteen ounces; lime fresh-prepared two pounds; water six pounds. To one pound of water, in an iron or an earthen vessel, add the lime broken down, and close the vessel for twenty-four hours. Distil, till the lime falls into powder, which is to be put into a retort.

To this add the muriat of ammonia dissolved in five pounds of water, and, shutting the mouth of the retort, mix them with agitation. Laterly, distil with such a moderate heat, that the operator can easily apply his hand to the retort into a receiver kept cold, until twenty ounces have distilled over. In this process the vessels are to be so luted, as that the penetrating vapours may be effectually confined.

Dose about twenty drops internally; outwardly it is used as a rubefacient.

Alcohol ammoniaticus, ammoniated alcohol, Ed. Sp. ammoniac, Lond.

Take of distilled alcohol four pounds; muriat of ammonia four ounces; carbonat of potassa six ounces. Mix, and draw off two pounds by distilling with a gentle fire.

Alcohol ammoniaticus aromatice, aromatic ammoniated alcohol, Ed. Sp. ammoniac aromaticæ, Lond.

Take of spirit of ammonia eight ounces; volatile oil of rosemary a drachm and a half; volatile oil of lemon one drachm. Mix so as to dissolve the oils. In the Ph. Lond. oil of cloves is ordered instead of the rosemary oil.

Dose from twenty to forty drops.

Alcohol ammoniaticus foetidus, foetid ammoniated alcohol, Ed. Sp. ammoniac foetidae, Lond.

Take of spirit of ammonia eight ounces; asefertul half an ounce. Let them be digested in a close vessel for twelve hours; then bring over eight ounces by the heat of a water-bath.

Dose thirty or forty drops.

Spiritus ammoniacus succinatus, Ph. Lond.

Succinatius spirit of ammonia, London.

Take of alcohol one ounce; water of pure ammonia four ounces; rectified oil of amber one scruple; soap ten grains. Digest the soap and the oil of amber in the alcohol until they are dissolved; then add the water of pure ammonia, and mix by agitation.

This has been named cau de luce.

Carbonas potassæ, carbonate of potassa, Ed. Kali preparatum, Lond.

Let impure carbonate of potassa (pearl-ashes) be put into a crucible, and brought to a red heat, that the oily impurities, if there are any present, may be burnt out; then rubbing the carbonate with an equal weight of water, let them be well mixed by agitation. The liquor, after the impurities have subsided, being poured off into a clean iron pot, is to be boiled to dryness; towards the end of the boiling the salt is to be kept constantly stirred, lest any adhere to the vessel.

In the London college this preparation is better ordered by dissolving the pearl-ashes, and evaporating the solution till a paste appears on the surface; then immediately setting it aside, previous to further evaporating.
PHARMACY.

Aqua supercarbonatis soda, water of supercarbonat of soda.

This is prepared from ten pounds of water, and two ounces of carbonat of soda, in the same mode as the supercarbonat of potass.

Aqua acidi ammonii, water of acetic of ammonob, Ed. Kalli acetatum, Lond.

Take of pure carbonat of potass any quantity. Boil it with a gentle heat in four or five times its weight of distilled acetic acid, and at different times add more acid, until on the watery part of the former portion being nearly evaporated, the acid newly added occasions no effervescence.

This will be the case when about twenty parts of acid have been consumed. Then let it be continued until it becomes white, and then turn it off, and evaporate to nine pounds.

Potass, potas, Lidd. Kalli potash, Lond.

Take of water of potass any quantity; evaporate it in a covered vessel of iron, until the effusion be finished, the saline matter flows smoothly like oil, which will be the case before the vessel is at red heat. Then pour it on a clean iron plate; cut it into small masses before it becomes hard, and immediately put them into a phial well stopped.

Potassa cum calce, potass with lime, Ed. Calx cum kalli puno, Lond.

Take of water of potass any quantity. Evapo rate to one-third in a covered iron vessel; then mix it with as much newly skinned slaked lime as may suffice to give it the consistence of a hard paste, which is to be kept in a stoped vessel.


Take of sulphuric acid, diluted with six times its weight of water, any quantity; put it into a large glass vessel, and gradually drop into it of carbonat of potass, dissolved in six times its weight of water, as much as may suffice perfectly to saturate the acid. The effervescence being finished, filter the liquor through paper; and, after due exhaustion, put it aside that crystals may form. This salt may otherwise be made by dissolving the residuum of the distillation of nitrous acid in warm water, and saturating with carbonat of potass. Sulphates potassum cum sulphure, sulphat of potass with sulphur.

Take of nitrat of potass in powder, sublimed sulphur, equal weights. Thrown them well mixed into a red-hot crucible, by small quantities, until the diaphragm begins over, let the salt cool. Keep it in a glass phial well stopped.


Take of carbonat of potass one pound; supercarbonat of potass three pounds, as much as necessary; boiling water fifteen pounds. To the carbonat of potass dissolved in the water add gradually the supercarbonat of potass rubbed to fine powder, as long as effervescence is excited, which generally ceases before the weight of carbonat of potass have been thrown in. When the liquor is cold filter it through paper, and put it aside, that crystals may be formed.

Dose as a purgative one ounce.

Tartari potassae et sodae, tartar of potass and soda, Lidd. Natron tartaratum, Lond.

This is to be prepared from carbonat of soda and supercarbonat of potass, in the same mode as tartar of potass.

A pleasant purge. Dose an ounce.

Phosphas sodae, phosphat of soda.

Take of bones burnt to whiteness and powdered ten pounds; sulphuric acid six pounds; cold water, six pounds; mix the powder with the acid in an earthen vessel, then add the water, and again mix. Keep the vessel in a water-bath for three days; then dilute the matter, by adding potass, and strain through a strong linen cloth, pouring gradually over boiling water, until all the acid is washed out. Put aside the strained liquor that the impurities may subside, from which pour it off, and evaporate to nine pounds. To this liquor, again pour off from its impurities, and heated in an earthen vessel, add carbonat of soda dissolved in warm water, till it no longer excites effervescence. Now strain, and put it aside, that crystals may form. These being removed, add, if necessary, to the liquor, a little carbonat of potass, that the phosphoric acid may be completely saturated, and again prepare it by evaporation to form crystals as long as these can be produced. Lastly, let the crystals be preserved in a vessel well stop'd.

A mild and useful cathartic. Dose one ounce.

Sulphuris sodae, sulpha of soda, Ed. Natron vitriolatum, Lond. (Glauber's salt.)

Dissolve the acidiulius salt, which remains after the distillation of muriatic acid, in water, and add to it chalks, in order to remove the superfluous acid. Put it aside until its impurities have subsided; then having poured off the liquor, and strained it through paper, reduce it by evaporation, so as to form crystals.

Dose one ounce, or more.


Take of carbonat of potass, sublimed sulphur, of each eight ounces; having rubbed them together, let them be put into a large crucible, which from being adapted, apply the fire cautiously, until the materials melt. The crucible, when it has cooled, is to be broken, and the sulphur taken out, and preserved in a close stop'd phial.

Hydro-sulphuratum ammonii, hydro-sulphurat of ammonii.

Take of water of ammonii four ounces. Expose it in a chemical apparatus to the stream of gas which arises from sulphur.
Metallic, metallic preparations.

Nitrates argentii, nitrat of silver, Ed. Argen-
tium nigritum, Lond.

Take of the purest silver, extended in plates
and cut, four ounces; distilled nitric acid
eight ounces; distilled water four ounces.

Dissolve the silver with a gentle heat in a
phial and evaporate the solution to dryness.
Then put the residue into a large crucible,
which is to be placed on the fire, at first
gently, and gradually increased, until the
mass flows like oil. Then pour it into iron
pipes, warmed and rubbed with grease.
Keep it in a glass vessel well stoppt.
A strong, and frequently employed, caust.

Sulphuretum ammonii, prepared or sul-
phurated ammony, Ed. Antim. prepara-
tum, Lond.

This is to be prepared in the same manner as
carbonat or lime.

Oxidum ammonii cum sulphure vitrificat-
um, vitrified sulphurated oxide of ammony,
Ed. Antim. vitrificatum, Lond.

Straw sulphuret of ammony coarsely power-
dered like sand on a shallow earthen vessel
not glazed, and apply to it a moderate fire
that the sulphuret of ammony may be slow-
ly heated; at the same time stir the powder
constantly, that it may not run into lumps.
White vapor arises, smelling like amphi.
When these, while the same degree of heat
is kept up, cease, augment the heat in
some measure, that vapours may again ex-
hale. Proceed in this manner until the
powder, now rained to a red heat, gives out
no more vapours. This powder being put
into a crucible, is to be melted with a
strong fire, until it assumes the appearance
of fused glass. It is now to be poured un-
pon a heated brass plate.

Oxidum ammonii vitrificatum cum cera,
vitrified oxide of ammony with wax.

Take of yellow wax one pound; vitrified
sulphurated oxide of ammony eight parts.
To the wax melted in an iron vessel, add
the oxide reduced to powder, and roast
with a gentle fire for a quarter of an hour,
continously stirring with a spatula; then
pour off the matter, which when cold is to
be powdered.
This is an obsolete remedy.

Oxidum ammonii cum phosphate calcis,
oxide of ammony with phosphat of lime,
Ed. Palvis ammoninis, Lond.

Take of sulphur of ammony coarsely pow-
dered, hornshot shavings, of each equal parts.
Mix and throw them into a wide iron pot red-hot, and keep them constantly
stirred until they are burnt into a cerini-
tious-coloured matter, which is to be re-
moved from the fire, rubbed into a powder,
and put into a coated crucible. In this
crucible, lute another inverted, in the bot-
tom of which is drilled a small hole; apply
the fire, which is to be gradually raised to
a white heat, and kept so for two hours.
Lastly, rub the matter when cold into a
evry fine powder.
This preparation is nearly the same as
James’s powder. Dose five or six grains.

Sulphuretum ammonii precipitatum, pre-
cipitated sulphuret of ammony, Ed. Sul-
phuratum ammonii precipitatum, Lond.

Take of water of poottas four pounds; water
three pounds; prepared sulphare of ant-
mony two pounds. Boil them in a co-
verted iron pot on a gentle fire for three
hours, stirring frequently with an iron spe-
tula, and adding water occasionally. Strain
the liquor while hot through a double
linen cloth, and to the strained liquor add
as much as may be necessary to precipi-
tate the sulphuret, which carefully wash
with warm water.

A precipitate nearly similar to this has
been much employed on the continent, es-
pecially under the name of Lecithes mineral.
Both the one and the other have been prin-
cipally used as alterative or diaphoretic.
Their operation is uncertain. Dose five or
six grains.

Oxidum ammonii cum sulphure per nit-
ratum potasii, oxide of ammony with sul-
phur and nitrat of potasii, Ed. Coccus ant-
monii, Lond.

Take of sulphuret of ammony, nitrat of pot-
ass, of each equal weights. Triturate them
separately; and having mixed them well
/together, throw them into a red-hot cruci-
ble. The deplagration being finished, sepa-
rate the reddish matter from the white
/urn, and rub it into powder, which is to
be frequently washed with warm water un-
til it becomes tastless.
This is used in some of the other prepa-
/ations; but as a medicine it is so uncertain
in its operation, that it is scarcely employed.

Antimonii muriatus, muriat of ant-
mony, Ed. and Lond.

Take of oxide of ammony with sulphur,
nitrat of potasii, sulphuric acid, of each one
pound; dried muriat of soda, two pounds.
Pour the acid into a retort, adding by de-
grees the muriat of soda, and the oxide of
antimony previously mixed. Then distil
from warm sand. Expose the distilled mat-
ter on some days to the air, that it may
liquefy; then pour the liquid from the insi-
/purities.

This preparation is not proper for inter-
nal administration.

Tartaris ammonii, tartare of ammony (tar-
tric acid), Ed. Antimonium tartarica-
tum, Lond.

Take of oxide of ammony with sulphur by
nitrat of potass three parts; supertartare
of potass four parts; distilled water thir-
ty-two parts. Boil them in a glass vessel for
a quarter of an hour; strain the liquor
through paper, and set it aside that it may
form crystals.

The most certain and useful of all anti-
monial preparations. Dose, as an emetic,
from one to two or more grains; as a dia-
/phoretic, a quarter of a grain.

Vimno tartarit is ammonii, wine of tartarite
of ammony.

Take of tartarite of ammony twenty-four
grains; white wine one pound. Mix so as
to dissolve the tartarite.

Vimno ammonii tartarici, Ph. L. Wine
of tartarised ammony.

Take of tartarised ammony two scruples;
boiling distilled water by measure two
ounces; Spanish white wine eight ounces.
Dissolve the tartarised ammony in the boil-
ing distilled water, and add the wine.
The two last preparations material-
differ in strength. Dose, as a diaphoretic, of the former about 40, of the latter 20, drops.

Vinum ammonii, ammonial wine, Ph. L. Take of varnished ammony powdered one ounce; Spanish white wine one pound and a half. Digest for twelve days with frequent agitation, and filter through paper. This is a preparation of very uncertain strength.

Antimonium calcium, calcedin ammony, Ph. L. White oxide of antimony. Take of ammony in powder eight ounces; powdered nitre two ounces. Mix them, and throw the mixture gradually into a red-hot crucible. Burn the matter which remains after the declaration for half an hour, and when cold rub it to powder; then wash it with distilled water.

This has been employed as a substitute for James's powder. Its dose is however uncertain.

Ammoniacum cupri, ammoniater of copper (cuprum ammoniacum). Take of pure sulphat of copper two parts; carbonat of ammonia three parts. Rub them in a glass mortar until all effervescence is over, and they form into a violet-coloured mass, which being wrapped in fibulous paper, is to be dried first on a charcoal, and afterwards by means of a gentle heat. The ammoniacum is to be preserved in a glass phial well stopped.

Dose half a grain at first, gradually increased to three or more grains.

Solutio sulphatis cupri composita, compound solution of sulphat of copper. Take of sulphat of copper and sulphat of alum, of each three ounces; water two pounds; sulphuric acid one ounce and a half. Boil the sulphats in water, that they may dissolve; then to the liquor filtered through water add the acid. Aqua cupri ammoniati, water of ammoniated copper, Lond.

Take of sal ammoniac (muriat of ammonia) one drachm; line-water one pound. Allow them to remain in a copper vessel until the ammonia is saturated with copper.

This is employed as a gentle escharotic.

Carbonas ferri precipitatus, precipitated carbonat of iron. Take of sulphat of iron four ounces; carbonat of soda five ounces; water ten pounds. Dissolve the sulphat in the water; then add the carbonat, previously dissolved in a quantity of water, as much as necessary, and mix them well together. Let the carbonat of iron which is precipitated be washed with warm water and afterwards dried.

Dr. Griffith's preparation of steel is an extemporaneous formula similar to the above.

Sulphas ferri, sulphat of iron, Ed. Ferrum vitriolatum, Lond.

Take of purified filings of iron six ounces; sulphuric acid eight ounces; water two pounds and a half. Mix them; and the effervescence being finished, digest for a short time in a sand-bath. Then strain the liquor through paper, and after proper evaporation put it on one side in order to form crystals.

This is perhaps the most active and useful of the calcium salts. Dose from one to four or five grains.

PHARMACY.

Sulphas ferri esculentus, dried sulphat of iron.

Take of sulphat of iron any quantity; heat it in a carthen vessel unglazed on a gentle fire until it becomes white and perfectly dry.

Oxidum ferri rubrum, red oxide of iron.

Let dried sulphat of iron be exposed to a violent heat until it is converted into a red matter.

Tinctura muriati ferri, tincture of muriat of iron, Ed. Tinctura muriati ferri, Lond.

Dose from ten to twenty drops.


Take of purified quicksilver two pounds; sulphuric acid two pounds and a half; muriat of soda dried four pounds. Boil the quicksilver with the sulphuric acid in a glass vessel placed on a sand-bath till the solution becomes clear. When cold, mix it with the muriat of soda; then sublimate in a glass crucible, with a heat gradually raised. Separate the sublimed matter from the superfluous submuriat.

This (the corrosive sublimate) is the most active of all the mercurial preparations. Dose about a fourth of a grain. It is not now so much as formerly used in the cure of syphilis.

Submurius hydrargyrus, submuriat of quicksilver, Ed. Coloniæ, Lond.

Take of muriat of quicksilver rubbing to powder in a glass mortar four ounces; purified quicksilver three ounces. Let them in a glass mortar be rubbed together, with a little water, in order to guard against the acid powder which would without this precaution arise, until the quicksilver is extinguished. Put the dried powder into a small phial, of which it shall occupy one-third, and let it be sublimed in a sand-bath. The sublimation being completed, and the phial broken, the red powder about the bottom and white about the neck of it, are to be both rejected, the remaining mass is again to be sublimed and rubbed into a fine powder, which is lastly to be washed with boiling distilled water.

This of all mercurial preparations is the most important in medicine. Its dose, according to the different diseases and circumstances under which it is employed, varies from an eighth of a grain to ten or more grains. It ought never to be given in solution.

Submurius hydrargyrus precipitatus, precipitated submuriat of mercury, Ed. Hydrargyrus muriatus mitis, Lond.

Take of diluted nitrous acid, purified quicksilver, of each eight ounces; muriat of soda four ounces and a half; boiling water eight pounds. Mix the quicksilver with the diluted acid, and towards the end of the effervescence digest with a gentle heat, frequently shaking the vessel. It is necessary that more quicksilver should be mixed with the acid than this can dissolve, that the solution may be obtained completely saturated. Dissolve at the same time the muriat of soda in the boiling water while it is warm; pour on it the other solution, and quickly mix them together. Alter the precipitation, pour off the salmine liquor, and wash the submuriat of mercury by degrees with the acetic acid; pour it off and after each time of the subsiding of the precipitate until it comes off tasteless.

This preparation does not materially differ from the preceding.

Oxidum hydrargyrus cinereum, ash-coloured oxide of quicksilver.
Take of purified quicksilver four parts; diluted nitrous acid six parts; distilled water fifteen parts; water of carbont of ammonia as much as sufficient. Dissolve the quicksilver in the acid; add gradually the distilled water; then pour on as much of the water of carbont of ammonia as will sufficient to throw down the oxide of quiksilver, which is then to be washed with pure water and dried.

This has lately been recommended by Dr. Home and others as one of the most efficacious and permanent of antisyphilitic remedies. Dose: one grain.

Oxidum hydargyri rubrum per acido nitricum, red oxide of quicksilver by nitric acid, Ed. Hydargyrum nitricus ruber, Lond. Take of purified quicksilver one pound; of diluted nitrous acid sixteen ounces. Let the quicksilver be dissolved, and with a gentle fire evaporate the solution into a dry white mass, which rubbed into powder is to be put into a glass cuber, a thick glass plate being put over its surface; then having adapted a capital, and placed the vessel in sand, let it be roasted with a fire gradually raised until it assumes the form of small red scales. This is used as an escharotic.

Subulsus hydargyri flavus, yellow sub-sulphat of quicksilver, Ed. Hydargyrum vitriolatus, Lond. Take of purified quicksilver four ounces; sulphuric acid six ounces. Put them into a glass cuber, and when they boil in a sand-bath to dryness; the white matter remaining at the bottom of the vessel being powdered, is to be thrown into boiling water; it will thus be changed into a yellow, which ought to be frequently washed with warm water. This preparation, formerly denominated turpeth mineral, is scarcely at present employed in medicine.

Sulphureum hydargyri nigrum, black sulphur of quicksilver, Ed. Hydargyrum cum sulphi nigro, Lond. Take of purified quicksilver and sublimed sulphur, of each equal weights. Let them be rubbed together in a glass mortar with a glass pestle; until the globules of quicksilver entirely disappear. This is vulgarly denominated ethios mineral. It is the least active of all the mercurial preparations, and is not much in use.

The following additional preparations of mercury are found exclusively in the Ph. Lond. Hydargyrum sulphurus ruber, red subphurat quicksilver.

Take of purified quicksilver forty ounces; sulphur eight ounces. Mix the quicksilver with the melted sulphur. If the mixture inflames, extinguish it by covering the vessel. Powder and sublimate the material.

This (cinnabar) is principally used to fumigate venereal ulcers.

Hydargyrum cum creta, quicksilver with chalk.

Take of purified quicksilver three ounces; prepared chalk five ounces. Rub them together till the globules disappear. This is scarcely employed.

Hydargyrum calciatus, calcined quicksilver.

Take of purified quicksilver one pound. Expedition in a glass cuber with a flat bottom, in a sand-bath, to a lust of 600°, until it concretes into a red powder.

This has been recommended in doses of half a grain or a grain in confirmed syphilis, which has appeared to oppose other mercurial preparations.

Calcium hydargyri albo, white calx of quicksilver.

Take of muriated quicksilver, sal ammoniac, water of prepared kali, of each half a pound. First dissolve the sal ammoniac, and then the muriated quicksilver, in diluted water, to which add the water of prepared kali. Wash the powder until it is tasteless.

White precipitate, as the above preparation is commonly called, is used externally in the form of ointment in pox, and other affections of the skin.

Acetum plumbi, acetate of lead, Ed. Cerussa acetata, Lond. Take of white oxide of lead any quantity, put it into a cuber, and mignon it pour twice its quantity of distilled acetous acid; the mixture is to stand on warm sand, until the acid becomes sweet; then pour it off, and add a fresh quantity of acid, as often as may be necessary, until it ceases to become sweet; then the whole liquor, freed from impurities, is to be evaporated to the consistence of thin honey, and put aside in a cool place that crystals may form, which are to be dried in the shade. Evaporate the remaining liquor so as to form new crystals, and repeat this process, till the liquor ceases to crystallize.

This preparation (the sugar of lead) is employed chiefly for injections and collyria.

Aqua lithargyri aceta, water of acetated litharge, Ph. Lond. Take of litharge two pounds and four ounces; distilled vinegar one gallon. Mix then and boil to six pounds, stirring constantly; then put the liquor into funnels, and after the impurities have subsided, strain it. This preparation has long been employed under the denomination of Goulard's extract. It is applied to the same purposes with the preceding.

Oxidum zinci, oxide of zinc.

Let a large crucible be placed in a furnace filled with burning coals, in such a manner that it shall be somewhat inclined to its mouth; and when the bottom of the crucible is at a moderate red heat, throw in pieces of zinc, each of them about the weight of a drachm. The zinc shortly inflames, and is converted into white floculi, which from time to time are to be removed from the surface of the metal, with an iron spatula, that the combustion may be more effectual; when the inflammation ceases, remove the oxide of zinc from the crucible. Another piece being thrown in, renew the operation, which repeat as often as may be necessary. Lastly, let the oxide of zinc be prepared in the same manner as carbonat of lime.

Dose: as a tincture, from 2 to 3 or more grains.

Sulphus zinci, sulphat of zinc. White vitriol.

Take of zinc, cut into small pieces, three ounces; sulphuric acid, five ounces; water, twenty ounces. Mix them, and the subsequent effervescence being over, digest for some time on warm sand. Then strain through paper, and after due exhaustion pour the liquor into a silver, or glass vessel, that crystallizes in form. This is often used as an injection and collyrium.

Solutio sulphatis zinci, solution of sulphate of zinc.

Take of sulphat of zinc sixteen grains, distilled water eight ounces, diluted sulphuric acid sixteen drops. Dissolve the sulphat of zinc in the water; then the acid being added, filter through paper.

Aqua zinca, each of camphora, water of vitriolated zinc with camphor. Ph. Lond. Take of vitriolated zinc half an ounce, camphorated spirit half an ounce by measure, boiling water by measure two pounds. Mix the ingredients and filter through paper.

This is used as a collyrum; it requires no further dilution.

Solutio acetatis zinci, solution of acetate of zinc.

Take of sulphat of zinc, one drachm; distilled water ten ounces. Dissolve it, then of acetate of lead, four scruples; distilled water, ten ounces; dissolve this. Mix the solutions; and when the liquor has remained some time at rest, strain it. The solution is regarded as more astringent than the acetate of lead, and of a less irritating nature than the sulphat of zinc.

Pulveres, powders.

Pulvis aromaticus, aromatic powder. Ed. and Lond.

Take of cinnamon, smaller cardamom seeds, and ginger, each equal parts. Rub them into a very fine powder, which is to be preserved in a glass phial well stopped. In the Ph. Lond. the proportion of cinnamon is greater, and one part is added of long pepper.

Pulvis asari Europae compositus, compound powder of asarabecz, Ed. Pulvis asari compus. Lond. Take of asarabecca leaves three parts; the leaves of marjoram and lavender flowers, of each one part. Rub them together to a powder.

A mild erhine.

Pulvis carbonatis caleis compositus, chalk powder.

Take one prepared carbonat of lime, four ounces; of cinnamon, a drachm and a half; nutmeg, half a drachm. Rub them together to powder.

Pulvis creta compositus, compound powder of chalk. Ph. Lond. Take of prepared chalk, half a pound; cinnamom, four ounces; tormentil and gun arabc, of each three ounces; long pepper, half an ounce. Reduce them to powder separately, and then mix them.

Dose of either of the above aromatic astringents, from 13 grains to half a drachm.

Pulvis e creta compositus omop. Take of compound powder of chalk, eight ounces; hard purified opium, rubbed to powder, one drachm and a half. Mix them.

Dose, one scruple, or half a drachm.
Pulvis chararum cancri compositus, compound powder of crab's claws. Ph. Lond. Take of half prepared crab's claws one pound; prepared chalk, prepared coral, of each three ounces. Mix them.

This, though apparently a compound, is in reality a simple preparation, as the ingredients are all mere carbunclotics of lime.

Pulvis jalape compositus, compound powder of jalap. Take of the powder of jalap one part; superfine powder of potass two parts; rub them together into a very fine powder.

Dose in the dose of a drachm and a half, is an excellent cathartic.

Pulvis ipecacuanhae et opii, powder of ipecacuan and opium. Ed. Pulvis ipecacuanhae compositus, Lond. (Dover's powder.) Take of ipecacuan powder and opium, of each equal parts; sulphur of potass eight parts. Rub them together into a fine powder.

Dose from 15 grains to half a drachm.

Pulvis opii, opiate powder. Take of opium one part; prepared carbonat of lime nine parts. Rub them together to a fine powder.

Dose from 10 grains to a scruple.

Pulvis scammonii compositus, compound powder of scammony. Take of scammony, superfine powder of potass of each equal parts. Rub them together into a very fine powder.

Dose from 10 grains to a scruple.

Pulvis scammonii compositus, compound powder of scammony. Ph. Lond. Take of scammony, extract of jalap, of each two ounces; ginger half an ounce. Rub them to powder separately, and mix them.

Dose from 10 grains to 15.

Pulvis scammonii compositus cum aloes, compound powder of scammony with aloes. Ph. Lond. Take of scammony six drachms; extract of jalap, socoriron aloes, of each one ounce and a half; ginger half an ounce. Rub them to powder separately, and mix them.

Dose 10 or 15 grains.

Pulvis sulphatis aluminii compositus, compound powder of sulphate of argil. Take of sulphate of argil four parts; kino one part. Rub them into a fine powder.

A styptic powder principally used externally.

Pulvis aloes cum canella, powder of aloes with canella, Ph. Lond. Take of socoriron aloes one pound; white canella three ounces. Rub them separately to powder, and mix them.

This is generally given in spirits as a tincture.

Pulvis aloes cum guaiaco, powder of aloes with guaiaco, Ph. Lond. Take of socoriron aloes one ounce and a half; guaiaco gum-resin one ounce; aromatic powder half an ounce. Rub the aloes and guaiaco into powder separately, then mix them with the aromatic powder.

This is seldom used: dose 15 or 20 grains.

Pulvis aloes cum ferro, powder of aloes with iron, Ph. Lond. Take of socoriron aloes one ounce and a half; myrrh two ounces; dried extract of gentiana and sulphate of iron, of each one ounce. Rub them separately to powder, and mix them.

Dose from 10 to 15 grains.

Pulvis cerussae compositus, compound powder of cerussa, Ph. Lond. Take of cerussa five ounces; senna one ounce and a half; tragacanth half an ounce. Rub them together into powders.

This is used diffused in water as an injection and collyrium.

Pulvis contrayerva compositus, compound powder of contrayerva, Ph. Lond. Take of contrayerva rubbed to powder, five ounces; compound powder of crab's claws one pound. Mix them.

Dose a scruple, or half a drachm.

Pulvis senna compositus, compound powder of senna, Ph. Lond. Take of senna, crystals of tartar, of each two ounces; scammony half an ounce; ginger two drachms. Rub the scummony separately, the others together, into a powder, and mix them.

Dose from half a drachm to a drachm.

Pulvis tragacanthae compositus, compound powder of tragacanth, Ph. Lond. Take of tragacanth powdered, gum arabic, starch, of each one ounce and a half; refined sugar, three ounces. Rub them into a powder together.

Dose one or two drachms.

Electuarium, electuary.

Electuarium aromatricum, aromatic electuary, Ed. Confectio aromatica, Lond. Take of aromatic powder one part; syrup of orange-peel two parts. Mix beating them well together so as to form an electuary.

Electuarium cassinæ fistulae, electuary of purging cassia, Ed. El. cassia, Lond. Take of cassia pulp in pods four parts; tamarind pulp, and manna, of each one part; syrup of pale rose four parts. Dissolve the manna beat in a mortar, in the syrup, with a gentle heat; then add the pulp, and by continuing the heat, reduce the mixture to a proper consistence.

This is scarcely used.

Electuarium cassinæ senna, electuary of senna, Ed. Elect. senna, Lond. Take of senna leaves eight ounces; seeds of coriander four ounces; liquorice root three ounces; olibanum one pound; pulp of tamarind, of cassia, and of prunes, of each half a pound; sugar two pounds and a half. Rub the senna with the coriander seeds; and separate by passing through a sieve, ten ounces of mixed powders. Let the residuum with the senna and liquorice be boiled in four pounds of water down to one-half, then express and strain. Evaporate the strained liquor to about one pound and a half; afterwards add the sugar so as to form a syrup; add the syrup gradually to the pulp, and lastly mix in the powdered.

This is the well known hortive electuary.

Dose from half an ounce to an ounce.

Electuarium catechu, electuary of catechu. Take of catechu extract four ounces; kino three ounces; cinnamon and nutmeg of each one ounce; opium, powdered, through a sufficient quantity of Spanish white wine, one drachm and a half; syrup of red rose boiled to the consistence of honey, two pounds and a quarter. Reduce to powder the solid ingredients, and mixing them with the opium and syrup, form an electuary.

In this electuary, formerly called japonic confecion, one grain of opium is contained in rather more than three drachms of the mass.

Electuarium opii, opiate electuary, Ed. Confectio opii, Lond. Take of aromatic powder six ounces; Virginia man root finely powdered, three ounces; opium, powdered, in a sufficient quantity of white wine, half an ounce; syrup of ginger, one pound. Mix so as to make an electuary.

This preparation has been inserted in the Pharmacopoeia, in the place of the complicated medicins of the antients, and the Amoriques.

Electuarium scammonii, electuary of scammony, Ph. Lond. Take of scammony powde et one ounce and a half; cloves and ginger, of each six drachms; oil of caraway half a drachm; syrup of rose as much as may be sufficient. Mix the aromatics rubbed together into a powder, with the syrup; then add the scammony, and lastly the oil of caraway.

A stimulant purgative; dose 1 drachin or more.

Pilule, pills.

Pilule aloeticæ, aloetic pills. Take of socoriron aloes in powder, soap, of each equal parts. Beat them with common syrup, so as to form a mass fit to be made into pills.

Pilule aloes composita, compound aloes pills. Ph. Lond. Take of socoriron aloes in powder one ounce; extract of gentian half an ounce; oil of caraway two scruples; syrup of ginger as much as necessary. Beat them together.

Dose 2 or 5 pills.

Pilule aloes composita, pills of aloes with assafetida. Take of socoriron aloes, assafetida, soap, of each equal parts. Beat them with mucilage of gum arabic into a mass.

Dose 2 or 3 pills.

Pilule aloes composita, pills of aloes with coloacythus. Take of socoriron aloes, scammony, of each eight parts; coloacythus four parts; sulphate of potass, one scruple, oil of cloves, of each one part. Let the aloes and scammony with the salt be reduced to powder; then let the coloacythus be rubbed into a fine powder, and the oil be added. Lastly,
centum simplex, simple cretæ, Ed. Ceratum spermatiæ cæli, Lond. Take of olive oil six parts; white wax three parts; spermaceti one part.

The above three compositions differ in composition.

Unguentum aditus suillus, ointment of hog's lard, Ph. Lond. Take of prepared hog's lard two pounds; rose water three ounces. Beat the lard with the rose water until they are mixed, then dissolve with a gentle heat, and put it aside that the water may subside. After pour off the ointment, stirring it constantly until it has cooled.

Unguentum resinosum, resinous ointment, Ed. Ung. resinae flavæ, Lond. Take of hog's lard eight parts; white resin five parts; yellow wax two parts. This ointment is used principally when suppuration is wished to be promoted.

Unguentum pulvis rueæ vesicatorii, ointment of the powder of cathartic, Ed. Ceratum cantharidis, Lond. Take of resinous ointment seven parts; powder of cathartics, one part.

The cathartics ointment is used principally when the discharge, excited by a blister, is wished to be preserved and converted into a purulent matter.

Unguentum infusii melosæ vesicatorii, ointment of infusion of cathartics, Ed. Ung. cantharidis, Lond.

Take of cathartics, white resin, yellow wax, of each one part; Venice turpentine and hog's lard, of each two parts; boiling water four parts. Macerate the cathartics in the water for a night, and strain the liquor, pressing it strongly; having added the lard oil, when the water is evaporated, then add the wax and resin. These being melted and removed from the fire, add the turpentine.

This is milder than the preceding.

Unguentum subacetis cupri, ointment of subacetate of copper (verdigris). Take of resins ointment fifteen parts; subacetate of copper one part.

An escharotic applied principally to foul and obstinate ulcers.

Unguentum hydragryi, ointment of quicksilver (blue ointment). Take of quicksilver, five parts; obtuse, each one part; hog's lard three parts. Carefully rub them in a mortar until the quicksilver globules disappear. It may be made with double or triple the quantity of quicksilver.

Unguentum hydragryi fortius, stronger ointment of quicksilver, Ph. Lond. Take of purified quicksilver two pounds; prepared hog's lard twenty-three parts; prepared tallow one ounce. Rub first the quicksilver with the tallow, and a little lard, until the globules disappear. Then add the remaining lard so as to form an ointment.

Unguentum hydragryi munitus, milder ointment of quicksilver, Ph. Lond. Take of the stronger ointment of quicksilver one part; prepared hog's lard two parts. Mix them. One drachm of the stronger ointment to be introduced by friction; the weaker ointments are superfluous.

Ung. m. oxidi hydragryi cineris, ointment of grey oxide of quicksilver.
Unguentum oxidii zinci, ointment of oxide of zinc.
Take of simple liniment six parts; oxide of zinc one part.
This is employed likewise in ophthalmia.

Unguentum picis, ointment of tar, Ed. and Lond.
Take of tar five parts; yellow wax two parts.
The chief use of tar ointment is in lineae capsae.

Unguentum sulphuris, ointment of sulphur, Ed. and Lond.
Take of hog's lard four parts; sublimed sulphur one part. To each pound of this ointment add essential oil of lemon, or oil of lavender, half a drachm.
This is deemed one of the most efficacious ointments in psora.

Unguentum olei compositum, compound ointment of olei, Ph. Lond.
Mix the ingredients, oil of hog's lard four ounces; ointment of hog's lard four ounces; essence of lemon half a scruple.
Mix them so as to form an ointment.

This ointment is often employed in psora.

Unguentum sanitatis, ointment of elder, Ph. Lond.
Take of elder flowers four pounds; prepared muillon suet three pounds; olive oil one pound. Beat the elder flowers with the suet and oil, until they become friable; then pour out the fluid and strain it.
Ceratum saponis, cerate of soap, Ph. Lond.
Take of soap eight ounces; yellow wax ten ounces; litharge in powder one pound; olive oil one pound; vinegar one gallon. Boil the vinegar with the litharge on a gentle fire, constantly stirring, until the mixture becomes uniform and thick; then mix with it the other ingredients, so as to form a cerate.

Emplostra, plasters.

Take of yellow wax three parts; muillon suet and resin of each two parts.
This is principally employed as an application after a blister.

Emplostra olimphi plumbo semivitreis, plaster of semivitreous oxide of lead, Ed. Emp. lithargyri, Lond.
Take of the semivitreous oxide of lead one part; olive oil two parts. Having added water, boil them, stirring constantly, until the oil is entirely unite and form plaster.
This is chiefly applied to excoriations or trivial wounds.
Emplostra resinosum, resinous plaster, Ed. Emp. lithargyri cum resina, Lond.
Take of plaster of semivitreous oxide of lead twenty-four parts; resin six parts; yellow wax, olive oil, of each three parts; red oxide of iron eight parts. Rub the red oxide of iron with the oil, and add to it the other ingredients.
The strengthening plaster, applied principally in lumbago.

Emplostra ascellitidae, ascellitida plaster.
Take of plaster of semivitreous oxide of lead, assaefolia, galbanum, yellow wax, of each equal parts.
This is sometimes used in hysteric complaints, applied to the breast.

Emplostra gummorum, gum plaster.
Take of plaster of semivitreous oxide of lead eight parts; amniaca, galbanum, yellow wax, of each one part.
A stimulant plaster employed to encourage suppuration.

Emplostra hydriargyri, quicksilver plaster, Ed. Emp. lithargyri cum hydrargyro, Lond.
Take of quicksilver three parts; plaster of semivitreous oxide of lead eight parts; and other plaster; shed soap one part. Mix the soap with the plasters melted together.
This is a discutient inferior to the preceding.

Emplostra meloeos vesicatorii, plaster of cantharides, Ed. Emp. cantharidis, Lond.
Take of mutton suet, yellow wax, resin and cantharides, of each equal weights. The Spanish flies rubbed with fine powder, are to be used with other ingredients, melted together, and removed from the fire.

Common blistering plaster.

Emplostra meloeos vesicatorii composiun, compound plaster of cantharides.
Take of Burgundy plaster two parts; turpentine and cantharides of each twelve parts; subacetate of copper two parts; mustard seed and black pepper of each one part.
To the melted Burgundy pitch and wax, add the turpentine. When the liquefaction is complete, and while the fluid is still warm, sprinkle in the other ingredients, powdered and mixed, stirring constantly so as to form plaster.

Emplostra ammoniaci cum hydrargyro, plaster of ammoniac with quicksilver, Ph. Lond.
Take of strained ammoniac one pound; purified quicksilver six ounces; sulphonated oil one drachm, or as much as sufficient. Rub the quicksilver with the sulphonated oil, until the globules disappear; then gradually add the melted ammoniac and mix them.

Emplostra cumin, cumin plaster, Ph. Lond.
Take of cumin, caraway, bay berries, of each three ounces; Burgundy pitch three pounds; yellow wax three ounces. With the pitch and wax melted, mix the other ingredients rubbed to powder.

Emplostra ladani composiun, compound plaster of ladanum, Ph. Lond.
Take of ladanum three ounces; frankincense 10

PHARMACY.
one ounce; cinna... a grain of opium in each drachm of the tincture. Tinct. opii ammoniaci, Lond. has a grain of opium to half an ounce of the tincture.

Tinctura saponis cum opio, Ed. has a scruple of opium in each ounce of the liquid. Tinct. opii ammoniaci, Lond. has a grain of opium in ten grains of the powder. Pulvis ipecacuanha compositus, Lond. the same.

Pulvis opisthus, Ed. and Lond. ten grains contain a grain of opium. Tincturam cataplasmum, Ed. has in each ounce about two grains and a half of opium. Tincturam opium, Ed. has in each drachm a grain and a half of opium. Confectio-opiata, Lond. has one grain of opium to thirty-six grains.

Pulveris dracayyi, Ed. has fifteen grains of mercury to each drachm, Lond. a grain to each two grains and a half.

Pulvis opiate, Ed. Ten grains of the mass contain a grain of opium, Lond. five grains contain a grain of the same.

Trocchis glycerithrizum cum opio, Ed. One drachm of the mass has a grain of opium. Unguentum nitritis hydrargyri tortius et mitius, Ed. The first has in each drachm four grains of quicksilver and four grains of nitrous acid; the second has half a grain of quicksilver and one of nitrous acid, in each scruple. Unguentum hydrargyri, Ed. in each drachm has twelve grains of quicksilver. Ung. hyd. fortius, Lond. has a drachm of quicksilver in two of the mass; the mitius has a drachm in five drachms.

Emplastrum hydrargyri, Ed. has in each drachm about sixteen grains of quicksilver.

Table of the gradations in doses of medicine, from Mr. Murray's Materia Medica. Suppose that the proper dose of the medicine to be given is one drachm:

For a person from 14 to 21 years, it will be two-thirds or two scruples.

For a person from 7 to 14 years, it will be one-half or half a drachm.

For a person from 4 to 7 years, it will be one-third or a scruple.

For a person of 4 years, it will be one-fourth or fifteen grains.

For a person of 3 years, it will be one-sixth or half a scruple.

For a person of 2 years, it will be one-eighth, or eight grains.

For a person of 1 year, it will be one-twelfth or five grains.

PHARMACEUM, a genus of the peptonia triaziana class of plants, without any corolla; but the calyx resembles one, being covered on the inside, and its edges thin; the fruit is an oval capsule, obscurely trigonal, and to a large part covered by the cup; it consists of three cells, in which are contained numerous nits, orbicular, and depressed seeds, surrounded with a margin.

PIRAO is the name of a game of chance, the principal rules of which are: the banker holds a pack consisting of 32 cards; he draws all the cards one after the other, and lays them down alternately at his right and left hand; then the ponte may at his pleasure set one or more cards either before or behind the cards already laid down, and may draw new cards in the same way; he does this twice, and the last couple containing his card twice, then he loses his whole stake. De Moivre has shown how to find the gain of the banker in any circumstance of cards remaining in the stock, and the number of times that the ponte's card is contained in it. Of this problem he enumerates four cases, viz. when the ponte's card is once, twice, three, or four times in the stock. In the first case, the gain of the banker is 

\[
\frac{n - 2}{n - 1} + \frac{2}{n - 1}, \quad \text{supposing } y = 2
\]

In the second case, his gain is

\[
\frac{n - 3}{n - 1}, \quad \text{supposing } y = 3
\]

In the fourth case, the gain of the banker, or the loss of the ponte, is

\[
\frac{2n - 5}{n - 1} + \frac{n - 3}{n - 1}, \quad \text{supposing } y = 4
\]

De Moivre has calculated a table, exhibiting this gain or loss for any particular circumstance of the play; and he observes, that at this play the least disadvantage of the ponte, under the same circumstance of cards remaining in the stock, is when the card of the ponte is but twice in it; the next greater when three times, the next when once, and the greatest when four times. He has also demonstrated, that the whole gain per cent. of the banker upon all the money that is adventured at this game, is 21. See De Moivre's Doctrine of Chances, p. 77.

PHARIUS, a genus of the hexandra order, in the monoece class of plants, and in the natural method ranking under the fourth order, gramina. The male calyx is a bivalved unilobous glume; the corolla, a bivalved glume; and the female calyx the same with it; the corolla an unilobous, long, and wrapping glume. There is but one seed. There are three species, grasses of the East and West Indies.

PHYRNYX. See Anatomy.

PHASCOM, in botany, a genus of the order of musci, belonging to the cryptogama class of plants. The anthera is operculated, with a ciliated mouth; the calyptra are minute.

PHASELOUS, kidney-bean, an genus of the diadelphia decandra class of plants, the corolla whereof is papilloseous; the vexillum is coriaceous, obtuse, emarginated, and reeled with reflex sides; the ala are roundish, of the same length with the vexillum, and stand upon long unguis; the carina is narrow, and revolved spirally in a contrary direction to the sun; the fruit is long, straight, coriaceous, and obtuse pod; the seeds are oblong, compressed and kidney-shaped. There are 21 species.

PHASES. See Astronomy.

PHASIANUS, in ornithology, a genus belonging to the order of gallinae. The cheeks are covered with a smooth naked skin. The
The plumage of the cock peacock, or argus, is peculiarly magnificent. The Dick Linnæus describes the various representations of it painted on paper-hangings and China porcelain, confirmed by a figure and description in a Chinese book, which came under his inspection.

We have lately seen," says Latham, "a drawing of the tail feather of a bird of the argus species, brought to this island, which is measured in length, and which, it is probable, must have belonged to some bird not hitherto come to our knowledge. The drawing is in the possession of major Davies, who took it from the original feathers, which were in possession of a gentleman of his acquaintance, and were brought from China. They are exactly in shape of the two middle feathers of the painted peacock; the general colour is that of a dull blue grey, margined on the sides with a rufous cream-colour, and marked on each side the shaft with numerous bars of black; between 70 and 80 bars in all, those on the opposite sides of the shaft seldom corresponding with each other.

The argus, though a native of China, is very commonly found in the woods of Sumatra, where it is called coo-ow. It is found extremely difficult to keep alive for any considerable time, and very difficult catching it in the woods; never for more than a month. It seems to have an antipathy to the light, being quite inanimate in the open day; but when kept in a dark place it appears perfectly well, and sometimes makes its note or call, from which it takes its name, and which is rather plaintive, and not harsh like that of a peacock. The flesh resembles that of the common pheasant.

For the parrot, which Mr. Latham reckons a variety of the common pheasant, and which is found in the woods of America, and remarkable for its loud cry, see Plate Nat. Hist. fig. 331.

PHASMA, a genus of insects of the order hemiptera; the generic character is, head large; antennæ filiform; eyes small, rounded; stemmata three, between the eyes; wings four, membranaceous, the upper pair abbreviated, the lower plaited; feet formed for walking.

This, which is not, strictly speaking, a Linnæan genus, being formed from some of the Linnæan mantes, differs from the genus mantis in having all the legs equally strong for walking, or without the falculoid joint, which distinguishes the fore-legs in the genus mantis. The antennæ are several, and the head large and broad; to these characters may be added the shortness of the upper wings or hemiytra, which scarcely cover a third part of the body, while the lower wings are large and long. In their mode of life the phasmae differ from the mantis; feeding entirely on vegetable food. In the extraordinary appearance of many of its species this genus is at least equal to that to which we allude.

The most remarkable is the phasma gigas, or giant phasma, (Mantis gigas, Lin.) This insect measures six or eight inches in length, and is of a very lengthened shape both in the male and female. It has a sub-cylindrical form, the thorax being prolonged on the edges and upper surface by numerous small spines or tube-rice; the upper wings are small, green, and veined like the leaves of a common vine, but the lower are very ample, reaching half the length of the body or farther, of a very pale transparent brown, elegantly varied and embellished by darker spots and patches; the legs are of moderate length, with the tarsi prolonged into the arms of the larva and pupa of this species bear a more singular appearance than even the complete insect, greatly resembling, on a general view, a piece of carved statuary; and in several small broken twigs adhere to it; for this insect has been generally known in collections by the name of the walking-stick, and under this title is figured in Edwards's Gleanings of Natural History, and many other publications. It is, however, probable, that the thorax is a pale brown in its dry state, it is in reality green when living; the natural colour fading after death, as in many others of this tribe. It is a native of New Guinea or Asinina. It may be added, that this insect either runs into several varieties as to size and some other particulars, or that there exist in reality many distinct species, which have been confounded under common name natives are very ample, reaching half the length of the body or farther, of a very pale transparent brown, elegantly varied and embellished by darker spots and patches; the legs are of moderate length, with the tarsi prolonged on the edges and upper surface by numerous small spines or tube-rice; the upper wings are small, green, and veined like the leaves of a common vine, but the lower are very ample, reaching half the length of the body or farther, of a very pale transparent brown, elegantly varied and embellished by darker spots and patches; the legs are of moderate length, with the tarsi prolonged into the arms of the larva and pupa of this species bear a more singular appearance than even the complete insect, greatly resembling, on a general view, a piece of carved statuary; and in several small broken twigs adhere to it; for this insect has been generally known in collections by the name of the walking-stick, and under this title is figured in Edwards's Gleanings of Natural History, and many other publications. It is, however, probable, that the thorax is a pale brown in its dry state, it is in reality green when living; the natural colour fading after death, as in many others of this tribe. It is a native of New Guinea or Asinina. It may be added, that this insect either runs into several varieties as to size and some other particulars, or that there exist in reality many distinct species, which have been confounded under common name.
arm'd with far larger and stronger ones. The general colour of the thorax, abdomen, and head, is more or less bluish, and all probably have been green in the living animal. The wings are scarcely larger than the elytra or wing-sheaths, and seem originally to have been reddish; the tips are green. These wings are very strongly veined with brown fibres; the wing-cases are of a strong opaque green, and were doubtless more vivid in the living insect; they have a great resemblance to a pair of leaves. The mouth has four palp, which are either short or under the mouth are situated two leaf-shaped organs, perhaps belonging to the action of that part. The abdomen is terminated by a kind of boat-shaped organ, the keel of which possesses a considerable space beneath the abdomen, so that fewer segments appear on that part than above. The concavity of this organ is covered by a terminal scale and bilb process, constituting the tip of the abdomen on the upper part. On raising this valve, an oval, nearly of the size of a pea, but of a more lengthened form, is discovered lying in the cavity beneath; and on inspecting further into the cavity of the abdomen, a great many more ova were found, to the number of five or six and twenty: these eggs are of a slightly oblong shape, but flattened at one end; they are of a brown colour, and marked all over with numerous impressed points, and have on one or more broad waved line, so disposed as to represent a kind of cross, as if carved on the surface; the flattened end is surrounded by a small rim or ledge, and seems to be the part which opens at the expiration of the larva, since it readily separates from the rest. On immersing some of these ova in warm water, and opening them, the included yolk, of a deep yellow colour, and of the appearance of a transparent gun, was discovered; and this, when burned, afforded the usual smell of animal substances, but in some it was accompanied by a slight degree of fragrance.

Some insects of this genus, like the preceding, are remarkable for the extreme, and even deceptive resemblance which their upper wings bear to leaves of trees. This is a wise provision of nature for the security of the animal against the attacks of birds, as well as for the retention of its element of its prey, since when sitting among the branches, it eludes the notice of both. PHEASANT. See Phasianus.

PHELANDRIUM, water-hemlock, a genus of the daisy order, in the peniculiad class of plants. The flowers of the disk are smaller; fruit ovate, even crowned, with the perianthium and pistillum. There are two species, one of which, viz. the aquilegia, is a native of Britain. This grows in ditches and ponds, but is not very common. The stalk is remarkably thick and dichotomous, and grows in the water. It is a poison to horses, bringing upon them, as Linnaeus informs us, a kind of palsy, which, however, he supposes to be owing not so much to the noxious qualities of the plant itself, as to those of an insect which feeds upon it, breathing within the stalks, and which he calls curculio paraplectenius.

PHIADELPHUS, the pipe-tree, or mock orange, a genus of the monogynia order, in the icosandria class of plants. The species are:

1. The coronarius, white syringa, or mock orange, has been long cultivated in the gardens of this country as a flowering shrub; it is not well known in Italy, but it is to be found native. 2. The scoparius. 3. The aromaticus. 4. The laniger. The propagation of all the sorts is very easy: they are increased by layers, cuttings, or suckers.

PHILIPPIC, mock privet, a genus of the monogyentia order, in the dicotylida class of plants. Each flower contains two males and one female. There are three species, all of them shrub-like plants, and natives of France and Portugal.

1. Philyran media, the oval-leaved phillyrea, or mock privet, the medical-leaved phillyrea, a tall evergreen shrub, native of the south of Europe. 2. Phillyrea latifolia, the lance-leaved phillyrea, or mock privet, a tall evergreen shrub, native of the south of Europe. 3. Phillyrea angustifolia, the narrow-leaved phillyrea, or mock privet, a deciduous shrub, native of Spain and Italy.

PHILOLOGY. See Experimental and Natural Philosophy, Ethics, &c.

PHILIPSAM, a genus of the class and order monandra monogynia. The spathe is one-flowered; perianthium none; corolla four-petalled; pistillum none; capsule three-seelled, many-seeded. There is one species, a herb of China.

PHILEBOTHONY. See Surgery.

PHILUM, cutis-tailed fish, a genus of the triandria class of plants, the corolla of which consists of two valves; and the seed, which is single, is included within the calyx and corolla. There are four species. See in Rangedia.

PHILLOS, a genus of vernus testacea; the animal an ascidia; shell bivalve, diarivate, with several lesser differently shaped accessory ones at the hinge; hinges recurved, the inner one larger, beneath the hinge, is an incurved tooth. The inhabitants of this genus perforate clay, spongy stones and wood, while in the younger state; and as they increase in size, enlarge their habit, and finally are imprisoned.

They contain a phosphoric liquor of great brilliancy in the dark, and which illuminates whatever it touches or happens to fall upon. There are 15 species. All that we can know with certainty is, that they must have penetrated these substances when very small, because the entrance of the hole in which the philo buds is always much less than the inner part of it, and indeed than the shell of the phila itself. Hence some have supposed that they were hatched in holes accidentally formed in stones, and that they naturally grew of such a shape as was necessary to fill the cavity.

The entrance to these insects lodge, are usually twice as deep, at least, as the shells themselves are long; the figure of the holes is that of a truncated cone, excepting that they are terminated at the bottom by a dome or vault, and their position is usually somewhat oblique to the horizon. The openings of these holes are what betray the phila being in the stone; but they are always very small in proportion to the size of the fish. 3 F 2
PHIL. PHO

Beccaria observed, that though this fish ceased to shine when it became putrid, yet that in its most putrid state it would shine, and make the water in which it was immersed luminous when it was agitated. Galeatus and others, by using a glass tube and dissolving in it some aq. destillata, were enabled to distinguish this light; that in common oil it continued some days, but in rectified spirit of wine or urine, hardly a minute.

In order to observe in what manner this light was affected by different degrees of heat, they made the use of a Reaumur's thermometer, and found that water rendered luminous by these fishes increased in light till the heat arrived to 42°, but that it then became suddenly extinct, and could not be revived again.

In the experiments of Beccaria, the solution of sea-salt increased the light of the luminous water; a solution of nitre did not increase it quite so much. Sul ammoniac diminished it a little, oil of tartar or petrolatum nearly extinguished it, and the acids entirely. This water poured upon fresh calcined gypsum, rock crystal, cedrus, or sugar, became more luminous.

He also tried the effect of it upon various other substances, but there was nothing very remarkable in them.

Afterwards, using luminous milk, he found that oil of vitriol extinguished the light, but that of tartar increased it.

Obertioni held the curiosity to try how differently-coloured substances were affected by this kind of light: and having, for this purpose, dipped several ribbons in it, the white came out the brightest, next to this was the green; then the blue; and the other colours hardly perceivable. It was not, however, any particular colour, but only light, that was perceived in this case. He then dipped boards painted with the different colours, and also glass tubes filled with substances of different colours, in water rendered luminous by the fishes. In both these cases, the red was hardly visible, the yellow was the brightest, and the violet the dimpest. But on the boards, the blue was nearly equal to the yellow, and the green more languid; whereas in the glasses, the blue was inferior to the green.

Of all the liquors to which he put the phloas, milk was rendered the most luminous. A single phleo made seven ounces of milk so luminous, that the faces of persons might be distinguished by it, and looked as if illuminated.

Air appeared to be necessary to this light; for when Beccaria put the luminous milk into glass tubes, no agitation would make it shine unless bubbles of air were mixed with it.

Also Montius and Galeatus found, that, in an exhaustsed receiver, the phloas lost its light, but the water was sometimes made more luminous; which ascribed to the rising of bubbles of air through it.

Beccaria, as well as Reaumur, had many schemes to render the light of these phloas permanent. For this purpose he kneaded the juice into a kind of paste with flour, and found that it would give light when it was immersed in warm water; but it answered best to preserve the fish in honey. In any other method of preservation, the property of becoming luminous would not continue longer than six months, but in honey it lasted above a year; and then it would, when plunged in warm water, give as much light as ever it had done.

PHILOMIS, the sage-tree, or Jerusalem sage, a genus of the gymnospermia order, in the dianumia class of plants. The calyx is angular; corolla, upper lip incumbent, compressed, violet. There are 22 species, all of which have perennial stems, and stalks always perennial. The latter rise from two to five or six feet high, and are adorned with yellow, blue, or purple flowers in whors. They are all ornamental plants, and deserve cultivation on this account.

Seals are sometimes hard to endure the ordinary winters in this climate, but they require a pretty warm situation.

PHILOX, lychaideis, or bastard lychnis, a genus of the monogynia order, in the pentandria class of plants. The corolla is salver-shaped; filam. unequal; stigma trid; calyx prismatic; capsules three-celled, one-seeded.

There are 12 species, all but one natives of North America. They have perennial roots, from which arise herbaceous stems from nine inches to a foot high, adorned with tubulated flowers of a white or purple colour. They are propagated by offsets, and will bear the winter in this country. They require a light situation in order to thrive better and grow taller than in any other.

PHOCA, seal, a genus of quadrupeds of the order ferae. The generic character is: tooth-teeth in the upper jaw six, pointed, parallel, the external longer; in the lower jaw four, bluntish, parallel, distinct, equal; calcine teeth one each side in both jaws, large, pointed; the upper ones distinct from the cutting-teeth, the lower from the grinders. The grinders five each side above, six below, obliquely truncated. This genus is marine. It is, however, so constituted as to require occasionally some intervals of repose, and even a considerable degree of continuance, on dry land; foraging, at particular periods, the water, and congregating in vast multitudes on the shores, on floating ice, or on insulated rocks, especially during the season in which the young are produced. See AMERICAN.

There are about 19 species, the most noted are:

1. Phoca vitulina, the common seal, is a native of the European seas, and is found about all the coasts of the northern hemisphere, and even extends as far as the opposite side, being seen in vast numbers about the southern polar regions. It also inhabits some fresh-water lakes, as that of Biskal, Oron, &c., and in these lakes it is considerably smaller, but much fatter, than when found in the sea.

The size of the seal varies, but its general length seems to be from five to six feet. The head is large and round, the neck small and short; on each side the mouth is situated several strong vibrissae or whiskers, each hair being marked throughout its whole length with numerous alternate contractions and dilations. The pupils of the eyes are very small; there are no external ears; the tongue is pointed at the end; the legs are very short as to be scarcely perceptible; and the hind ones are so placed as to be only of use to the animal in swimming, or but very little to assist it in walking, being situated at the extremity of the tail, and not corresponding to each other. All the feet are strongly webbed, but the hind ones much more widely and con-
the females are cincereous. The flesh of the females and the young is said to resemble lamb, and the young are said to be as good as sucking pigs.

They live in families; each male has from eight to fifty females, whom he guards with the jealousy of an Eastern monarch. Though they lie by thousands on the shore, each family keeps itself separate from the rest, and is sometimes so numerous as to amount to above a hundred. The old animals which have been deserted by the females, are said to live apart, and are most excessively solitary and quarrelsome. They are extremely fierce, and enormously fat. It sometimes happens that they approach or intrude upon each other's station, in which case a battle ensues between the two individuals claiming to a space, conflict, disturb the repose of some of their neighbours, till in the end the discord becomes universal, and is in a manner spread through the whole shore. Exclusive of the contests between these solitary males, similar disagreements take place between those who live in a more social state, either from invading each other's seats, endeavouring to allure the females, or interfering in the disputes of their neighbours in the way of removing them and the wounds they receive are very deep, and resemble the cuts of a saber. At the end of the fray they fling themselves into the sea to wash away the blood. They shew a great attachment to their offspring, and some signs of the deepest concern on losing them.

The ursean seal is an inhabitant of the islands in the neighbourhood of Kotlinchaka. In these islands they are seen from June to September, during which time they breed and educate their young. In September they are said to quit their stations, and to return, some to the Asiatic, and some to the American shore; but are general moved towards the north to settle in those seas between lat. 50 and 56. They swim very swiftly, at the rate of seven miles an hour, and are very fierce and strong. They are said to be very tenacious of life, and to live a fortnight after receiving such wounds as would immediately destroy almost any other animal.

3. Phoca leonina, bottle-nosed seal. This species (in the male) is distinguished by its projecting mouth, and the three bones covering the lower jaw: the upper part consisting of a loose wrinkled skin, which the animal, when angry, has a power of inflating, so as to give the nose an arched or hooked appearance. It is a very large species, the male measuring twenty, and the female about eighteen feet in length. The feet are short: the hinder ones webbed in such a manner as to resemble a kind of fins.

In the British Archipelago it is a tolerably well preserved skin of a female, which formerly belonged to the museum of the Royal Society. This species inhabits the seas about New Zealand, the island of Juan Fernandez, and the Falkland islands. They are common in December, during the breeding-season, viz. in June and July, they are seen in great numbers suckling their young on the shore. They bring two young at a birth; the females are observed to be extremely fierce during the time of rearing the young; towards evening both the male and female swim out a little way to sea, the female bearing the young on her back, which it is said the male frequently pushes off, in order to oblige them to exercise their swimming-power. On the arrival of these animals on the breeding-islands, they are said to be so extreme as to be almost incredible; the tumultuous motion of the blubber being plainly perceptible beneath the skin. A single animal has been known to yield a butt of oil, and to be so full of blood that what has run out has filled two hogsheads. The flesh is edible. Lord Anson's sailors ate it under the denomination of beef, to distinguish it from that of the seal, which they termed lamb.

4. Phoca jubata, sea lion, or leonine seal. This is so termed from the large and loose head or floating hair which hangs between the head and neck of the male are furnished. The nose is short and turns up a little, the eyes are large, the whiskers very large and strong, the hair on the whole body is smooth, short, and glossy, its colour is a deep brown; but those of this species which are found in Kamschatka are said to be reddish, and the females tawny. The males are far larger than the females; and grow from the length of feet to fourteen feet; the fore-feet are six to eight feet, and of a more slender form than the males. The weight of a full-grown male is from twelve to fifteen hundred pounds. A specimen of the sexes are seen on those of Falkland islands, viz. that of twenty-five feet in length, and nineteen or twenty feet round the shoulders.

These animals inhabit, in vast numbers, the islands called Penguin and Seal islands, near Cape Desolation; on the coast of Patagonia; and are found within the Magellauian straits, and on Falkland islands, but have not been discovered in any other part of the southern hemisphere, nor in any other place nearer than the sea between Kamschatka and America. They live in families distinct from the ursean and other seals; their manners, however, are nearly the same; they are polygamous, each male being accompanied by from two to thirty females. The males utter a snorting sound, and occasionally roar like bulls; the voice of the females resembles that of calves, and the young bleat like lambs. The food of the leonine or seal consists of the smaller kinds of sharks, fish, seals, which during the breeding-season they are said to fast for three or four months, during which time they swallow a number of large stones, in order to keep their stomachs in a distended state.

5. Phoca lupina, urige seal. This is a smaller species than the former, being found from about three to eight feet in length. The body is thick at the shoulders, and gradually lessens to the hind legs. The head resembles that of a dog with close-cut ears; the nose is short and blunt; in the mouth are six cutting teeth above, and four below; the fore feet have four toes inclosed in a membranaceous sheath, so as to resemble fins; and the hind feet are hid in a continuation of the skin of the back, and have five toes unequal length like the fingers of a hand, and is three inches long; the skin is covered with two sorts of hair, one like that of an ox, the other harder; the colours are various. These animals are the seals-evoluted by navigators off the island of Loango near the river Pinta. They are said to appear there in vast multitudes, and to meet the ships, and even to hang at the ship's side by their paws, seeming to stare at and admire the crew, then drop off and return to their former haunts. The natives of Chili kill them for the sake of their oil.

PHICNICOPTERUS, or Flamingo, in ornithology, a genus of birds belonging to the order of grails. The beak is naked, teethed, and bent, as if it was broken; the wings are large; the legs are long, and four-toed. There is but one species, viz. the bhaanenesis of Catesby, a native of Africa and America. This bird resembles the heron in shape, excepting the bill, which is of a very singular form. It is two year old before it arrives at its perfect colour, and then it is entirely red, excepting the quill-fathers, which are black. A full-grown one is of equal weight with a wild duck, and when it stands erect, it is five feet high. The feet are webbed. The flesh is delicate, and most resembles that of a partridge in taste. The tongue, above any other part, was in the highest esteem with the luxurious Romans. These birds make their nests on lillocks in shallow water, on which they sit with their legs extended down, like a man sitting on a stool. They breed on the coasts of Cuba and the Bahamas in the West Indies, and in frequent salt lakes, and in the particular shape of this bird, this bird, in eating, twists its neck from side to side, and makes the upper mandible touch the ground. They are very stupid, and will not take at the report of a gun: nor is it any warning to those who survive that they see others killed by their side; so that, by keeping himself out of sight, a fowler may kill as many as he pleases.

These birds prefer a warm climate. In the old continent they are not often met with beyond 40 degrees north or south. They are met with very early on the African coast and adjacent isles, to the Cape of Good Hope; and sometimes on the coasts of Spain, Italy, and those of France lying in the Mediterranean sea; being at times found at Marselles, and for some way up the Rhone. In some seasons they frequent Aleppo and the parts adjacent. They also make their appearance on the Persian side of the Caspian Sea, and thence along the western coast as far as the Wolga; though this is at uncertain times, and chiefly in considerable flocks coming from the north-east coast, mostly in October, but as soon as the wind changes they totally disappear. They breed in the Cape Verde isles, particularly that of Sal. They go for the most-part together in flocks, except in breeding time. They are very numerous at the Cape; keeping in the day on the borders of the lakes and rivers, and lodging themselves at night in the long grass on the hills. They are also common to various places in the warmer parts of America, frequenting the same latitudes as in other quarters of the world; being found at Peru, Chili, Caymen, and the coast of Brazil, as well as the various isles of the West Indies: Some found them in Jamaica. When seen at a distance, they appear as a regiment of soldiers, being ranged alongside one another, on the borders of the rivers, searching for food, which chiefly consists of small fish, or the eggs of the water-fish, which they search for after by plunging in the bill and part of the head, from time to time trampling with their feet to muddy the water, that their prey may be raised from the bottom. Whilst they are feeding, one of them is said to stand sentinel.
PHOENIX.

and the moment he sounds the alarm, the whole flock takes wing. This bird, when at rest, stands on one leg, the other being drawn up close to the body, with the head placed under the wing on that side of the body it stands to, and is the size of a partridge. (See Plate 2.)

They are sometimes caught young, and are brought up tame; but are always impatient of cold; and in this state will seldom live a great while, gradually losing their colour, both, and appetite, and dying for want of that food which in their state of nature at large they were abundantly supplied with.

PHOENIX, in astronomy, one of the constellations of the southern hemisphere, unknown to the ancients, and invisible in our northern parts. See Astronomy.

PHOENIX, the great palm or date-tree, a genus of plants belonging to the order palmaceae. The calyx is 3-parted; corolla 3-petalled; male stamens three; female pistil one, drupe ovate. There is only one species, viz., Phoenix canariensis, or common date-tree, a native of Africa and the Eastern countries, where it grows to 50, 60, and 100 feet high. The trunk is round, smooth, and studded with pulverulent, which are the vestiges of the decayed leaves. From the top issues forth a cluster of leaves or branches eight or nine feet long, extending all round like an umbrella, and bending a little towards the earth. The bottom part produces a number of stalks like those of the middle, but seldom shooting so high as four or five feet. These stalks, says Adamson, diffuse the tree very considerably; so that when it actually grows in forests, it is extremely difficult to open a passage through its prickly leaves. The date-tree was introduced into Jamaica soon after the conquest of the island by the Spaniards. There are, however, but few of them in Jamaica at this time. The fruit is somewhat in the shape of an acorn. It is composed of a thin, light, and glossy membrane, somewhat pellucid and yellowish, which contains a fine, soft, and pulpy fruit, which is firm, sweet, and somewhat visous to the taste, esculent, and wholesome; and within this is enclosed a solid, tough, and hard kernel, of a pale grey colour on the outside, and finely marbled within like the almond. The best are brought from Tunis: they are also very fine and good in Egypt, and in many parts of the East. Those of Spain and France look well; but are never perfectly ripe, and very subject to decay. Dates have always been esteemed moderately strengthening and astringent.

Though the date-tree grows every where indiscriminately on the northern coasts of Africa, it is not cultivated with care, except by the mount Atlas; because the heat is not sufficiently powerful on the coasts to bring the fruits to proper maturity. We shall here extract some observations from M. Des Fontaines respecting the manner of cultivating it in Harissia, and on the different uses to which it is applied. All that part of the Zaora, which is near mount Atlas, and the only part of this vast desert which is inhabited, produces very little corn; the soil being very dry, and the sun extremely hot for the cultivation of grain, its only productions of that kind being a little barley, matza, and sorge. The date-tree, however, supplies the deficiency of corn to the inhabitants of these countries, and furnishes them with almost the whole of their subsistence. They have flocks of sheep; but as they are not numerous, they preserve them for the sake of their wool; besides, the flesh of these animals is very wholesome food in countries that are excessively warm; and these people, though ignorant, have profound experience to justify them in their assertion that it was salutary for them to abstain from it. The date-trees are planted without any order, at the distance of 12 feet one from the other, in the neighbourhood of rivulets and streams, which issue from the sand. Forests of them may be seen here and there, some of which are several leagues in circumference. The extent of these plantations depends upon the quantity of water which can be procured to water them, for they require much moisture. All these forests are intensified with orange, almond, and pomegranate trees, and with vines which twist round the trunks of the date-trees; and the heat is strong enough to ripen the fruit, though they are never exposed to the sun.

It is generally in winter that new plantations of this tree are formed. For this purpose those who cultivate them take shoots of those which are sterile, and plant them at a small distance one from the other. At the end of three or four years, these shoots, if they have been properly taken care of, begin to bear fruit: but this fruit is as yet very small; and when cut off without kernels; they never reach the highest degree of perfection of which they are susceptible till they are about 15 or 20 years old.

These plants are, however, produced from the seeds taken out of the fruit, provided they are fresh. They should be sown in pots filled with light rich earth, and plunged into a moderate hot-bed of Tanner's bark, which should be kept in a moderate temperature of heat, and the earth frequently refreshed with water. When the plants are come up to a proper size, they should be each planted in a separate small pot, filled with the same light earth, and plunged into a hot-bed again; observing, however, to let them have air in proportion to the warmth of the season, and the bed in which they are placed. During the summer time they should remain in the same hot-bed; but in the beginning of the year should be placed in a green house, or some share of air to harden them against the approach of winter; for if they are too much forced, they will be so tender as not to be preserved through the winter without much difficulty, especially if you have not the convenience of a barn-stove to keep them in.

The trees, however, which spring from seed, never produce so good dates as those that arise from shoots, they being always poor and ill-shaped. They are, however, obliged by force of cultivation, and after several generations, that they acquire a good quality. The date-trees which have been originally sown, and grown properly, and have been assured that they bear fruit in the fourth or fifth year. Care is taken to cut the inferior branches of the date-tree in proportion as they rise; and a piece of the root is always left of some inches in length, which affords the easy means of cutting off the branches; and after a long time, according to the account of the Arabs; and in order to prove it, they say that when they have attained to their full growth, no change is observed in them for the space of three generations.

The number of females which are cultivated is much superior to that of the males, because they are much more profitable. The sexual organs of the date-tree grow, as is well known, upon different stalks, and these trees flower in the months of April and May, at different times, according to the male branches to which they are attached. The purpose of the people is to make them in the trunk of each branch which they wish to produce fruit, and place in it a stalk of male flowers; without this precaution the date-tree would produce only abortive fruit. In this case the males branches are only shaken over the females. The practice of impregnating the date-tree in this manner is very unprofitable. Pliny describes it very accurately in that part of his work where he treats of the palm-tree.

There is scarcely any part of the date-tree which is not useful. The wood, though of a spungy texture, lasts such a number of years, that the inhabitants of the country say it is incorruptible. They use it for making beams and instruments of husbandry; it burns slowly, but the coals which result from its combustion are very strong, and produce a great degree of heat.

The Arabs strip the bark and fibrous parts from the young date-trees, and eat the substance, which is in the centre; it is very nourishing, and has a sweet taste: it is known by the name of the marrow of the date-tree. They eat also the leaves, when they are young and tender, with lemon-juice; the old ones are laid out to dry, and are employed for making mats and other works of the same kind, which are much used, and with which they carry on a considerable trade in the interior parts of the country. From the sides of the stumps of the branches which have been left, arise a great number of delicate filaments, of which they make ropes, and which might serve to fabricate cloth.

A white liquor, known by the name of milk, is drawn also from the date-tree. To obtain it, all the branches are cut from the tree, and after several incisions have been made in it, they are covered with leaves, in order that the heat of the sun may not dry it. The sap drops down into a vessel placed to receive it, at the place where the leaves are laid. It soon is made below the incisions. The milk of the date-tree has a sweet and agreeable taste when it is new; it is very refreshing, and is even given to sick people to drink, but it generally turns sour at the end of 24 hours. Old trees are chosen for this operation, because the cutting of the branches, and the large quantity of sap which flows from them, greatly exhaust them, and often cause them to decay.

The male flowering shoots of the date-tree are also useful. They are eaten when still tender, mixed up with a little lemon-juice. They are reckoned to be very provoking; the odor which they exhale is probably the cause of this property being ascribed to them. These date-trees are very lucrative to the inhabitants of the desert. Some of them produce 20 bunches of dates; but care is always taken to keep off a part of them, that those which are left may be large and sweet; 10 or 12 bunches only are kept on the most vigorous trees. It is reckoned that a good tree produces, one year with another, about the value of 10 or 12 sailings to the propounder. A pretty considerable trade is carried on with
dates in the interior part of the country, and large quantities of them are exported to France and Italy. The crop is gathered towards the end of November. When the bunches are taken from the tree, they hang up in some very dry place where they may be shielded from rain and insects.

Even the stones, though very hard, are not thrown away. They give them to their canals and sheep as food, after they have bruised them or laid them to dry in water. The date, as well as other trees which are cultivated, exhibits great variety in its fruit, with respect to shape, size, quality, and even colour. There are reckoned to be at least 20 different varieties. Dates are very liable to be plundered by worms, and they soon corrupt in moist or rainy weather.

From what has been said, it may easily be perceived that there is, perhaps, no tree whatever used for so many and so valuable purposes as the date-tree.

PHORBUM, flox-plant, a genus of the class and order Herbsendroniognyma. There is no calyx; the corolla is six-petalled, three inner larger; capsule oblong, three-sided; seeds covered with a straw-like outgrowth. There is one species: the leaves resemble those of flax; the flowers are in one variety yellow, and in the other a deep red. Of the leaves of these plants, with very little preparation, the New Zealanders make all their common apparel, and also their strings, lines, and cordage, for every purpose; which are so much stronger than anything we can make with hemp, that they will not bear a comparison. When raw plant is steeped in water, preparation, they draw long slender fibres, which shine like silk, and are as white as snow. Of these, which are very strong, they make their finest cloths; and of the leaves, without any other preparation than splitting them into proper bands, and tying the strips together, they make their fishing-nets, some of which are of an enormous size. The seeds of this valuable plant have been brought over in large quantities and have appeared to have lost their vegetative power.

PHOSPHATES, salts formed by the phosphoric acid, with the alkalies, earths, and metallic oxides. They may be very readily distinguished by the following test: (1) They are not precipitated nor decomposed by boiling or redissolved by acetic or carbolic acid; but are decomposed by a mixture of nitric and sulphuric, or nitric and hydrochloric acids. (2) When the phosphates are converted into a globule of glass, which in some cases is transparent, in others opaque. (3) Soluble in nitric acid without effervescence, and precipitated from that solution by lime-water.

(4) Decomposed, at least partially, by sulphuric acid; and their acid, which is separated, when mixed with charcoal and heated to redness, yields phosphorus. (5) After being strongly heated, they often phosphorize.

The phosphates readily combine with an excess of acid, and form superphosphates.

The phosphates at present known amount to 12; two of which are triple salts. Some of these salts occur in different states, constituting varieties.

Phosphates of barytes. It may be prepared by mixing either with saturating phosphoric acid with barytes or carbonated of barytes, or by mixing together an alkaline phosphat and nitrate of barytes. In either case, the phosphates of barytes precipitate immediately in the form of a white powder.
from the atmosphere, and is converted into a viscous liquid. When heated, it first undergoes the watery fusion; then allows its water of crystallization to evaporate, and is reduced to dryness. In a high temperature it melts into a transparent glass, which depletes and solidifies at a temperature of 1550°.

It is completely decomposed by the sulphuric, nitric, and muriatic acids; and by barytes, strontian, and lime.

2. Phosphat of potass. This salt may be obtained by mixing together superphosphat of potass and pure potass, and exposing them to a strong heat in a platinum crucible. A white-colored substance is obtained, which is the phosphat in question. This salt is tasteless and insoluble in cold water, but soluble in hot water, and it precipitates as the solution cools in a gitty brilliant powder. It is extremely fusible; melting before the blowpipe into a transparent bead, which becomes colourless and insoluble in cold water, but soluble in hot water, and it precipitates as the solution cools in a gitty brilliant powder. When sufficiently diluted, the alkaline occasion no precipitate in these solutions; but when they are evaporated, a precipitate appears.

Phosphat of soda. This salt exists readily in urine, and was the first known of all the phosphats. It occupied a good deal of the attention of chemists; and the difficulty of giving occasion to various hypotheses concerning its nature. Hcllot remarked it in urine; and described it in 1737, as a salt different from those that had usually been observed. Haupt described it in 1765 as the salt of muriatic per Iatum, or "wonderful per Iated salt." It was called per Iated from the grey, opaque, pearl-like colour, which it assumed when melted by the blowpipe. Margraff examined it in 1743, and found it would not yield phosphors when treated with charcoal, as the other salts of urine did.

Dr. Pearson afterwards introduced it into pharmacology, under the name of medicine as a purgative. He gave the following process for preparing it: Dissolve, in a long-necked matlass, 1400 grains of crystallized carbonat of soda, in 2100 grains of water at the temperature of 60°; add gradually 500 grains of phosphoric acid of the specific gravity 1.85. Boil the liquor for some minutes; and while it is boiling-hot, filter it, and pour it into a shallow vessel. Let it remain in a cool place, and crystals will continue to form for several days. From the above quantities of materials he has obtained from 1450 to 1550 grains of crystals.

Its crystals are rhombozial prisms, of which the sides are 140° and 130°, terminated by a three-sided pyramid. Its specific gravity is 1.333. Its taste is almost the same with that of common salt. It is soluble at the temperature of 60° in about four parts of water, and in two parts of boiling water. This solution crystallizes on cooling; but in order to obtain the salt properly crystallized, the solution should contain a slight excess of alkali. When exposed to the air, this salt very soon effloresces on the surface. When heated, it undergoes the watery fusion. At a red heat it melts into a white enameled. Before the blowpipe it melts into a transparent globule, which becomes opaque on cooling, and its surface acquires a polyhedral figure. It is not altered by conductibles nor metals. With metallic oxides it forms its fusion, and forms a coloured globule of glass. Sulphuric, nitric, and muriatic acids, decompose it partially, and convert it into superphosphat of soda. In this state it is more soluble in water, and not so easily crystallized; but may be obtained, by proper evaporation, in the state of thin scales, not unlike boracic acid.

The greater number of earths may be fused along with this salt, and converted into glass.

This salt has been applied to various uses. It has been introduced into medicine as a purgative, and on account of its pleasant taste has of late been much used. It is usually taken in broths, which is employed to season instead of common salt. It may be substituted for borax to promote the soldering of metals. Mineralogists employ it very much as a flux when they examine the action of heat on minerals by means of the blowpipe.

Phosphat of amonnia. It exists also in urine, and seems to have been first accurately distinguished by Rouelle. It is usually prepared by saturating with amonnia the superphosphat of lime obtained from bones, in a state of coarse, to such a consistency, that, when allowed to cool, the phosphat of amonnia is obtained in crystals. It crystallizes in four-sided prisms, terminated by equal-sided pyramids. Its taste is slightly salt, and amoniacal. Its specific gravity is 1.30. It is soluble in four parts of water at the temperature of 60°, and in rather a smaller proportion of boiling water. It is by spontaneous evaporation that it is obtained in the state of regular crystals. It is not altered by exposure to the air. When heated, it undergoes the watery fusion; it then dries; but if the heat is continued, it swells up, loses its alkaline base, and the acid melts into a transparent glass. It is the only one of the earthy and alkaline phosphates which can be decomposed by heat. Hence the reason that it yields phosphors when distilled along with charcoal.

It is decomposed by the sulphuric, nitric, and muriatic acids, and by a mixture of them which, being of equal parts, is of nearly equal and alkaline earths. It is capable of combining with an additional dose of acid, and of passing into the state of a superphosphat.

This salt is much employed as a flux in experiments with the blowpipe. It enters also as an ingredient in those coloured glasses called pastes, which are made in imitation of precious stones.

Phosphat of magnesia. It is usually prepared by dissolving carbonat of magnesia in phosphoric acid, and evaporating the solution gradually till the salt crystallizes; but it may be obtained in large regular crystals by a much easier process. Mix together equal parts of water and aqueous solutions of phosphat of soda and sulphat of magnesia. No apparent change takes place at first; but in a few hours large transparent crystals of phosphat of magnesia make their appearance in the solution. Its crystals are six-sided prisms, the sides of which are unequal. It has very little taste; however, it leaves a cooling and sweetish impression upon the tongue. Its specific gravity is 1.55. It requires about 15 parts of cold water to dissolve it. It is more soluble in boiling water, but it crystallizes in part as the solution cools. When exposed to the air it loses its decomposition of its crystallization, and falls down in powder. When heated moderately, it is also reduced to a dry powder. In a high temperature it melts into a transparent glass.

Phosphat of glucina. It is obtained by pouring phosphat of soda into the solution of glucina in sulphuric, nitric, or muriatic acids. The phosphat of glucina is precipitated in the state of a white powder. It does not crystallize. It is tasteless, insoluble in water unless it contains an excess of acid, and is not liable to be altered by exposure to the air. When heated strongly, it melts into a transparent glass.

Phosphat of yttria. When the solution of phosphat of soda is mixed with the sulphat, nitrat, or muriat of yttria, phosphat of yttria precipitates in gelatinous flakes.

Phosphat of alumina. It may be formed by saturating phosphoric acid with alumina. It is a tasteless powder, insoluble in water. Dissolved in phosphoric acid it yields a gritty powder, and a gummy solution, which, by heat is converted into a transparent glass.

Phosphat of soda and amonnia, known to chemists by the name of muriamic acid, and fusible salt of urine, was extracted from urine, and examined, much sooner than any of the other phosphats: it was long before philosophers were able to form precise notions concerning its composition, and how to obtain it in a state of purity. This indeed could not be expected till the phosphats of soda and of amonnia had been accurately examined, and their composition ascertained. Fourcray was the first who gave a precise account of the proportion of its component parts. According to him, it is composed of

32 acid 24 soda 19 ammonium 23 water

100.

The properties of this salt are nearly those of the phosphat of soda and phosphat of amonnia combined. It answers better than any of them as a flux; because the heat soon drives off the water, and leaves an excess of acid. Its specific gravity is 1.5. When exposed to the air, this salt effloresces, and gradually loses its amonnia.

Phosphat of ammonia and magnesia was first discovered by Fourcray, who found it in a calculous concretion formed in the colon of a horse. Since this discovery Fourcray and Vattapolin have observed it also in human bones.

It might be prepared by mixing together solutions of the phosphats of amonnia and of magnesia in water; the triple salt immediately precipitates in the state of a white powder. When urine is allowed to remain a considerable time in close vessels, it often deposits this salt in regular crystals on the sides and bottom of the vessel. These crystals are small four-sided prisms, terminated by irregular four-sided pyramids. This salt is tasteless, scarcely soluble in water, and not liable to be altered by exposure to the air. When heated it loses powder, gives off its ammonia, and in a high temperature melts into a transparent globe. It is composed of
Phosphoric acid and silica, when mixed together and exposed to a strong heat, melt into a beautiful transparent glass, which is not decomposed either by the action of acids or of alkalies. Fourcroy has given this compound the name of phosphat de silice; but it is essentially different from silicates, and ought therefore rather to be ranked among some other class of bodies.

**PHOSPHITES**, salts formed with the phosphorous acid united to the earths, alkalies, and metallic oxides. These salts may be distinguished by the following properties:

1. When heated, they emit a phosphorescent flame. 2. When distilled in a strong heat, they give out a little phosphorus, and are converted into phosphates. 3. They decompose when heated with nitric or oxynitrate of pottas, and are converted into phosphates. 4. They may be converted into phosphates by nitrifying and oxynitric acid. 5. They are fusible in a violent heat into glass.

The phosphites at present known amount to eight:

1. Phosphite of lime. This salt may be formed by dissolving lime in phosphoric acid. When the saturation is complete, the salt precipitates in the state of a white powder. It is tasteless and insoluble in water; but it dissolves in an excess of acid, and forms a superphosphite. This last salt may be obtained in prismatic crystals by evaporating the solution. It is not altered by exposure to the air. When heated, it phosphoresces and emits a little phosphorus. In a violent heat, it melts into a transparent globule.

It is composed of 34 acid

| 51 lime |
| 15 water |
| 100.0 |

2. Phosphite of barytes may be formed by pouring phosphorous acid into barytes water, or the last water into a solution of phosphorous acid of soda. In either case phosphorus precipitates in the form of a white powder. It is tasteless, and but very sparingly soluble in water, unless there is an excess of acid. It is not altered by exposure to the air. Before the blowpipe it melts, and is surrounded with a light so brilliant that the eye can scarcely bear it. The globule which it forms becomes opaque as it cools.

It is composed of 41.7 acid

| 51.3 barytes |
| 7.0 water |
| 100.0 |

3. Phosphite of magnesia is best formed by mixing together aqueous solutions of phosphite of potas or soda and sulphate of magnesia; the phosphite of magnesia gradually precipitates in beautiful white flakes. It has no sensible taste. It is soluble in 400 parts of water at the temperature of 60°, and scarcely more soluble in boiling water. When its solution is evaporated slowly, a transparent pellicle forms on its surface, flakes are deposited, and towards the end of the process small tetrahedral crystals are precipitated. When exposed to the air it phosphoresces. When heated it phosphoresces and melts into a glass, which becomes opaque on cooling.

It is composed of 3 acid

| 20 magnesia |
| 36 water |
| 100.0 |

4. Phosphite of potass. This salt is formed by dissolving carbonate of potash in phosphoric acid, and evaporating the solution slowly till it deposits crystals of phosphite of potass. It crystallizes in four-sided rectangular prisms, terminated by dihedral summits. Its taste is sharp and saline. It is soluble in three parts of cold water, and still more soluble in boiling water. It is not altered by exposure to the air. When heated, it decomposes, and then melts into a transparent globule, which becomes opaque on cooling. It does not phosphoresce so evidently as the other phosphites, perhaps because it contains an excess of potass, which saturates the phosphoric acid as it forms.

It is composed of 39.3 acid

| 40.9 potass |
| 11.0 water |
| 100.0 |

5. Phosphat of soda may be prepared exactly in the same way as phosphite of potas. Its crystals are irregular, forked prisms or elongated rhombooids. Sometimes it assumes the form of square plates, or of plannose crystals. Its taste is cooling and agreeable. It is soluble in two parts of cold water, and scarcely more soluble in boiling water. When exposed to the air it phosphoresces. Before the blowpipe it emits a beautiful yellow flame, and melts into a globule, which becomes opaque on cooling.

It is composed of 16.3 acid

| 23.7 soda |
| 60.0 water |
| 100.0 |

6. Phosphite of ammonia may be prepared by the same processes as the two last-described phosphites. It crystallizes sometimes in long transparent acicles, and sometimes in four-sided prisms terminated by four-sided pyramids. It has a very sharp saline taste. It is soluble in two parts of water at the temperature of 60°, and still more soluble in boiling water. When exposed to the air, it attracts moisture, and becomes slightly deliquescent. When distilled in a retort, the ammonia is disengaged partly liquid and partly in the state of gas, holding phosphorus in solution, which becomes luminous when mixed with oxygen gas. Before the blowpipe on charcoal, it boils, loses its water of crystallization; it becomes surrounded with a phosphorescent light; and bubbles of phosphoreted hydrogen gas are emitted, which burn in the air with a lively flame, and form a fine coronation of phosphoric acid vapour. This gas is emitted also when the salt is heated in a small glass bulb, the tube belonging to which is plunged under mercury.

This salt is composed of 36 acid

| 51 ammonia |
| 23 water |
| 3 G |
| 100.0 |

7. Phosphite of ammonia and magnesia. This salt may be formed by mixing together the aqueous solutions of the two component parts. It is sparingly soluble in water, and may be obtained in crystals; but its properties have not been examined with precaution.

8. Phosphite of alumina may be prepared by saturating phosphorous acid with alumina, and then evaporating the solution to a proper consistence. It does not crystallize, but forms a gaseous mass, which emits gradually, and does not afterwards attract moisture from the air. Its taste is astringent. It is very soluble in water. When heated, it fizzes and gives off phosphorus, but it does not readily melt into a glass.

**PHOSPHORIC ACID.** Phosphors forms an acid with two different proportions of oxygen: combined with the largest portion of oxygen, it constitutes phosphoric acid, and with the smaller it constitutes phosphorous acid.

1. It may be formed by setting fire to a quantity of phosphors contained in a vessel filled with oxygen gas. The phosphors burns with great rapidity and effect, and a number of white flakes are deposited, which are phosphoric acid in a state of purity. It may be obtained too by heating phosphors under water till it melts, and then causing a stream of oxygen gas to pass through the melt of a tube. In this case the acid as it forms combines with the water; but the liquid may be evaporated off by the application of heat, and then the acid remains behind in a state of purity. But the usual method of procuring it, is to throw phosphors in small pieces at a time into hot nitric acid. A violent effervescence takes place, the phosphorus combines with the oxygen, and an acid is produced. After the whole of the phosphorus is acidified, the liquid is to be evaporated to dryness, in order to drive off the remains of nitric acid which may not have been decomposed. This process was first put in practice by Lavosier. Care must be taken not to apply too much heat, nor to add too much phosphors at once, and not to have the nitric acid too strong; otherwise the phosphorus takes fire, and usually breaks the vessels in pieces.

2. The acid, thus prepared, may be put into a platinum crucible, and heated to redness to drive off all the water. It is then in a state of purity. It will be a clear, colourless, and transparent, and not unlike glass in appearance. It reddens vegetable blues; it has no smell; its taste is very acid, but it does not destroy the texture of organic bodies.

When exposed to the open air, it soon attracts moisture, and deliquesces into a thick oily-like liquid, in which state it is usually kept by chemists. When exposed to the fire in a platinum crucible, its water gravitantly evaporates, and leaves it in the state of a transparent jelly. If the heat is increased it boils and bubbles up, owing to the separation of the remainder of its water accompanied with a small portion of acid. At a red heat it remains in the form of a transparent liquid, and when cooled assumes the form of the purest crystal. In this state it is known by the name of phosphoric glass. This glass is merely phosphoric acid totally deprived of water; it has an acid taste, is soluble in water, and deliquesces when exposed to the air.
PHO

The specific gravity of this acid, in a state of dryness, is 2.887; in the state of glass 2.85 in the state of deliquecence 14.

3. This acid is very soluble in water. When in the state of white flakes, it dissolves with a hissing noise similar to that made by red hot steel plunged into water. When in the state of glass it dissolves much more slowly. The heat evolved during the combination of this acid and water, is much inferior to that evolved when sulphuric acid enters into a similar combination. Phosphoric acid obtained by delique-scence, when mixed with an equal quantity of distilled water, acquired so little heat as to raise the thermometer only one degree, as Mr. Sage observed. Mr. Lavosser proved, that 45 parts of phosphoric acid boiled to the consistency of a syrup, and from 50° to 63°, by mixing phosphoric acid boiled to the consistency of a syrup with an equal quantity of water; and from 50° to 104° when the acid was as thick as turkey-brown.

4. Oxygen gas has no action on phosphoric acid, whatever is the temperature. Neither is it decomposed or altered by any of the simple combustibles, if we except charcoal; which, though it has no action on it while cold, at a red heat decomposes it completely; carbonic acid is formed, and phosphorus sublimed. This is the common process for obtaining phosphorus.

5. Neither of the simple combustibles has any particular action on it.

6. This acid, when in a liquid state, is capable of oxidizing some of the metals, especially when assisted by heat; at the same time hydrogen gas is exhaled. Hence we see that the oxidizement is owing to the decomposition of water. In this manner it oxidizes iron, tin, zinc, antimony, bismuth, manganese; but on some of these it acts very slowly. When fused with several of these metals, as tin, iron, and zinc, it is converted into phosphorus; a proof that they have a stronger affinity for oxygen.

It does not act upon gold, platinum, silver, copper, mercury, arsenic, cobalt, nicked. It appears, however, to have some action on gold in the dry way, as it is called; for when fused with goldleaf it assumes a purple color, a proof that the gold has been oxidized.

7. Phosphoric acid combines with alkalies, earths, and metallic oxides, and forms with them salts known by the name of phosphates.

8. Its affinities are as follow:

Barytes, Strontian, Lime, Potass, Soda, Ammonia, Magnesia, Glucina, Alumina, Zirconia, Metallic oxides, Silica.

9. The component parts of this acid have been ascertained in a more satisfactory manner than almost any other chemical compound. Mr. Lavosser proved, that 45 parts of phosphoric acid, when burnt in oxygen, absorbed about 63.375 parts of that gas, and produced about 114 parts of phosphoric acid.

Hence it follows that this acid is composed of about 60 parts oxygen and 40 parts phosphorus.

10. or 3 parts oxygen to 2 parts of phosphorus.

This acid is too expensive to be brought into common use. If it could be procured at a cheap rate, it might be employed with advantage, not only in several important chemical manufactures, but also in medicine, and perhaps even in domestic economy.

PHOSPHOROUS ACID: the acid obtained by the burning of phosphorus differs according to the rapidity of the combustion; when heated, part of it is raised, according to the temperature in which the process is conducted. When heated to 140° it burns rapidly, and the product is phosphoric acid: when allowed to burn gradually, at a moderate rate, the product is phosphorus acid, which contains a smaller proportion of oxygen. The difference between these two acids had been remarked by Sage, by Proust, and by Morin, the latter who first, in 1777, demonstrated that they form different compounds with other bodies, and that the difference between them is owing to the difference in the proportions of oxygen which they contain.

1. Phosphoric acid is prepared by exposing phosphorus during some weeks to the ordinary temperature of the atmosphere. Even in water the phosphorus undergoes a slow combustion, and is gradually changed into a liquid acid. For this purpose, it is usual to put small pieces of phosphorus on the inclined side of a glass funnel, through which the liquor which is formed drops into the bottle; the name rising, according to the temperature at which it contains. This is the common process for obtaining phosphorus acid.

2. Phosphoric acid, thus prepared, is a viscid liquid, of different degrees of consistence, according to the size of the glass vessel in which it is contained. It emits the smell of garlic, especially when heated. Its taste is acid, like that of phosphoric acid, and it produces the same effect upon vegetable color; and its specific gravity has not been determined.

3. It combines with water in every proportion; but it cannot, like phosphoric acid, be obtained in a concrete state.

When air of the water which it contains is at first evaporated. When large bubbles of air rise to the surface, there they break, and emit a dense white smoke, or even take fire if the experiment is performed in an open vessel. The emission of these bubbles of phosphated hydrogen gas continues for a long time. When the process is finished, the acid which remains is no longer phosphoric, but phosphoric acid. These phenomena would lead one to suspect that phosphoric acid is not, as has been hitherto supposed, a compound of phosphorus and oxygen; but that it is phosphoric acid saturated with phosphated hydrogen gas.

4. This acid is converted into phosphoric acid by exposure to air or oxygen gas. The process is exceedingly slow, and the conversion is never complete. It succeeds better when the acid is diluted with a great proportion of water.

5. Phosphoric acid is not acted upon by any of the simple combustibles except charcoal, and perhaps also hydrogen. Charcoal decomposes it at a red heat as well as phosphoric acid. The products are carbonic acid and phosphoric acid. It does not act on the simple incombustibles.

6. Its action on metals is exactly similar to that of phosphoric acid, excepting only that the hydrogen gas evolved during the oxidization of the metals has a fetid smell, and holds phosphorus in solution.

7. It combines with alkalies, earths, and metallic oxides, and forms compounds distinguished by the name of phosphates.

8. Sulphuric acid produces no change upon it while cold; but at a boiling heat it parts with some of its oxygen, and the phosphorus acid is converted into phosphoric acid. Nitric acid also, when assisted by heat, converts it readily into phosphoric acid. This furnishes us with the best process for obtaining phosphoric acid at present known.

The affinities of phosphoric acid, as ascertained by Bergman, Fourcroy, and Vaupelin, observe the following order: Limestone, Barytes, Strontian, Potass, Soda, Alumina, Glucina, Alumina, Zirconia.

This acid has not hitherto been put to any use. The historical account is sufficient to convince us, that it is composed of the same constituents as phosphoric acid; but the exact proportion of these constituents has not hitherto been ascertained.

PHOSPHORUS, in chemistry, a combustible substance remarkable for its strong attraction for oxygen, and which consequently spontaneously inflames in the open air at a moderate temperature.

History of its discovery. It was accidentally discovered by Brandt, a chemist of Hamburgh, in the year 1680, as he was attempting to extract from human urine a liquid capable of converting matter into gold. He showed a specimen of it to Kraft, a German chemist of considerable eminence, who mentioned the fact as a piece of news to one Kraft, a friend of his at Dresden. Kraft immediately requested his friend to procure the secret from Brandt for 200 dollars, exclaiming, that he, from the same time a promise not to reveal it to any other person. Soon after he exhibited his phosphorus publicly in Britain and France, expecting doubtless that it would make his fortune. Kunkel, who had mentioned to Kraft his intention of getting possession of the process, being vexed at the treacherous conduct of his friend, attempted to discover it himself; and about the year 1674 he succeeded, though he only knew from Brandt that urine was the substance from which phosphorus had been procured. Accordingly he is always reckoned, and truly also, as one of the discoverers of phosphorus.

Poyc likewise discovered phosphorus, and revealed the process to Godfrey Haukewitz, a London apothecary, who continued for many years to supply all Europe with phosphorus. Hence it was known to chemists by the name of English phosphorus.

Phosphorus may be procured by the fol-
PHOTOGRAPHY

1. The amount of process that a photographer can
2. The most important factor in the process is
3. The process is carried out in a darkroom
4. The process depends on the chemistry of
5. The process involves the use of light-sensitive
6. The process is divided into three main stages:
   a. Exposing the photographic plate
   b. Developing the plate
   c. Fixing the image
7. The process is used in various fields:
   a. Fine art
   b. Journalism
   c. Medical imaging

PHYSIOLOGY

1. The study of the functions of the body
2. The body's response to stimuli
3. Homeostasis is maintained by the
4. The nervous system and the endocrine system work together
5. The brain controls various functions
6. The circulatory system transports nutrients and oxygen
7. The respiratory system exchanges gases with the environment

PHYSICS

1. The study of matter and energy
2. The behavior of particles
3. Quantum mechanics predicts
4. The uncertainty principle limits
5. The wave-particle duality explains
6. The speed of light is constant
7. The laws of motion describe

PHYSIOLOGY

1. The study of the functions of the brain
2. The brain controls various functions
3. The nervous system transmits
4. The endocrine system regulates
5. The brain's structure is divided into
6. The cerebrum controls
7. The brainstem regulates

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serving as a kind of prop or stay, preventing the case or tube from slipping too forwards during the time the animal is feeding.

Of the European phrynagnes, one of the largest is the hydrangea grandis of Linnaeus, usually measuring somewhat more than an inch in length, and having very much the general aspect of a phalena: the upper wings are grey, marked by various darker and lighter streaks and spots, and the under wings yellowish-brown and semitransparent. The larva, which measures near an inch and three quarters in length, is of a flesh-coloured grey, with brown head and legs, and inherits a portion of the peculiar off-kink, small fragments of grass-stalks, or other substances. Like other larvae of this genus, it is known by the name of caddew-worm, or cad-bait, and is frequently used by anglers as a bait. When taken and even on the young case or tube by several silken filaments to the stem of some water-plant, or other convenient substance, in such a manner as to project a little above the surface of the water; and casting its skin, a phryganea of a lengthened shape, and displaying the immovable limbs of the future phrynagnes, which in the space of about fourteen days emerges from its chrysalis.

Phrygana rhombica is a smaller species than the former, and is of a yellowish-brown colour, with two obliquely transverse rhomboid semitransparent white spots on each upper wing; the lower wings being whitish, with blackish brown towards the upper edge. The larva forms its case of small pieces of the slender stems of grasses or other plants, curiously disposed in an obliquely transverse direction. It is of a greenish-brown colour, and like the former, is found in rivulets and stagnant waters. The larve of the phrynagnes in general feed not only on the smaller water-insects, but on the spawn of fishes, and even on the young fry itself. There are twenty-four species.

Phryma, a genus of the didynium gymnospermae class and order. The essential character is, seed one. There are two species, herbs of North America and the West Indies.

Phrynium, a genus of the monandria monogyne class and order. The calyx is three-leaved; petals three-equal; nectarine; tube varying in length; corolla five-petalled; capsule three-celled; nuts three. There is one species, a plant of Malabar.

Phthisis. See Medicine.

Phygethon, in surgery, a broad, but not much elevated tumour, of the same nature with the bubo. See the article Bubo.

Phylactery, in antiquity, a charul or annulet, which being worn, was supposed to preserve people from certain evils, diseases, and dangers. The Jews were remarkable for wearing phylacterys of parchment, in the form of slips or rolls, wherein were written certain passages of the law: these they wore upon their foreheads, and upon the wrists of their left arms. The modern Jews think themselves under no obligation to this practice, which they observe only at morning prayers.

Phylachne, a genus of the dioecia monandria class and order. The calyx is three-leaved, superior; corolla funnelform; fem, stigma four-cornered; capsule inferior, many-seeded. There is one species, a small mossy plant of South America.

Phyllacris, bastard chelone, a genus of the monogyne order, in the pentandria class of plants; the perianthium five-parted, tuberine, petals none; capsule trilocucent. There are twenty species, of which three are commonly found in the gardens of this country; but being natives of warm climates, they require to be kept in pots, and housed in winter. They are all shrubby plants, rising from three to five or six feet high, and adorned with masses of white flowers. They are propagated by cuttings.

Phyllanthus, exo-side laurel; a genus of the triandria order, in the monocotyledon class of plants. The male calyx is six-parted, bell-shaped; no corolla; female calyx six-parted; styles three, bident; capsules three-celled; seeds solitary. There are eleven species, all of them natives of warm climates; and rise from twelve or fourteen feet to the height of muddling trees. They are tender, and cannot be propagated in this country without artificial heat.

Phyllis, a genus of the pentandria digynia class and order. The stigmas are bis-ped, fructifications scattered; cal, two-leaved; obsolete; corolla five-petalled; seeds two. There is one species, a herb of the Canaries.

Phyrsal, winter cherry, a genus of the monogyne order, in the pentandria class of plants. The corolla is wheel-shaped; stamna convoluted; trampy within an infatuated calyx, two-celled. There are seventeen species, of which the most remarkable is the alkekengi, or common winter-cherry. This grows wild in Spain and Italy. The flowers are produced from the wings, standing upon slender footstalks; they are of a white colour, and have but one petal. They are succeeded by round berries about the size of small cherries, inclosed in an inflated bladder, which turns red in autumn; when the top opens and discloses the red berry, which is soft, pulpy, and filled with flat kidney-shaped seeds. The plant is easily propagated, either by seeds, or paring the roots; and is very hardy.

Physeter, cachalot, a genus of fishes of the order cete. The generic character is, teeth visible in the lower jaw only; spine on the head or snout. 1. Physeter, the cachalot; cachalot, the sperm whale, which is one of the largest species, is scarcely inferior in size to the great mysticete, often measuring sixty feet or more in length. The head is of enormous size, constituting more than a third of the whole animal; the mouth wide; the upper lip rounded, thick or high, and much broader than the lower; which is of a somewhat sharpish form, fitting, in a manner, into a longitudinal bed or groove in the upper. The teeth, at least the visible ones, as mentioned in the generic character, are situated only in the lower jaw; and when the mouth is closed, are received into so many corresponding holes or cavities in the upper: they are very numerous, rather blunt, and of a somewhat conic form, with a very slight bend or inclination forwards. There are also, according to Fabricius, small, curved, flatish, concave, and sharp-pointed teeth, running along the gums of the upper jaw; though, from their peculiar situation and size, they are not visible like those of the lower; being imbedded in the fleshy interspaces of the holes which receive the lower teeth, and preventing only their internal concave surfaces to meet the latter when the mouth is closed. The front of the head is very abrupt, descending perpendicularly downwards; and on its top, which has been much admired by some authors, there is an elevation or angular prominence containing the spine, which appears externally simple, but is double within. The head is distinguished or separated from the body by the reverse curvature or gentle rise. The eyes are small and black; and the ears or auditory passages extremely small. About the middle of the back is a kind of spurious fin, or dorsal tubercle, of a callous nature, not movable, and sometimes abrupt or cut off behind. The tongue is of the shape of the lower jaw, clay-coloured externally, and of a dull red within. The throat is but small in proportion to the animal. The body is cylindrical beyond the pectoral fins, growing narrower towards the tail. The colour of the whole animal is black, but when advanced in age grows whistin beneath. It swims rapidly, and is said to be a violent enemy to the finless porpoise. This whale is the cyclops of the sea, for the greenlanders use the flesh, skin, oil, tendons, &c, in the same manner as those of the sperm whale; it is reckoned very difficult to take, being very tenacious of life, and surviving for several days the wounds it receives from its pursuers.

It is in a vast cavity within the upper part of the head of this whale, that the substance called spermaceti is found, which, while fresh and in its natural receptacle, is nearly liquid; but when exposed to the air, concretes into opaque masses: this substance being so universally known, it becomes unnecessary to describe it farther.

A more curious and valuable production, the origin of which had long eluded the investigation of naturalists, is obtained from this animal, viz. the celebrated perfume called ambergris, which is found in large masses in the intestines, being in reality no other than the faces.

2. Physeter catodon, small cachalot. This species is of far inferior size to the former, measuring about twenty-five feet in length. In its general structure, it is allied to the preceding, but has a smaller mouth in proportion, and is without any visible protuberance on the back. It is found in the northern seas.

3. Physeter micros, small-eyed cachalot. This species, sometimes even superior size to the first-described species, and is a native of the northern seas. The head is very large, and nearly half the length of the body: the eyes extremely small, and the curvature of the head is a long and somewhat upright narrow and pointed fin. This species swims swiftly, and is said to be a great enemy to the porpoise, which it pursues and preys upon. Its colour is blackish above, and whitish beneath. Some of the supposed varieties of this whale are said to grow to the length of eighty or a hundred feet. The teeth are of a more curved form than the rest of the genus.
Physyseter tursio, high-finned eulachet. This is particularly distinguished by the great length and narrow form of its dorsal fin, which is placed almost upright on the back, and is said by some observers to appear at a distance like the mast of a small ship; the animal growing, if we may believe report, to the length of a hundred feet. In its general appearance it is said much resembles the former species, of which it may perhaps be a variety rather than truly distinct; but so much obscurity still prevails with respect to the cetaceous animals, that this point must be considered as very doubtful.

Physicians. No person within London, nor within seven miles of the same, shall exercise as a physician or surgeon, except he be examined and approved by the Bishop of London, or by the dean of St. Paul's, calling to them four doctors of physic, and for surgery, other expert persons in that faculty, of them, that have been approved; upon the pain of forfeiture for every month 5l. one half to the king, and the other half to any that will appear in suit for it.

One that has taken his degree of doctor of physic in either of the universities, may not practise in London, and within seven miles of the same, without licence from the college of physicians there held; that if a person, not duly authorized to be a physician or surgeon, undertakes a cure, and the patient dies under his hands, he is guilty of felony; but he is not excluded from the benefit of clergy.

Physic, called also physiology, and natural philosophy, is the doctrine of natural bodies, their phenomena, causes, and effects, with their various affections, moions, operations, &c. So that the immediate and proper objects of physics, are body, space, and motion.

Physiology is a word which, in its etymological signification, comprehends the science of nature in general: modern use, however, has restricted it to that department of physical knowledge which has a sole relation to organic existence; and, indeed, when employed as a generic term, without any specific mention, it is made exclusively to denote the science of animal life. Inferiorly organized bodies are those which have an origin by generation, a growth by nutrition, and a termination by death. In developing, however, to mark the precise distinction between living or organic, and matter which is inanimate or destitute of vitality, it will be found of considerable import to ascertain the prime characteristic of either, or that to which all other influences, in such manner as to subordination.

It is indivisibility, or mutual connection of parts with the whole, which appears to constitute the essential character of a living organized body. The mode of existence of each part of inanimate matter belongs to itself, but in living bodies it resides in the whole. Separate a single branch from a tree in the full vigour of vegetation, and the part thus separated shall instantly drop, and emaciate, and shortly die; that is, it will cease to be influenced as formerly by air, heat, and other powers which support vegetation; will no longer display those phenomena which had previously resided in the agency of such powers; will become, in the language of the Brunnonian philosophy, unsusceptible, and subject to the government of new laws. In the animal creation, also, the same effect will result from the same process: if a limb is separated from an animal body, the life of such limb, without any apparent injury to its organization, will be inevitably destroyed. Supposing we have thus reduced organic to inorganic, let us consider the relation of an animal body, for instance, let us pursue our experiments on the material thus changed; let the part to which we have given a new mode of existence before be divided, and we shall now find nothing of the like result, as in the first process, to take place; its quality by this last operation will only be altered inasmuch as its quantity is diminished. Each part will be found to have a separate and independent existence.

There has been a confusing of integral principle interfered with; and, placed exactly under the same external circumstances, an identity in the mode of existence would be retained to the end of time by each division. Let us pursue our experiments still further. Let us subject the two parts to a difference of external circumstance; enclose one in an atmosphere of 40° of heat, the other in one of 100°, and the difference will be a deprivation of that identity which till then they had retained. Each part will not continue the same mass of dead matter, but will assume a new character. Now it will be seen that in those processes we have operated an essential change; and in each, of an essentially different nature. By separating a part from the whole of an organic body, we effect the loss of its vitality, even though such external agents shall be applied as previously operated its life and growth. By a further mechanical separation we do not effect an alteration in quality, in any other way than as this will depend on quantity, until we occasion a change in exterior agents; by which change, however, we finally ensure an actual alteration of principle or composition, as well as of aggregate powers.

We have thus endeavored to illustrate the simple and prime characteristic of organic as separated from inorganic being. But physiology we have said, according to the general acceptance of the word, confines its researches to the animated life; but the prime and peculiar to the other itself, it will be proper further to state. The usual division of organized existence is into animal and vegetable; the former possessing those faculties from which result sensation and locomotion; the latter being destitute of such faculties; an opinion indeed has recently been hazarded that such division is unfounded and artificial; that vegetable and animal life are subject to the same laws; that plants are not merely organized, but animalized; that their motions indicate sensation and consequent volition. To enquire into the grounds of these assumptions, does not fall within the province of the present article, we are to take at for granted the negative of the proposition, and proceed to consider first, the primary faculties, and secondly, the resulting functions, of those existences which are universally acknowledged to be possessed of the powers of feeling and of motion, and are truly and evidently animalized.


Sensibility has been defined, the faculty which organs have of feeling; the aptitude they possess of perceiving, by the contact of an extraneous body, an impression more or less powerful, which changes the order of their motions, accelerates or retards, suppresses or completes them. "This faculty," says the author from whom we have taken the definition (M. Richerand), "generally diffused in all the organs, does not exist in all to the same degree. In some it is obscure and scarcely apparent, and seems reduced to a degree absolutely indispensable for the fluids to determine the actions necessary to the functions they ought to go through, they may seem that no part of the body can do without this sensibility absolutely necessary for life. Without it, how could various organs act upon the blood, to draw from it the means of their powers, polyvalent and for the different secretions? Therefore this degree of sensibility is common to every thing which has life; to animals and vegetables; to a man when asleep and awake; to the fetus, and the infant; to the organs of vegetation, and to those which put us on a level with surrounding beings. This low degree of sensibility could not have been sufficient for the existence of man, and of beings resembling him, subjected to numbers of circumstances which are different both as to the things of which man is the component part, and to the vast number of things that surrounds them; therefore they possess a sensibility far superior, by which the impressions affecting certain organs are perceived, judged, compared, &c. This sort of sensibility would be called, in the proper sense, the faculty of perceiving, the faculty of judging, of the motions experienced. It requires a center to which impressions have a mutual relation, and extends itself to all things which, like man, have a brain, or something equivalent in its place; whilst zoophytes, and vegetables, not possessing this central organ, are both destitute of this faculty; however, as to the mental actions, we have seen, that they have certain spontaneous motions, which seem to indicate the existence of volition, and consequently of sensibility; these actions, like that of a muscle from the thigh of a frog excited by the blow of a stick, are occasioned by an impression that extends beyond the part itself, and in which sensibility and contractility exist in a confused state." Elements of Physiology by A. Richerand, translated.

By the above definition and description of simple sensibility, as opposed to perceptibility, it will appear that our author does not consider sensation as the necessary consequence of the faculty which he terms sensibility.

The author, however, whom we have quoted, admits that this kind of latent and imperceptible sensibility "cannot be exactly compared to that which we find in the parts in which it resides, generally possessing such a small share of sensibility in a state of health, have an increased or perceptible degree of sensibility when in a state of disease," and after giving numerous examples he adds, "should it not be suspected that if we have not that consciousness of impressions made upon our organs by the fluids contained in them during health, it is from being accustomed to the sensations they excite almost without interruption, of which we have only a confused perception, that terminates imperceptibly? And may we not be permitted in this point of view to compare these organs to.
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those in which reside the senses of vision, hearing, smell, taste, and feeling, which can no longer be excited by habitual stimuli to which they have been long accustomed. We find, however, some difficulty in admitting this principle even with the most precise definition of sensibility becomes in this manner latent, or we cease to take cognizance of such functions as are exercised independently of the will merely by the force of habit, does it not follow that the origin of those functions, at least in their aggregate, would have been accompanied by more sensation than is consistent with the healthy state? Thus the moment an animal became conscious of existence, it would be the subject of impressions which we usually consider as at least to derive life. Does it not appear that involuntary living action results from a principle dissimilar to that which is preceded by sensation; and that the sensibility here spoken of is a quality of the animal body between that which gives sensation and volition, and that upon which muscular irritation or contraction from stimuli depends? When the galvanic experimenter excites motions in the muscles of the isolated thigh of a frog, it cannot be supposed that such actions are attended by perception (for, as it has been properly observed by M. Cuvier, "it appears regnant to the sensations we entertain of self, and of the utility of our being, to admit the possession of sensation by these fragments"); although the actions are excited through the medium of nervous excitability, and are of a different nature from those which would follow from the mere irritation of the muscular fibre. May we not then conclude that the nervous organization is endowed with a sensibility indistinguishable of the brain, or what M. Richerand perhaps improperly designates percipient sensation; and that it is through the medium of this faculty that the incessant and unperceived performance of the vital functions is accomplished? When the voluntary faculty of the brain is to acknowledge its accustomed and appropriate stimuli; when sensation for a time is totally suspended, as in apoplexy, or in experiments on frogs by pouring opium on the brain of these animals; the functions of vitality are performed by means of the sensibility now alluded to. We have nowhere endeavoured to prove that convulsive agitation, whether taking place in the muscles of volition, or in those organs which are independent of the will, results from deficient or transient excitement (see Medicine, section Nervous Diseases); and such defective excitement seems to result from an unhealthy condition of this nervous susceptibility, which, in all instances of sudden death produced by an abrupt and entire abolition of the sentient and loco-motive faculty, for some time longer lingers in the system, deranged indeed, but not yet destroyed, and produces those spasmodic motions which are observed in an animal body under the circumstances which we are now supposing. When, for instance, a domestic bow! is deprived of life, either by its head being severed from its body, or by the more moderate mode of screwing the neck, a spasmodic convulsive kind of verticelli will be observed, and indicate the remains of this susceptibility of action, for some time after perception or actual sensation is gone. If the principle more contended for is adopted, our compassion for the animal in this state would be misplaced; and it must likewise follow that the notion which has been maintained by some is altogether erroneous, of death from decapitation being a lingering, and therefore cruel, mode of terminating existence. Of acute stupor, or of analogous worms, a like separation of parts does not appear to operate the same immediate destruction of the sensitive and loco-motive faculty; for in all there is no single brain, but ganglia, as the centres of sensations and commencing points of volition. Each part of a divided worm is thus a distinct living and sentient being. From the remains of this principle of susceptibility may originate those convulsive affections which almost invariably precede death in the course of nature, and which are oftentimes exhibited in a violent degree for some time posterior to the departure of the sentient or perceiving faculty, but which last itself destroyed prior to the total destruction of muscular irritability, or the vis insita of Haller. This last (Haller's irritability) is denominated by modern physiologists, contractility. As actual sensation is destroyed through the medium of nerve, so the general organ of motion is the fibrous or muscular fibre. This fibre contracts itself by volition, but the will only exercises this power through the medium of the nervous system, whenever it acts upon the nervous filaments, and the obedience of the fibre ceases when the communication of that filament with the rest of the system is interrupted. Certain external agents applied immediately to the muscles or to the viscera, or such as are produced by means of the voluntary action, and they preserve their action upon it even after the section of its nerve, or its total separation from the body, during a period which is longer or shorter in different species of animals. This faculty of the fibre is called its irritability. Does it in the latter case depend upon the portion of the nerve remaining in the fibre after its section, which always forms an essential part of it, or is the influence of the will only a particular circumstance, and the effect of an irritating action of the nerve on a faculty inherent in the muscular fibre? Haller and his followers have adopted the latter opinion; but every day seems to add to the probability of the opposite theory.—Cuvier's Comparative Anatomy.

If, however, we resort to analogy, which, in the present state of our knowledge with respect to the composition of muscular fibre, is all the aid with which we are furnished to solve the question of distinct or separate residencies of nervous and muscular power, we should perhaps be compelled to revert to something like the Hallerian doctrine of a vis insita, or independent excitability, and consider that the nerves are merely instruments by which the faculty of contractility is developed, and that this faculty may otherwise be produced by extraneous stimuli, without the interference of the nerves. Many plants are possessed of contractile, although not (as it appears) actually sensitive and loco-motive power; this contractility, from the mode of its excitation, and from the phenomena which it exhibits, seems in every way similar to the irritability of the animal fibre, nevertheless neither brain nor nerves have hitherto been detected in vegetables. The attempts to prove that irritability and sensibility are one, seem to proceed from the general tendency observed in the philosophy of the present period, to strain the analogy between vegetable and animal life. M. Delametherie, a French physiologist, carries this doctrine to the extent of denying the existence in feto of any part which was not at least in its aggregate animal, and has been ordinarily considered to be muscle; he considers as "a congeries of blood-vessels, lymphatics, and nervous filaments, bound together by cellular membrane, in the interstices of which a deposited animal gelatine and fat." Considerations on the Ecto'-organis., &c.

It appears to us, however, that sensibility and irritability, although intimately connect- ed, and never separate in a living animal body, are by distinct principles; at least, that more and stronger facts than have hitherto been advanced, are requisite to the full establishment of the modern doctrine, "that they are in effect the same property."

Irritability, or the power of contraction upon the application of stimuli, has been divided into two species; the one has been named by some physiologists the tonic power, the other muscularity: this difference, however, rather refers to the difference of exciting agents, which is the one and the other; the slow, gradual, and tonic-like action of the bladder in expelling the urine," seems principally to vary from that of the voluntary muscles by being more bound the influence and caprices of the will.

The most remarkable characteristic both of sensibility and irritability (forming together vital excitability) is, that as they are subservient to different purposes, and resident in various organs, they are susceptible of development or excitation, by peculiar and respective agents. Thus light is a stimulus to the eye, sound to the ear, a rapid substance to the taste, and an odoriferous body the smell. Thus mercury will stimulate the hepatic, fogseal the renal viscus, although in each instance the indivisible faculties of sensibility or irritability are called into play; and no difference indicating peculiar excitability can be traceable in the anatomist in the arrangement, or the chemist in the composition, of the ultimate fibril con- structing either the nerves or the contractile organs of these respective parts.

The animal frame is supported in the same manner as a piece of complicated machinery, composed of several springs, each of which is kept in exercise by a principle peculiar to itself, while the combined effect of them all is one resulting whole, effected by one prime and operating principle; this, in the living machine, is named the vital principle, of which we are now to speak.

Researches into the nature and cause of living actions, appear to have been impeded by errors arising from different, and in one sense, opposite sources; the one of old, the other of modern date. The earliest philo- sophers could not have been long in ob- serving, while contemplating the phenomena of life, "that it exhibits an order of truths peculiar to itself, which is no where to be found beyond the sphere of living existence." (Dumas.) Before the proper boundaries were discovered of human research, and the true nature of philosophizing ascertained,
these phenomena were accounted for by the supposition of an occult agency endowed with intelligence, and acting with design; hence the origin of the vague terms archai, or preexisting premises. The ancients, and other expressions, the inventors of which do not appear to have been conscious that they not merely amount to a confession of ignorance, but instead the judgment by attaching it to certain preconceived systems framed from ideal knowledge. It is the province of philosophy not to imagine but to infer. When it is observed, that life in all its modifications and stages, requires for its development and maintenance the incessant agency of peculiar powers on matter peculiarly constructed, as in the experiments before alluded to, we are not merely justified in concluding, but we are irresistibly impelled to the inference, that the combination of effects to which we have applied the term life results from such agency on such organized matter. The nature of the link which constitutes this connection may for ever be concealed, but the connexion is not to be explained away, for the nature of life then is not to be confounded either with the abstract nature of the matter acted upon, or the agents through the medium of which it is produced. "There is no interior indestructible identity between the external sign and the interior object. There is no exterior abstract power. In the employment then of the term vital principle, we ought to be regarded as simply announcing a fact, not as conveying a notion of cause; and in this view, the contrary arguments, especially to the sentiments of some authors from whom it is almost tenuity to differ, that the passive rather than the active voice of verbs, should be made use of in calculations on vital forces and effects. See the articles BRUNONIAN SYSTEM; and likewise MEDICINE, section Pater."

But an error from a different source than that just alluded to, appears to have inanted itself into the physiology of the present day, viz. that of too hastily registering under one head, facts which both in their origin and result, are of a nature essentially different. We allude to the chemico-animal physiologists who, without inquiring into the different inferences which accompany the extrication of the galvanic fluid, upon the same principle that a piece of skin contracts which is brought near the fire, or on which is poured a concentrated acid, a caustic alkali, or any other caustic body."

Thus it has been inferred that the newly discovered source of nervous excitation operates upon the muscles, by virtue of an attractive power in the muscles, in the same manner as an acid rushes into combination with an alkali, or as oxygen unites itself with an inflammable base. "I suppose, (says M. Delametherie) that muscular contraction is caused by the heat which accompanies the extrication of the galvanic fluid, upon the same principle that a piece of skin contracts which is brought near the fire, or on which is poured a concentrated acid, a caustic alkali, or any other caustic body."

From such mode of reasoning it has been inferred, that the science of medicine is reduced to a simple combination and separation of principles as in the chemist's laboratory; and that life and health are to be preserved and restored in the same manner as a fluid body is made viscid by the introduction of a portion of its own principles. Thus we have advanced to the writings of medical systematics of this class the processes described, and the results confidently anticipated, of oxygenating, deoxygenating, hyperoxygenating, and galvanizing, the human system."

"It is however obvious, that these speculations are fundamentally erroneous; for life and health are built upon a firmer basis than that either of aggregative or chemical action; and that life is a condition of things between every the most minute portion of a living body, must be preserved, the indivisibility of the frame must first be dissolved, in a word life must have deserted the body, before chemical processes can be admitted. In what manner, according to the tenets we are now canvassing, could that remarkable property of animal life (calorici) be preserved, of retaining a regular quantity of interior, untill all the galvanic fluid, utterly, is consumed? Almost every chemical combination is effected by a variation, and in very many cases, a trivial variation, in temperature; but the living body is capable of sustaining or of resisting heat to a degree which would immediately change animal or vegetable substance deprived of life into substance of a totally different nature."

"Life, in the systems we are commenting upon, appears, as before observed, to be con formed with that which produces or excites life. Vital phenomena are not observed and arranged in their natural and regular sequence, unless we have arrived at the proper stage point; thus, although we even accord to the position of M. Cuvier, 'that the living and contracted muscular fibre is not, strictly speaking, the same body, nor composed of the same chemical materials, as the relaxed or inactive fibre,' we are not therefore compelled to the alternative of referring the commencement of muscular action to a change of affinity; or with Humboldt and others, to acknowledge the separate operation of every agent on living matter is virtually an instance of chemical combination."

"Let us follow in idea, the influence of the most minute portion of some materials which affect the state of the human body, and that most distant fibre of the body, we shall often find, for instance, an immediate excitation of all the vital functions, result from their reception into the stomach; now, allowing that the agency of each different class and different nature of these new combinations strictly chemical, in the fluids and solids, does it therefore follow that the primary impulse on the excitability is a chemical process? If so, how is it possible that the central idea of a cause ab origine mental? or how could the mandates of the will contract the fibre?

"Without further enlargement, therefore, (and was it not for the practical importance of the subject, we should state an apology already due to the reader,) we trust we may be permitted to conclude, that as the natural philosopher demonstrates a particular quality in bodies to be proportioned to their quantity, and designates this principle by the term gravitation; as the chemist finds the mixture of two different bodies to form a third, and refers it to the state of the two uncombined particles; so the physiologist, recognizing the difference of character in the phenomena of life from either of the above modifications of being, makes a separate register or classification of such phenomena, without a comprehensive title of the vital principle; in other words, that 'the primary motions of matter (or rather we should say, laws of nature) are capable of division into the three classes of gravitational, chemical, and animalistic.'"

In the above sketch we have confined our observations to what may be regarded the great characteristic of living existence, indivisibility; under the immediate influence of which the individual is preserved, and the species propagated; or the secondary faculties are exercised, of assimilation and generation; these faculties we might now proceed to notice; but as they branch out into several functions, it will be more consistent with our limits to refer their consideration to such functions which we are now to describe, together with those resulting from sensibility and irritability, which it was however first necessary to view as the principal parts of an indivisible whole."

The following table (which we have taken from M. Richerand) presents, perhaps, the most comprehensive and accurate plan which has been formed of vital functions; we shall therefore follow its arrangement, and in instances where these functions have been treated of under separate heads, refer to them under their respective titles.
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Plan of a new Classification of the Functions of Life.

Genus 1. Digestion extracts the nutritive part.

Genus 2. Absorption carries it into the mass of humours.

Genus 3. Circulation propels it towards the organs.

Genus 4. Respiration combines it with atmospheric oxygen.

Genus 5. Secretion causes it to pass through several modifications.

Genus 6. Nutrition applies it to organs, to which it is to supply growth and restore their loss.

Genus 1. Sensations inform the being of their presence.

Genus 2. Motions approach towards or remove it from them.

Genus 3. The Voice and Speech cause it to communicate with similar beings without change of place.

Genus 1. Conception and Generation.

Conception and Generation.


Class I. Functions which serve for the preservation of the individual. (Individual life.)

Order I. Functions which assimilate the aliment by which the body is nourished. (Assimilating, internal, or digestive functions.)

Order II. Functions which form connections with surrounding objects. (External or relative functions.)

Class II. Functions which serve for the preservation of the species. (Life of the species.)

Order I. Functions which require the concurrence of both sexes.

Order II. Functions which exclusively belong to females.

Conception and Generation.


Conception and Generation.


Conception and Generation.


Conception and Generation.


Conception and Generation.

Of digestion.

Digestion, or that function by which the dissolution of the aliment is accomplished, and food is thus fitted for the lacteal absorbents, will be found described under the article of Digestion, Vol. I., page 150; and for those varieties in the digestive system of all other organs observed in different animals, the reader is referred to Comparative Anatomy.

Of absorption.

Absorption is that process by which the incessant waste of the system from the various secretions and excretions is constantly repaired. Thus after digestion has converted the aliment into chyle, this fluid is taken up by the lacteal or mesenteric absorbents, undergoes a further preparation in these vessels, is thence conveyed to the thoracic duct, and at length enters the mass of circulating blood, to furnish the requisite secretions, excretions, and exhalations; in this manner a perpetual change is operated in the materials of which an animal body is composed; for it should never be forgotten that organized living matter compounds and decomposes itself continually. But this composition and decomposition are perpetually under the influence of fibrinous stimulation. "Each orifice of a lacteal and lymphatic, enlaid with a peculiar degree of sensibility (susceptibility?) and power of contraction, dilates or contracts, absorbs or rejects, according to the mode in which it is affected by substances that are applied to it." Thus when the chyle is applied to the orifices of the lacteal vessels (which have been termed chylous absorbents), it is not solely by means of capillary or any other species of attraction, that this fluid is made to enter its appropriate vessels, but such entrance is gained in virtue of the power possessed by chyle of stimulating these organs; a demonstration of which principle is furnished from those substances being rejected which have not the power of producing that dilatation and contraction just spoken of.

Another curious fact in support of the principle that some substances are not capable of exciting the absorbent vessels, is furnished by those marks which sailors and others are accustomed to imprint on their skin. These are generally formed by first pricking holes in the cuticle, and then rubbing the part over with charcoal or gun-powder, substances which remain undissolved in the fluids, unabsorbed in the lymphatics, and therefore continue through life. Indeed solution is a necessary prelude to every case both of lymphatic and lacteal absorption. It is then by the peculiar action of the lymphatics on the exhaled fluids, that lymph is formed; and of the lacteals on the chyle, that this last becomes animalized. These glandular bodies which are observed in these vessels are supposed to have a very important influence on their contained fluids; and "although it is not known precisely in what these alterations consist of lymph and chyle, it may be said that the object of the glands seems to be, to occasion the most intimate mixture, the most perfect combination of elements; to impress a certain degree of animalization, as proved by the greater concreteness of lymph taken from the erina oriferentis, or those which pass from glands; to deprive them of mere heterogeneous principles, or, at least, to alter them so that they may not become harmful in passing into the mass of human nourishment." Thus we find, that after absorption has been in the first instance effected by vital action, the contents of the absorbing vessels, still, however, under the same influencing principle, are the subjects of a species of animal chemistry.

As the course of the lymph and the chyle is less rapid than that of the blood, the dilatations, curvatures, and frequent communications of the lymphatics, must considerably obstruct the progress of their contents; but the principal cause of retardation is in the numerous glands just mentioned, which every particle of lymph and chyle has to pass through previously to its entering the blood-vessels.

There are two questions remaining at issue respecting the physiology of the absorbent system: 1st, Whether the distribution of these vessels is universal; and 2d, Whether cutaneous absorption is effected independently of mechanical violence done to the cuticle. Anatomy has not hitherto detected absorbents in the substance of the brain; but analogy, as well as the circumstances attendant on diseases, disposes us to infer almost with certainty, their existence in every part. The second question, although it has recently been negatived by high authority (Dr. Rousseau, Dr. Currie, M. Seguin and others), is generally supposed to be decided in the affirmative. The principal facts in support of the latter opinion are, "the increase of weight in the body after a walk in damp weather, the abundant secretion of the urine after remaining for some time in a bath, the evidences of absorption in the inguinal glands after long-continued immersions of the feet in water, the effects of mercury administered by friction, the external application of turpentine without friction altering the urine, even when, according to some, its entrance into the system by the lungs had been guarded against, &c."

To which Dr. Watson's experiment may be added, of giving a Newmarket jockey, previous to a race, a glass of wine, about an ounce in weight, and finding immediately after the course, he had gained in weight 30 ounces.

Whether actual nutriment is introduced into the system in the way of cutaneous absorption, is perhaps extremely problematical. Dr. Darwin, however, inclines to this opinion, and among the nutrices in his materia medica, classes both substances that are taken by the surface and likewise by the lungs. Others have supposed, and perhaps with justice, that all matter which is nutritive must be received through the medium of the lacteals.

Of the circulation.

As absorption to digestion, so the description of the blood's circulation naturally follows to absorption, in tracing the mysterious round of animal functions. In describing the circulation, we shall, pursuing the order of the above table, speak first of the action of the heart; secondly, of the arteries and capillary vessels; and thirdly, of the veins.

Of the action of the heart. By referring to the article Anatomy, the reader will find the heart described as consisting of four large cavities, all of which have a communication with each other; of these the two ventricles are in a manner the principal, the auricles the accessory cavities. In following the blood's course through these different divisions, it will be necessary in the first instance to suppose, that each cavity is filled and emptied in a successive order. We then commence the description of the circulation, with the blood returning from every part of the body, and collected in the two venae cavae, interior and superior; these joining at their entrance into the right auricle, pour their blood into this auricle, which by consequence immediately contracts, and forces the received blood principally into the contiguous ventricle: a small part, however, flows back into the cave. The right ventricle now discharged likewise immediately contracts, and the blood is prevented from returning by the tricuspid valve, so that only a small part flows back, while the principal stream passes on into the pulmonary artery, at the entrance of which are the rigid valves. The blood is now impelled forwards through all the very minute divisions of the pulmonary artery, and by consequence through the lungs; in these organs it is exposed to the air by the intervention of only a very thin
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The mechanical sources of the blood's re
tardation are, 1st, increase of space occupied by the arteries; for the collection of all the branches from a trunk would form a larger area than that of the parent trunk, 2d, the resistance made by the curvatures of the arteries; this mechanism, its cause and effect, are beautifully illustrated in the tortuous course observed in the internal carotid which goes to the brain. The brain, therefore, is an inordinate flow of blood into this organ is in a great measure obliterated, 3d, friction is said to impede the blood's motion; and lastly, its course is retarded by the interposed distribution of the arant
dilations of the heart; but it is principally occasioned by that portion of the blood which is propelled into the aorta, coming in con
tact with the antecedent columns (for the arteries are always full), and thus communi
cating on this mass, which, impeded by this resistance, forces itself against the sides of the vessels, and gives them their pul
datory motion.

The pulse is more frequent in children, in females, and in persons of much irritability. In man, and individuals who are charac
terized by strength and regularity of ex
citement, it is less frequent but more vigor
ous. In early infancy, the pulsations are from 120 to 150 in the second year, at the end of the second year, they are about 100; at puberty 80, manhood 70 to 75, and in elderly persons 60 or under. There are great varieties in this respect. Mr. Aley has observed in his lectures having seen an adult with a natural pulse as low as 27, and it sometimes is more than 100.

Capillary vessels. Arteries are described by some physiologists as terminating in anastomosing capillaries, or a continuous texture, and in glands; others view the only proper terminations of these vessels to be that of their continuation into veins, which are connected with the arteries by the inter
termeditions of the capillaries. The orig

In the capillary vessels as the capillaries are capillary, the change of any number of capillaries is the change of the organ, and the change of the organ is the change of the capillaries. The change of the capillaries, however, these capillary powers have so trival an energy, that nature has guarded against impediments in the course of the blood through these capillaries, in some instances, unless the heart has facilitated this course, by such a distribu
tion of the vessels as shall ensure an action of the muscles in propelling the vital fluid. The motions of the neighboring arteries as
tists the venal circulation, as also the vales, in like manner with those of the lymphatics, which divide the column of fluid into a num
ber of small streams, equivalent to the dia
meters of the spaces thus formed.

Although one of the comparative tardiness of venal circulation, and its not hav

The pulse of the arteries is vulgarly attri
buted to the alternate contractions and dilata
tions of the heart; but it is principally oc
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Borated fluids of a nature widely different from each other, as well as from that whence they proceed. Thus, what can be more unlike than the urine and the blood from which it is prepared; or than the urine itself, and every other substance? This equality of result, like others, has been referred to a mechanical filtration, and to chemical action; but a knowledge of the mechanism of the different glandular organs, still leaves us ignorant of the actual body in which this extraordinary change of combination occurs. 

Secretion is, therefore, a vital action; and with this, as an ultimate fact, the physiologist must rest contented, while he is justified in instituting a research respecting the chemical composition of the fluids formed, and their formation.

Secretory processes are divided into three kinds by cellular transudation, which is affected by a mere termination of arteries on the surfaces upon which the fluid is poured out, without any intermediate structure; as on the surface of the body, furnishing the sweat; or into the cavity of a sacculus effaced, finishing the lubricating fluids of these organs.

2d. Secretion by follicles, crypts, or lacunae, which are supplied with a great quantity of vessels and nerves terminating on their surfaces, and with a vessel, by the egress of secretions, and the follicles, &c., in the form of a vast afferent. This kind of gland is found in the ear, in the tonsils, and in all parts which secrete mucus.

The more complicated glands which serve for the secretion of the fluids into the cavities, constituted of an assembly of nerves, and all kinds of vessels, disposed in packets, and united together by cellular membranes. These are called compound-rate glands; those of a more simple and smooth structure are named cheno grebes.

Secretion of the fat. Every fibre of the body is connected, and every organ enveloped by cellular texture. This membrane, however, does not merely serve the purpose of connection and envelopment, it is likewise the secretory organ of the aedeagus, which is found enclosed in separate cells in almost every joint, and on the adipose substance. Each of these cells is in a state of semi-fluidity, but concretes after death from the cessation of vital action, and the immediate reduction of animal temperature. The secretion of fat, both as to quantity and the composition, as well as to quality, is differently regulated; at different periods of life, in different parts of the body, and under various circumstances of health. In early life the secretion is more abundant immediately under the skin; hence the phlegm appearance of infants. In more advanced years the surface of the body is almost destitute of aedeagus, while the tendency to its deposit is more internal. In an adult man the subcutaneous substance is averaged at about the twentieth part of the body's weight.

A chemical analysis of this fluid, proves it to partake more of those principles which are generally predominant in vegetable fluids, than other animal secretions; that is, it contains but a small proportion of azote, and an abundance of hydrogen and carbon. The circumstance, with the phenomena accompanying its deposition and resolution, seem to favour the supposition of its being a kind of intermediate for a portion of the nutritive matter extracted from the food, through which it must necessarily pass before it is assimilated to the individual, of which it is destined to repair the loss. Thus an individual with much fat is able to abstain from all extraneous supplies without this deposit, and, during such abstinence, the collected fat is rapidly reabsorbed.

Adips, however, serves other purposes in the animal economy. Fat persons suffer less from cold than others; this appears to arise from the abundant oil beductor of the ear, and by the impossibility of withdrawing by the various secretory organs; are all preliminary and subservient to the function now to be considered.

The indivisibility and individuality of the living body can only be maintained by an internal change of the kind within its composition. "Thus the animal machine is continually destroyed, and at distant periods of life does not contain a single particle of the same constituent parts." The most com mon and added quality in the frame of which is the effect resulting from feeding animals with madder; for during the time that this substance is made part of the food, the bones become a red colour, which is again lost if the madder is only for a short time suspended; proving that there is a constant determination and reformation even of those portions of the frame, which, from their compact texture, must be supposed the least susceptible of change. As then the parts of the body are constantly destroyed, new parts of the same nature are as constantly required, and to supply this demand is the office of nutrition. "A bone, for example, is a secretory organ that becomes incrusted with the sulphate of lime: the lymphatic vessels, which in the work of nutrition perform the office of excretory ducts, remove this salt after it has remained a certain time upon the arcade of its nature. It is the same in muscles with respect to fibres, and in the brain with albumen." We, therefore, find animal nutrition and organization, to consist in this: that the animals having been converted first into chyle, and then into blood, and from this last having been furnished the various parts, solid and fluid, of which the animal is composed, such parts are at length separated by the concordant action of the respective organs; thus the body is supported by intussusception in its has been denominated; a process very far different from that union effected by mechanical juxtaposition of particles, or operated by chemical affinity.

It has ever been the aim of the physiologist, more especially of recent times, to detect the prime, and, in a manner, common principle subservient to nutrition, in order to estimate the proportionate quantity of matter which is required to support a given quantity of necessary substances. We must, however, as absurdly guard against that fallacy which would connect itself with our inferences from viewing the process of nutritive elimination as a process merely of chemistry. The separation and assimilation of nutritive matter, may be pronounced to have greater reference to vital action than to the chemical union of the body. For the latter, although the nutritive matter is extracted. For example: Let us suppose, with Dr. Cullen and many others, that the common principle derived from animal mutability is saccharine; let it even be demonstrated that such is the case; it by no means thence follows that the administration of saccharine matter in any form would be the mean of conveying into the system the largest portion of nutrition. This doctrine it will not be improper further to illustrate, by calling the reader's attention to circumstances connected with one or two chronic maladies. Diabetes, whether originating from a disordered state of the digestive organs, or from any other action of the kidneys, or, as appears most probable, from the conjugation of these two, is occasioned more immediately, or at least the emission which characterizes it, by a deficiency of that excitation of the blood and caloric feeds, and by the administration of certain astringent medicines. Again, in the rickets of infancy, which has an unquestionable dependence upon a loss to the bones of their integrity, and to the action of phosphoric acid. The physician's object is not immediately to convey this matter into the blood, but to restore that degree and kind of excitement in the osseous vessels, from which the secretion results; and this will be effected by materials widely different, both in composition and abstract agency, from the substance, the deficiency of which is to be remedied.

What quantity of phosphoric acid is the chemist in the common chalybeate preparations, or in the nutritive aliment, which, properly administered, prove of such obvious and extensive utility in the management of the disease of the bones, and which the physician cannot be induced to pass over in a cursory view? In the place, we were induced to remark, that the proximate cause of rickets does not so properly consist in "a deficiency of that matter which should form the solids of the system," as in a deficiency of that excitation upon which the formation and deposit of such matter are momentarily dependent. See INFANCY.

M. Richerand, in his excellent work on physiology, states that "the marine plant, the ashes of which form soda, if in a box filled with earth that does not contain a particle of that alkali, and moistened with distilled water, furnishes it in as great quantity as if the plant had been growing on the borders of the sea, in a manner always inundated by brackish or salt water." Now what would follow a deprivation for a time of oxygen, light, or water, from such plant? Certainly a debilitated action, and consequent interruption of function. To remedy the disorder thus produced, we should not, however, apply to the plant the matter of which it is composed; but restore those agents, through the medium of which it had preserved its vitality. Have not these facts of the subserviency of vital support to vital action, been too much overlooked in the recommend-
tiation and imagination. The study of medicine is an art, the practice of medicine is a science. When Dr. Darwin inferred that calcareous earth contributes to the nourishment of animals and vegetables, because 'whatever has composed a part of an animal or vegetable, may again, after its chemical solution, become a part of another vegetable or animal,' was not this vital agency and power of actually converting materials into those of an opposite nature, in some measure disregarded? But this is not the place for speculation. It is our business rather to compress dilate: and we shall conclude by observing, that the principle now contended for, however important, is not to be received as acted on the living, and legal subjects of food or medicine, in an unqualified or unlimited sense. A due supply of appropriate fuel as well as of stimulus, is necessary to support the functions of life. See Materia Medica.

It will be proper before quitting the subject, to observe, that as animal matter has been proved principally to differ from vegetable, in containing a larger proportion of air or carbonic acid, and the vital process of nutrition or assimilation, however imperfect, has been judged to be a species of azotization, the following extract on this subject is given from the work just alluded to of M. Halle, which proves that the hydro-carbonated oxide, or principle of nutrition, is combined with oxygen in the stomach and intestinal canal; whether the latter principle is introduced with the food into the primeval or furnished by the decomposed humours. The intestinal fluids suffer their azote to be disengaged, which is carried to the alimentary base, and replaces the carbonic acid that had been drawn by oxygen to form the carbonic acid gas, in this way the peristaltic waves that the hydro-carbonated oxide, or principle of nutrition, is disengaged from its portion of carbon; and as it disengages the azote from venous blood, it effects a new combination of this principle with the chyle; and when purgated to the skin, the atmospheric oxygen again disengages its carbon, and completes its azotification. Perhaps even the cutaneous organ as well as other purposes to the lymphatic system, as the pulmonary organ may effect to the sanguiferous system.

It will be obvious to the reader, that the above theory supposes nutrition to consist in the absorption of the air, and an instant supply of azote. It is admitted, however, that this is not the only account for the formation of phosphoric salts, aedes, and many other substances. It is, therefore, at least defective.

On sensations.
The arrangement we have adopted now leads us to notice those functions "which connect us with surrounding objects," and it was our original design in the present article to have treated at length on the physiology of the sense organs, especially of sight and hearing. As these last subjects, however, could not be made interesting or even intelligible, without connecting them with the anatomy of light, and of sound, it has been judged more expedient, in order to avoid repetition, to confine their consideration exclusively to the articles Optics and Sounds. The anatomy of the organ will be found under the article Anatomy.

Of smell. As the expansion of the optic nerve into the retina, constitutes the immediate instrument of vision, so being peculiarly invested with the faculty of perceiving light, as the portion mollis of the auditory nerve, is in like manner the direct medium for transmitting the sensation of sounds to the sensorium commune; so the organ of smell, constituted by the olfactory nerves on that membrane which lines the nasal fossa, is formed to receive, exclusively, the sensation of odours. It is apparently in proportion to the depth and extent of these organs, (affording a larger surface to the olfactory membrane,) that the perception of smell is variously regulated in different animals, and in some measure in different individuals of the same species; and the membrane itself requires to be in a perpetual state of moisture.

It is supposed by some that the olfactory nerves do not extend into the sinuses, but that those cavities merely assist the sense by long-retainng a greater mass of air, which is loaded by the innumerable particles that constitute the exciting cause of this perception. The nasal organs are supplied with numerous small branches arising from the fifth pair of cerebral nerves; but these branching to M. Richerand do not answer any further end, than that of contributing to general sensibility. The excitability to odours exists, according to our author, exclusively in those which are commonly denominated olfactory nerves.

Of taste. Every sense has been said to be strictly a modification of feeling; that of taste, however, approaches nearer than any other of the senses, even in its organization, to that of sight or hearing: the surface of the tongue, which is the principal residence of this perceptibility, only varying from the common integuments in being thinner, more vascular, and having crypts, or follicles, which secrete the mucus of the tongue. These are situated in greatest number near its tip, and are erected "when we masticate highly flavoured food, or have a strong desire for any savoury dish." It is observed that the taste of different animals is not perfectly in proportion as the nerves of the tongue are larger, the skin finer and more moist, its texture flexible, surface extensive, motions more easy and varied. The sense of taste may be, for example, more delicate that of any other animal, if he was not to blunt its sensibility early in life by strong drinks, spicy ragouts, and all the refinements of luxury that are daily invented. "Is the lingual branch of the fifth pair of nerves alone adapted for the perception of taste? Do the ninth pair equally serve for the same purpose?" This last question of M. Richerand has, we believe, generally been answered in the negative. It is from the fifth pair that the cinque, just spoken of, are supplied.

On touch. This has been with some propriety denominated the elementary sense, and all other considered as merely modifications accommodated to certain properties of bodies. "Every thing that is not light, sound, odour, or savour, is appreciated by the touch." This sense resides throughout the whole extent of nervous system; the peculiar organ, however, is that by which we come to a knowledge of the qualities of objects, is the cutis, spread over the external surface of the body. In some part, this sense is peculiarly modified; in the skin, for example, covering the splices of the fingers; and in such parts we meet with something resembling the papilla on the tongue; but perhaps, not exactly similar, as they are rather the sensations of heat and cold, than of glandular crypts: they are surrounded by an extremely fine vascular membrane. When the sense of feeling is exercised, these papilla are supposed to swell and elevate the epidermis, this being thought impossible to all such stimuli as act exclusively on living fibre. The epidermis, like the nails and hair, which last proceed from it, is mere defence of the body, unorganized, and consequently deficient in excitability.

Action of the nerves. On this subject every thing is conjectural. We have not in this instance the assistance of anatomy for any thing farther than the fact, that the nerves are the organs in which the sensitive faculty is developed. The form, appearance, and mode of attachment of the nerves, are sufficient evidences that they do not act as mere lines of transmission into the hypothesis of some theorists: that they are tubes for conveying a fluid from and to the cerebral mass, is inconsistent with what has been discovered respecting the minuteness of division of their processes appears incompatible with what may be called the reacting communications between the centre or centres of sensation, and the sensitive organs; and we have already occasion to observe that the discoveries of modern chemistry, have only brought us acquainted with a greater number of exciting agents; they do not appear to have cast any light upon the question respecting the actual mode of nervous or muscular excitation.

With respect to the analysis of our sensations, the production of ideas, and the comparative estimate of the human understanding and the sensitive faculties of the inferior animals, we cannot be expected in this place to institute any inquiry. We must be content with expressing our opinion, that endeavours to establish an identity of faculty and the brute (if the dispute is not a mere logomachy), have failed of their object; and as we believe that the fulness of the Hannayadees are not realized in the "trees of our forests," so we still flatter ourselves, notwithstanding the indications of reason, and the great powers of imitation which have been exhibited by some individuals of the ape species, that the human intellect is of a nature essentially different from that of the monkey.

Of sleep, dreaming, sonambulism, sympathies, habit. The condition and the exciting causes of sleep, need no description; it is probable certainly does not necessarily lie in the same obscurity with those of other animal and nervous affections. The artificial sleep which has been procured by pressure on the brain, proves nothing with respect to the actual condition of this organ in the sleep of nature; it is rather apoplexy than sleep, that is thus occasioned. With respect to the phenomena attendant upon sleep, it has been well observed, that "the human body presents with tolerable accuracy the model of the centripetal and centrifugal powers of antient philosophy. The motion of several of the
of generation.

We now proceed to notice those functions which nature has provided for the preservation not of the individual but of the species.

Differences of the sexes. During infancy we find that the sexes have different voices, the voice of the female being sweeter and more melodious.

Speech is the prerogative solely of the human species. It is constituted by modifications which the voice is made to pass through, from the motions of the tongue, lips, and breath. The variety of sounds thus produced is infinite, and is the basis of language.

Articulated sounds are constituted by vowels, the consonants being merely the organs for the purpose of connecting vowels together. The utterance of consonants is necessarily more forced and unnatural than that of vowels; hence the greater harmony of those languages which have the greatest number of such letters, as in the ancient language of the Greeks, "quibus diecriter otus rotundate musa quoct.

"The body is a temple, and the other hand, the harshness of the German, Dutch, and other languages. "It would be difficult," says M. Richaud, "to accumulate a greater number of consonants in one word, and consequently to subject a word of such delicate pronunciation, than is found in the proper name of a German, called Schmidtzen.

Singing, stammering, lisping, dumbness, and ventriloquism. Singing is performed by an enlargement or contraction of the glottis; by an elevation or depression of the larynx; by an elongation or shortening of the neck; or by an accelerated, prolonged, or retarded inspiration; and by either long or short, and abrupt expiration. "The agreeableness of the notes, the extent and variety of inflections of which it is capable, depend on the correct conformation of its organs, on the flexibility of the glottis, elasticity of its cartilages, and particular disposition of the different parts of the vocal passages, etc. If the two halves of the larynx or nasal fossa are unequally disposed, it is sufficient to occasion a defect in precision or harshness of the voice."

Stammering and lisping are occasioned by a tongue too large, its action being too long; and by deficiency or bad arrangement in the teeth. When the apex of the tongue is prevented from striking properly the roof of the mouth, the quality is produced of pronouncing the letter.

Natural dumbness is almost invariably consequent upon deafness, and does not arise from an inability to articulate, but from an entire ignorance of sounds. See Dumbness, and Deafness.

For the nature of those sounds produced by the ventriloquist, see likewise the article Ventriloquism.
PHYSIOLOGY.

Physiology, in a proper sense, has never existed in man, nor even in the inferior animals; the structure of whose genital organs are in the smallest measure analogous to man. An imperfection of organs, so as to render the sex doubtfull, has, indeed, in some very few instances presented itself; but not, as in man, in a great number of animals, and plants, a capability of self-impregnation.

Some physiologists have endeavored to trace an analogy between the sexual organization of the male and female, comparing the ovaries and tubes of the uterus of the human, with the vesiculae seminales, the ovariis and vagina with the penis. These resemblances are in some measure the ovary and testicle both secrete a seminal fluid, the Fallopian tubes and vesiculae seminales both convey such fluid into appointed reservoirs—the uterus in the female, the ductus deferentia in the male.

The generative process in man is effected by an emission from the blood of the semen by the testicles; the semen immediately upon its secretion passes through the seminal ducts into the vesiculae deferentiae, which, after entering the abdomen, terminate in the vesiculae seminales, and there deposit their contents. These vesicles furnish reservoirs for the semen; and we find those animals, which have them, very few are the same, that do not. Thus, for example, continue a long time in sexual contact, on account of the semen, secreted during the act of copulation. Being directly transmitted through the testicles. At the separation in man passes the prostate gland, it is mixed with the mucous which this gland secretes, and thus mixed, enters the urethra to be ejected.

With respect to the part which the female performs in the process of generation, the following questions have been proposed:

"Does the ovary secrete a liquor, that, mixing with the male semen, produces the new being? or is there detached from it, at the time of ovulation, a corpuscle which is fertilized by the semen?"

Whatever part, says M. Richerand, is taken in this discussion, we shall be forced to admit that the ovary prepares something essential to generation. Since it is removed renders the female sterile. It is doubtless, likewise, concludes our author, that this something furnished by the ovaries, passes through the Fallopian tubes into the uterus, which receives one of those corpuscles, while the other, large, expanded, and fringed at its margin, floats in the cavity of the pelvis, supported by a small duplication of the peritoneum, but contracts itself, as it were, to itself, by the ovulation, during coition, and then constitutes a direct channel between this organ and the internal part of the uterus. The external office of the Fallopian tube, or its fringed parts, has not been investigated, excepting in certain females opened immediately after coition. It may happen from some organic defect that the Fallopian tube cannot embrace, the ovum. In dissecting a subject at La Charite, I have found the fringed margins, or expanded extremities of the tubes, adhering to the lateral and superior parts of the pelvis, so that it had been impossible for them to perform their motions.

Although the semen is conveyed into the uterus, the penis does not actually enter this cavity: it is prevented by the smallness of the os tunic, and it would be difficult to conceive even the passage of the semen. If we did not know that the uterus, during coition, is entirely open in its situation, and attracts the semen by a real aspiration.

With regard to the theory of conception, the greatest obscurity prevails. Anomaly with what is observed in inferior animals, furnishes the physiologist in human beings to the physiologist in inferior animals. It is well known that eggs laid by a hen which has had no intercourse with the cock, are incapable of being hatched, although they contain the rudiments of the chick; hence it was inferred, and almost demonstrated, that it is the office of the male in general to furnish the visiting principle; that is, to animate the individuals, the germ of which are produced by the female.

This fecundation of the ovum is supposed to be effected in the ovariun, the seminal liquor received into the uterus having passed thither through the Fallopian tubes. This last assumption, however, has not perhaps been fully sustained. In the ovariun, after each conception, a small body is found (corpus luteum), which Haller proved to be the remains of a vesicle ruptured at the moment of conception, and permitting its contents to escape, which matter furnishes the germ of the fetus. It will be evident that the Fallopian tubes require to be pervious, in order that conception may take place. It is observed by Moravath, that they are often closed in women, in consequence of habitual excitement.

"Semen, when examined by a microscope, exhibits immaculae with a round head and slender tail, that move with rapidity; hence several conjectures of Lowenbuck, Becher, Cooper, and others, that every part of the seminal liquor is capable of becoming a being resembling that from which it was formed. These immaculae pass in a current through the Fallopian tubes to the uterus, where they enter into a violent contest, in which all are killed except one, which being left champion in the field of battle, penetrates into the ovarian cavity, to receive it." - Boerhaave.

Boerhaave, however, observed that every part of the body furnishes its appropriate mol•cles to compose the semen; and these atoms coming from the eyes, ears, &c. of the male and woman, arrange themselves round the internal mould, the existence of which he admits, believes it to form the base of the edifice, and to arise from the male, if it should be a boy, and from the female, if it should be a girl.

If it was necessary to offer any objection to this fanciful hypothesis, it would suffice to say that infants are often born perfectly organized, the parents of whom have had defects in structure.

For the history of gestation, delivery, &c. consult the article MIDWIFERY.

On ages, temperaments, varieties in the human species, &c.

The last subjects treated of by M. Richerand, very little remain to be said of in the present place.

Of infancy, its peculiarities and diseases, see the article INFANCY. The process of dentition for the most part commences towards the end of the seventh month, earlier or later, according to the constitution of the infant. To middle incisors of the upper jaw are the first to appear; shortly afterwards the incisors of the inferior maxilla; then the lateral incisors of the upper, afterwards of the under jaw; then the canine teeth in the same order; and between eighteen months and two years, the first incisors of the other mol•des. This completes the first dentition. Towards the end of the fourth year, two other mol•des come to be added. These last remain during life, but the first teeth fall out nearly in the same order as their appearance, and are succeeded by others larger and better formed. Towards the ninth year, two additional large mol•des appear beyond the former; and between the ages of eighteen and thirty, two teeth perforate the gums at the extremity of the alveolar processes: these are the dientes saniptices.

Each row of teeth exists at the same time in the maxillary and mandible, each alveolus containing two membranous follicles. That which is to constitute the primary tooth first swells, a calcareous matter encroaches on its surface and forms the body of the tooth, by which the follicle is obscured which secreted it. As it fills up the small bones formed, the membranous vesicle on the sides of the dental vessels and nerves are spread out, is in the centre of the body, and adheres to the parietes of its internal cavity.

Ossification is effected by a deposit of bony matter, which, as we have already observed, is principally formed of phosphat of lime, in the centres of the cartilages, which gradually proceed to their extremities or circumferences. Although ossification is some years before it is completed, there has been sufficient bony matter deposited in the cartilages, to enable the child to stand and walk, in the course of twelve months, or less, from birth. "The vital motions of infancy tend towards the head," hence the frequency of disease in this part.

Of puberty. In England the season of puberty is scarcely before the fifteenth year, sooner or later, according to constitutional variety. The principal marks of puberty in the male are, change of voice, which arises from a sudden dilatation of the aperture in the glottis, already spoken of. In females, the menstrual discharge forms the chief index of this state, the opposite of this discharge is not a mere flow of blood as from ruptured
"Without admitting this position," says our author, "believed by the avoures of riches, we cannot but allow that the differences in organization induce (should he not have said, as I accompanied with:) an obvious inequality in the perfection of mind, and intellectual faculties. This will be completely elucidated if we can point out their moral differences to be equally real and strongly marked as the physical characters of the human species, that have justly been recapitulated: opposed European activity, versatility, and restlessness, to Asiatic indolence, phlegm. and patience; examine what effects may be produced on the character of nations by the ferocity of the soil, serenity of the atmosphere, and mildness of the climate; shew by what obligation of physical and moral causes the influence of custom has so much power over Eastern people, that in India and China such forms of the worship, as existed long before the commencement of our era; investigate by what singularity these laws, manners, and religions, have suffered no alteration amidst the revolutions that have succeeded to overthrown those rich countries, which have been several times conquered by the warlike Tartars; demonstrate that ignorant and ferocious conquerors, by the irresistible ascendant of wisdom and information, have adopted the customs of the nations they have subjugated; and prove that the stationary state of the arts and sciences, in people who have enjoyed the benefits of society and the advantages of civilization beyond the force of us, is not so much to be attributed to the imperfection of their organization, as to the humbling yoke of a religion, abounding in absurd practices, and which makes learning the exclusive appendage of a privileged cast.

For physiology of plants, see Plants, physiology of.

PHYSSOPHORA, a genus of vines much confounded with the genus Madecassus; the body gelatinous, pendant from a slender aerial stem, with gelatinous members dividing from the sides, and numerous tentacles beneath. These are nearly allied to the medusae, and are the same species removed to that genus. There are three species.

PHYTHEUM, arctic rampions, in botany, a genus of the pentandria monogynia class of plants, the flower of which is compound, and the fruit a roundish capsule, containing three cells, with numerous seeds. There are sixteen species.

PHYTOLACCA, in botany, a genus of the dicotyled decugyna class of plants, the corolla whereof consists of five roundish, hollow, pentad petal; the fruit is an orbiculated forest-berry, with ten longitudinal furrows, and as many seeds in each of which is a single kidney-shaped seed. There are six species. In Virginia and other parts of America the inhabitants boil the leaves, and eat them in the manner of spinach. They in a great measure destroy malignity, and the juice of the root is violently cathartic. The stems when boiled are as good as parsnips. The Portuguese had formerly a trick of mixing the juice of the berries with their red wines, in order to give them a deeper colour; but as it was found to debase the flavour, and to make the wine detestable, the matter was represented to his Por-
teague majesty, who ordered all the stems to be cut down yearly before they produced flowers, thereby to prevent any further adulteration. The same practice was common in France till it was prohibited by an edict of cardinal de Retz in the 16th century.

The plants have been said to cure cancers; but the truth of this assertion has not been indisputably proved, and does not appear very probable.

PHYOLOGY, a discourse concerning the kinds and virtues of plants.

PHYTOTANIA, a genus of birds of the order passerases; the generic character is, bill conic, straight, serrate; nostrils oval, tongue short, oblique; feet four-toed. There is only one single species, viz. P. rara, that inhabits Chili, nearly equal in size to the sparrow; has a harsh interrupted cry, resembling the syllables ra, ra; feeds on fresh vegetables which it cuts down near the roots with its bill as a saw, and is on that account a great pest to gardeners; builds in high shady trees, in retired places; eggs white spotted with red.

PIA MATER. See Anatomy.

PICA. See Mus.

PICE, the second order of birds, according to the Linnean system. They are distinguished by a bill sharp-edged, convex above, and short, strong, armed for walking, perching, or climbing; body toughish, impure; food various, filthy substances; nest in trees; the male feeds the female while she is sitting. They live in pairs. Of this order there are twenty-six genera, viz. acelos, buceros, buccoe, buphagoe, cetrilia, coracias, corvus, crotophaga, cuculus, galbula, glaucops, gracula, merops, monocus, orientis, paradalis, pecos, poicillia, rhamphastos, scytophia, sitta, yuraha, trochilus, trigo, upupa, yunx.

PICKET, PICKET, or PIQUET, in fortification, a painted stuff shod with iron; used in marking out the angles and principal parts of a fortification, when the engineer is tracing out a plan upon the ground.

PIQUET, a celebrated game at cards played between two persons, with only thirty-two cards; all the twos, threes, fours, fives, and sixes, being set aside.

In playing at this game, twelve cards are dealt to each, and the rest laid on the table: when if one of the gamblers finds he has not court-card in his hand, he is to declare that he has carte-blanche, and tell how many cards he will lay out, and desire the other to discover, that he may show his game, and satisfy his antagonist, that the carte-blanche is real; for which he reckons ten. And here the eldest hand may take in three, four, or five, discarding as many of his own for them, after which the other may take in all the remainder if he pleases. After discarding, the eldest hand examines what suit he has most cards of; and, reckoning how many points he has in each suit, if the other has not so many in that, or any other suit, he reckons one for every ten in that suit, and he who thus reckons most is said to win the point. It is to be observed, that in thus reckoning the cards, every card counts for the number of bears; as a ten for ten; only all court-cards go for ten; and the ace for eleven, and the usual game is one hundred up. The point being over, each,
exams what sequences he has of the same suit, viz. how many aces, or sequences of three cards; orts, or sequences of four cards, suited, or sequences of five cards, &c. he has. These several sequences are distinguished in dignity by the cards they begin from: tens, ace, king, and queen, are stuck forward; king, queen, and knave, to a king; knave, ten, and ace, to a knave; and the best three, quarte, or quinte prevails, so as to make all others in that hand good, and to destroy all those in the other hand. In like manner a quarte in one hand sets aside a terce in the other.

The sequences over, they proceed to examine how many aces, kings, queens, knaves and tens each holds; reckoning for every three of any sort three; but here too, as in sequences, he that with the same number of threes or fours, has one that is higher than any other has, makes his own good, and sets aside all his adversary's; but four of any sort, which is called a guatorce, because fourteen are reckoned for it, always set aside the other.

The game in hand being thus reckoned, the eldest proceeds to play, reckoning one for every card he plays above nine, while the other follows him in the suit; but unless a card is taken by one above nine, except it is the last trick, no card is reckoned for it. The cards being played out, he that has most tricks reckons ten for winning the cards: but if they have tricks alike, neither reckons any thing. From all the other tricks, instead of ten, which is his right for winning the cards, he reckons forty, and this is called capo.

The deal being finished, each person sets up his game: they then proceed to deal as before; cutting afresh each time for the deal; if both parties are within a few points of being up, the carte-blanche is the first that reckons, then the point, then the sequences, then the quatorce, then the terce, and then the tenth cards. He that can reckon thirty in hand by carte-blanche, points, quaterces, &c. without playing, before the other has reckoned any thing, reckons ninety for them, and this is called a repique; and if he reckons any thing, he reckons so many above ninety. If he can make up thirty, part in hand, and part in play, before the other has told any thing, he reckons for them sixty; and this is called a quarte, whence the name of the game. Mr. de Mauve, in his doctrine of changes, has resolved, among others, the following problems: 1. To find, at picquet, the probability which the dealer has for taking one ace or more in three cards, he having none in his hands. He concludes from his computation, that it is 28 to 27 that the dealer takes one ace or more. 2. To find at picquet the probability which the eldest has of taking an ace or more in five cards, he having one in his hands. Answer; 23 to 91, or 5 to 2, nearly. 3. To find at picquet the probability which the eldest has of taking both an ace and a king in five cards, he having none in his hand. Answer; the odds against cartes-blanches are 3 to 2.

378,956, or 1791 to 1 nearly. 5. To find how many different sets essentially different from one another, one may have at picquet before going in. Answer; 29,807,287. This number falls into a number of all the distinct combinations, whereby twelve cards may be taken out of 32, this number 252,792,840; but it ought to be considered, that in that number many of the same import, but differing in suit, might be taken, which would not introduce an essential difference among the sets.

PICRAMNIA, a genus of the pentandria order, in the dogea class of plants; and in the natural method ranking with those that are doubtful. The calyx is tripartite; the corolla has three petals; the stamina from three to five, awl-shaped, and seem to join together at the base; there are two stily, which are short and bent backwards; the berry is roundish, and contains two oblong seeds, and sometimes one seed only. There are two species: The antisdea, or murjoe bush, is frequent in copes and about the skirts of the smoke mountain, and has a few blue or dark blue flowers, half or nine feet from the ground. The leaves are of an oval form, pointed, and placed in an alternate form along the branches; the flower-spikes are long, pendulous, and slender; the flowers are small and white; they are numerous, at first red, then a jet black colour; the pulp is soft, and of a purple complexion. The whole plant is bitter, and especially the berry. The negroes make a decoction of them, and use it in viscidness of the stomach and in venereal cases.

PICRIS, ox-tongue, a genus of the polygonia equalis order, in the syngeasia class of plants. The calyx is calyced; receptacle naked; seed transversely groove; down feathered. There are six species, of which the most remarkable is the echoides, or common ox-tongue, growing spontaneously in corn-fields in Britain. It has undivided leaves embracing the stem, with yellow blossoms, which sometimes close soon after noon, at other times remain open till nine at night. It is an agreeable pot-herb white young. The juice is milky, but not very acid.

PICRUM, in botany, a genus of the monoginia equalis order, of the syngeasia class of plants; and in the natural method ranking with those that are doubtful. The calyx is monophyllous and quinqued; the corolla monopetalous, and its tube is short; the filaments are four in number, and hooded at the place of their insertion; the style long and thick; the stigma bilaument; the capsule is round, bivalved, and contains a number of small seeds. There are two species, viz. the spicum and carnamol; both natives of Guiana. Both species are bitter, and employed in dyspepsy, and to promote the menses; they are also recommended in viscid obstetrical cases.

PICUS, the woodpecker, in ornithology, a genus belonging to the order of pica. The beak is straight, and consists of many sides, and like a wedge at the point: the nostrils are covered with bristles; the tongue is round, soft, plumby, and sharp at the point, which isiset with feathers bent backwards. See Plate Nat. Hist. fig. 337.

The grand characteristic of these birds is the tongue, the muscles necessary to the motions of which are singular and worthy of notice, affording the animal means of darting it forwards the whole length, or drawing it within the mouth at will. Latham enumerates more than fifty different species of woodpeckers, having peculiarities of some of them which amount to nine more. The most remarkable are as follows:

1. The picus martius, or greatest black woodpecker, is about the size of a jackdaw, being about 17 inches from the tip of the bill to the end of the tail, the bill is nearly two inches and a half in length, of a dark ash-colour; the whole bird is black, except the crown of the head, which is vermilion. The female differs from the male in having the hind head only red, and not the whole crown of the head; and the general colour of the plumage has a strong cast of brown in it. It has likewise been observed, that the red on the hind head has been wholly wanting; and indeed both male and female are apt much to vary in different subjects, some having a much greater proportion of red on the head than others. This species is found on the continent of Europe, but not in the island of Iceland.

It is said to build in old ash and poplar trees, making large and deep nests; and Frisch observes, that they often so excavate a tree, that it is soon after blown down with the wind; and that under the hole of this bird, may often be found a basket of dust and bits of wood. The female lays two or three white eggs, the colour of which, as Willoughby observes, is peculiar to the whole woodpecker genus, or at least all those which have come under his inspection.

2. The picus principals, or white-billed woodpecker, is somewhat bigger than the last, being equal in size to a crow. It is sixteen inches long, and weighs about twenty ounces. The bill is white as ivory; the head itself, and the body in general, are black.

This species inhabits Carolina, Virginia, New Spain, and Brazil; and is called by the Spaniards carpenter, and not without reason; as this as well as most of the other species make a great noise with the bill against the trees in the woods, where they may be heard at a great distance, as if carpenters were at work; making according to Willoughby music, in an hour or two, a bushel of chips.

3. The picus erythrocephalus, or redheaded woodpecker, is about eight inches three quarters long, and weighs two ounces. The bill is an inch and a quarter in length, of a lead-colour; the head and the neck are of a most beautiful crimson; the back and wings are black; the rump, breast, and belly are white. The cock and hen are very near alike.

This species inhabits Virginia, Carolina, and most of the parts of North America; but at the approach of winter, it migrates more or less to the southward, according to the severity of the season; and upon this circumstance the people of North America foretell the rigour or drenchy of the ensuing winter. During the winter they are very tame, and are frequently known to come within doors, and to perch upon the redbreast is wont to do in England. It is observed that this species is found chiefly in old trees; and the noise they make with their bills may be heard above a mile distant. It builds the earliest of all the woodpeckers,
agree. This species is much more uncom-
mon than the preceding, and keeps alto-
toge-ther in the woods. This bird is found in
England, France, and Germany, and other
parts of Europe, frequently the woods like
the rest of the family and is likewise met with
in America. It is a very cunning bird; for,
when a person has seen one on a tree, he is
almost sure to lose sight of it, if the tree is
large, and the observer not very attentive;
for, the moment it goes any one, it will creep
behind a branch, and there lie secure till
the danger is over.
PIEPOUDRE (Court of), the lowest,
and at the same time the most expedi-
tious, of justice known to the law of Eng-
land. It is called piepouldre (curia plebis pul-
veri-
salti) from the dusty feet of the suitors.
But the etymology given us by a learned
modern writer is much more ingenious and
satisfactory; it being derived, according to
him, from pied (poll) and pulvis, in old
French, and therefore signifying the court
of such petty chaffen as resort to fairs or
markets. It is a court of record, incident to
the market town, that is; the persons of
him who owns or holds the toll of the mar-
ket is the judge. It was instituted to admi-
nister justice for all injuries done in that
very fair or market, and not in any
such one, or that the injury must be
done, complained of, heard, and determined,
in the compass of one and the same
year, unless the fair continues longer.
The court has cognizance of all matters of
contract that can possibly arise in the course
of that fair or market; and the plaintiff
must make oath that the cause of action arose
there. From this court a writ of error lies, in
the na-
ture of an appeal, to the courts at West-
mington.
PIGEONS. Every person who shall
shoot at, kill, or destroy a pigeon, may be
committed to the common jail for three
months, by two justices of the peace, or pay
20s. to the poor. 44. a parrot, in old
French, and the.
PIKE, an offensive weapon, consist-
ing of a shaft of wood, twelve or fourteen feet
long, headed with a flat-pointed steel, called
the spear. The pike was a long time in use
among the infantry, to enable them to sus-
pend the weight of the cavalcade, which is now
taken from them, and the bayonet, which fixes on
at the end of the carabine, is substituted in its
place. Yet the pike still continues the weap-
on of the serjeants of foot, who perform no
motions with it but in charging.
PILASTER. See Architecture.
PILE, in artillery, denotes a collection
or heap of shot or shells, piled up by hori-
zontal courses into either a pyramidal or a
wedgelike form; the base being an equi-
lateral triangle, a square, or a rectangle. In
the triangular and square piles, the pile termi-
nates in a single ball or point, and forms a pyra-
mid.
In the triangular and square piles, the
number of horizontal rows, or courses, of the
number counted on one of the angles from
the bottom to the top, is always equal to
the number counted on one side, in the
bottom row. And in rectangular piles, the
number of rows, or courses, is equal to the
number of balls in the breadth of the base
row, or shorter side of the base; also in this
case, the number in the top row, or edge, is
one more than the difference between the
length and breadth of the base.
The courses in these piles are figurative
numbers.
In a triangular pile, each horizontal
course is a triangular number, produced by
taking the successive sums of the ordinates,
viz.,
\[
1 + 2 + 3 + \ldots + n = \frac{n(n + 1)}{2}
\]
and the number of shot in the triangular
pile, is the sum of all these triangular
numbers, taken as far, or to as many terms, as the number
in one side of the base. And therefore, to find
this sum, or the number of all the shot in the
pile, multiply continually together the number
in one side of the base row, and that number
increased by 1, and the same number increased
by 2; then \(\frac{1}{2}\) of the last product will be the an-
swer, or number of all the shot in the pile.
That is,
\[
\frac{n(n + 1)(n + 2)}{6}
\]
is the sum; where
\(n\)
is the number in the bottom row.
Again, in square piles, each horizontal
course is a square number, produced by taking
the square of the number in its side, or the suc-
cessive sums of the odd numbers,
viz.,
\[
1 + 3 + 5 + \ldots + (2n - 1) = n^2
\]
and the number of shot in the square pile is
the sum of all these square numbers, continued
so far, or to as many terms, as the number
in one side of the base. And therefore, to find
this sum, multiply continually together the number
in one side of the bottom course, and that
number increased by 1, and double the same
number increased by 1; then \(\frac{1}{2}\) of the last product
will be the sum.
That is,
\[
\frac{n(n + 1)(2n + 1)}{6}
\]
is the sum.
In a rectangular pile, each horizontal
course is a rectangle, whose two sides have
always the same difference as those of the base
course, and the breadth of the top row is, being only
1; because each course in ascending has its
length and breadth always less by 1 than the
course next below it. And these rectangular
courses are found by multiplying successively
the terms or breadth 1, 2, 3, 4, &c. by the same
terms added to the constant difference of the
two sides; thus,
\[
1, 1 + 2, 1 + 3 + 2, 1 + 3 + 4 + 3, &c.
\]
And the number of shot in the rectangular
pile is the sum of all these rectangles, which, it
is evident, consist of the sum of the squares,
together with the sum of an arithmetical progres-
sion, continued till the number of terms is the
difference between the length and breadth
of the base, and less than the edge or top row.
And therefore, to find this sum, multiply con-
n tinually together the number in the breadth
of the base row, the same number increased by 1,
double the same number increased by 1, and
also increased by triple the difference be-
tween the length and breadth of the base; then
\(\frac{1}{2}\) of the last product will be the answer.
That is,
\[
\frac{(2d + 1)(d + 3d)}{6}
\]
where \(d\) is the breadth of the base, and \(d\)
the difference between the length and breadth
of the bottom course.
PILE, in building, is used for a large stake runned into the ground in the bottom of rivers, or in marshy land, for a foundation to build upon.

PILE ENGINE. See Engine.

Pile, in coinage, denotes a kind of puncheon, which in the old way of coined with the hammer, contained the arm, or other figure and inscription, to be struck on the coin. Accordingly we still call the arms side of a piece of money the pile, and the head the cross; because in ancient coins, a cross usually took the place of the head in ours: but some have it called pile, from the impression of a ship built on piles, struck on this side of our ancient coins.

PILLAR. See Architecture.

PILOT, a person employed to conduct ships over bars and sands, or through intricate channels, into a road or harbour. Pilots are no constant and standing officers aboard our vessels, but are called in occasionally, on coasts or shores unknown to the master; and having piloted in the vessel, they return to the side from which they proceeded.

Pilots taking upon them to conduct ships up the Thames, are to be examined and approved by the master and warden of the Trinity-house at Deptford, or shall be liable to forfeit 10s. for the first offence, and 20s. for the second, Sc. and the like penalty, if they act without licence from the said master and warden; and if by their negligence they lose a ship, they shall be for ever disabled. 3 Geo. I. and 5 Geo. II. c. 20.

PHILARIA, a genus of the cryptogamic filices. There is one species.

PIMELIA, a genus of insects of the order coleoptera. The generic character is, antennae filiform; feelers four; thorax plano-convex, margined; head exserted; shell rather rigid; wings usually none. It is divided into sections, A, antennae moniliform at the tip; B, entirely filiform.

PIMELITE, a mineral distinguished by a fine apple-green colour: according to Klaproth, it is composed of

<table>
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<th>Component</th>
<th>Percentage</th>
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<tbody>
<tr>
<td>silica</td>
<td>33.00</td>
</tr>
<tr>
<td>zinc oxide</td>
<td>12.40</td>
</tr>
<tr>
<td>nickel</td>
<td>6.00</td>
</tr>
<tr>
<td>oxide of iron</td>
<td>4.58</td>
</tr>
<tr>
<td>magnesia</td>
<td>12.50</td>
</tr>
<tr>
<td>water</td>
<td>37.91</td>
</tr>
</tbody>
</table>

99.36

PIMENTA, or Pimento, Jamaica pepper, or allspice. See MYRTUS.

PIMPINELLA, burnet saxifrage, a genus of the diaphyse order, in the petandria class of plants. The petals are bent in; stigma subcapular; fruitlet ovate. There are nine species; the most remarkable of which are: 1. The major, or greater burnet saxifrage, growing naturally in chalky woods, and on the sides of the banks near hedges, in several parts of England. 2. The amount of common anise, an annual plant, which grows naturally in Egypt; but it is cultivated in Malta and Spain, whence the seeds are annually imported into Britain. Both these species are used in medicine.

The roots of pimpinella have a grateful, warm, very purgative taste, which is entirely extracted by rectified spirit: in distillation the menstruum arises, leaving all that it had taken up from the root united into a pungent aromatic resin. This root promises, from its sensible qualities, to be a medicine of considerable utility, though little regarded in common practice. A tincture of it is compounded in which it is an ingredient the pulvis are compurgadis. Stahl, Hoffman, and other German physicians, are extremely fond of it; and recommend it as an excellent stomachic, resolving, diuretic, diaphoretic, and alexipharmic.

Aniseed have an aromatic smell, and a pleasant warm taste, accompanied with a degree of sweetness. Water extract very little of their flavour; rectified spirit, the whole. These seeds are in the number of the four greater hot seeds: their principal use is in cold flatulent disorders, where tenacious phlegm abounds, and in the gripe to which young children are subject. Frederic Hoffmann strongly recommends them in weakness of the stomach, diarrheas, and for strengthening the tone of the visceræ in general; and they think will deserve the appellation given them by ancient, intestine remedies. The smaller kind of aniseed brought from Spain are preferred.

PIN, in commerce, a little necessary instrument made of brass wire, chiefly used by shipwrights in their dress. In the year 1543, by statute 34 and 35 of Henry VIII. cap. vi. it was enacted, that no person shall put to sale any pipes but only such as shall be double-headed, and have the heads soldered over the shank of the pipe smooth, the shank well shaped, the points well and round filed, caught, and sharpened.

From the above extract it should appear that the art of pin-making was but of late invention, probably introduced from France; and that our manufactories since that period have wonderfully improved.

Though pins are apparently simple, their manufacture is, however, not a little curious and complex. When the brass wire, of which the pins are formed, is first received at the manufactroy, it is generally too thick for the purpose of being cut into pins. The first operation therefore is that of winding it off from one wheel to another with great velocity, and causing it to pass between the two, through a circle in a piece of iron of smaller diameter; the wire being thus reduced to its proper dimensions, is straightened by drawing it between iron pins, fixed in a board in a zigzag manner, but so as to leave a straight line between them: afterwards it is cut into lengths of three or four yards, and then into smaller ones, every length being sufficient to make six pins; each end of these is ground to a point, which is commonly performed by boys, who sit each with two small gravel-stones before him, turned by a wheel. Taking up a handful, he applies the ends to the coarsest of the two stones, being careful at the same time to keep each piece moving round between his fingers, so that the points may not become flat: he then gives them a smoother from adjusting them, by keeping the wire parallel to the other stone, and by that means a lead of twelve or fourteen years of age is enabled to point about 16,000 pins in an hour. When the wire is thus pointed, a pin is taken off from each end, and this is repeated till it is cut into six pieces. The next operation is that of forming the heads, or, as they term it, head-spinning; which is done by means of a

spinning-wheel, one piece of wire being thrown with astonishing rapidity, wound round another, and the interior one being drawn out, leaves a hollow tube between the circumvolutions: it is then cut with shears, every two circumvolutions being then the wire forming a head: these are softened by throwing them into iron pans, and placing them in a furnace till they are red-hot. As soon as they are cold, they are distributed to children, who sit with needles and hammerers before them, by which they work with their feet, by means of a lathe; and taking up one of the lengths, they thrust the blunt end into a quantity of the heads which he before him; and catching on by the extremity, they apply them immediately to the nail and hammer; and by a motion or two of the foot, the point and the head are fixed together in much less time than it can be described, and with a dexterity only to be performed by practice; the spectator being in continual apprehension for the safety of their fingers' ends. The pin is now finished as to its form, but still it is dull; it is therefore thrown into a copper, containing: of tin and the leys of wine. Here it remains for some time; and when taken out assumes a white, though dull appearance: in order therefore to give a bright polish, it is put into a tub containing a quantity of bran, which is set in motion by turning a shaft that runs through its centre; and thus by means of friction it becomes perfectly bright. The pin being complete, nothing remains but to separate it from the bran; which is performed by picking it up by similar to the winnowing of corn, the bran flying off, and leaving the pin behind fit for immediate sale.

PINCBECK, an alloy containing three parts of zinc, and four of copper; it assumes the colour of gold, but it is not so malleable as brass. See Zinc.

PINE. See PINUS.

PINE-APPLE. See PIMELIA.

PINEAL GLAND. See Anatomy.

PINGUIKA, butternut, a genus of the monogynia order, in the diandra class of plants. The corolla is ringed, with a spur; and two veins, one in the capsule One-celled. There are five species, of which the most remarkable is the vulgaris, or common butterwort, growing commonly on bogs or low woods in England and Scotland, and is covered before by a soft upright pelucide pubescence, secreting a glutinous liquor. The flowers are pale red, purple, or deep violet-colour, and hairy within. If the fresh gathered leaves of this plant are put into the strainer through which warm milk from the cow is poured, and the milk is set by for a day or two to become acceess, it acquires a consisteny and tenacity, and neither whey nor cream separates from it. In this state it is an extremely grateful food, and as such is used by the inhabitants of the north of Sweden.

There is no further occasion to have recourse to the leaves; for half a spoonful of this prepared milk, mixed with fresh warm milk, will convert it to its own nature, and this again will change another quantity of fresh milk, and so on without end. The juice of the leaves kills lice; and the common people use it to cure their cracks or chaps in cows' udders. The plant is generally supposed injurious to sheep, by occasioning in them that disease called the rot; but from experiments...
made on purpose, and conducted with accuracy, it appears that neither sheep, cows, goats, hens, will feed on this plant. Wherever this plant, called also *Yorkshire snowite*, is found, it is a certain indication of a boggy soil. From the idea that the country-people have of its noxious operation on sheep, this plant has been called the white rot; since, as they imagine, it gives them the rots whenever they eat it, which they will not do but from great necessity.

The Laplanders, like the Weddles with the milk of cows, receive that of the rein-deer upon the fresh leaves of this plant, which they immediately strain off, and set it aside till it becomes somewhat accecat; and the whole acquires in a day or two the consistence of cream, without separating the serum, and thus becomes an agreeable food. When thus prepared, a small quantity of the same has the property of remnet in producing the like change on fresh milk.

**Pinguin**, or *Penguin*, in ornithology, a genus of birds of the order of Anseres, distinguished by the following characters: The bill is strong, straight, more or less bending towards the point, and furrowed on the sides; the nostrils are linear, and placed in the furrows; the tongue is covered with short spines, pointing backwards; the wings are small, very like fins, and covered with no longer feathers than the rest of the body, and are useless in flight; the body is clothed with thick short feathers, having broad shafts, and placed as compactly as the scales of fishes; the legs are short, thick, and placed near the vent; the toes are four, and are all placed forwards; the interior are loose, and the rest are webbed; the tail is very soft, consisting of broad shafts scarcely webbed.

It is agreed that penguins are inhabitants of southern latitudes only; being, as far as is yet known, found only on the coasts of South America, from Port Desire to the Straits of Magellan; and Frezier says they are found on the western shore as high as Concepcion. In Africa they seem to be unknown, except on a small island near the Cape of Good Hope, which takes its name from them. They are found in vast numbers on land during the breeding season, next to the shore but at that time: they form burrows under ground like rabbits; and the islands they frequent are perfectly undermined by them.

Their attitude on land is quite erect, and on that account they have been compared by some to pigeons, by others to children with white bibs. They are very tame, and may be driven like a flock of sheep. In water they are remarkably active, and swim with vast strength assisted by their wings, which serve instead of fins; their food in general is fish; not but that they will eat grass like geese.

Mr. Latham remarks, that this genus appears to hold the same place in the southern division of the earth that the swans do in the northern; and that, however authors may differ in opinion on this head, they ought not to be confounded with one another. The penguin is never seen but in the temperate and frigid zones of the earth, whereas the swan only appears in the parallel latitudes north of the equator; for neither of these genera has yet been observed within the tropics.

The wings of the penguin are scarcely any thing else than mere his, while the awk has real wings and gills, though they are but small. The former has four toes on each foot, the latter only three. While swimming, the penguin sinks wholly above the breast, the head and neck only appearing out of the water; while the awk, like most other birds, swims on the surface. There are several other peculiarities which serve to distinguish the two genera, but what we have mentioned are doubtless sufficient.

The bodies of the penguin tribe are commonly so well and closely covered with feathers that no wet can penetrate; and as they are in general excessively fat, these circumstances unite secure them from cold. They have often been found above 700 leagues from land, and frequently on the mountains of ice, on which they seem to ascend without difficulty, as the soles of their feet are very rough, and suited to the purpose. Mr. Latham enumerates nine different species of this genus, besides two varieties of the black-legged penguin.

1. The first, which is a very beautiful species, our author calls the crested penguin. The birds of this species are twenty-three inches long; the bill is three inches long, and is provided with black, back, and sides, are black. Over each eye there is a stripe of pale yellow feathers, which lengthens into a crest behind, nearly four inches long. The female has a streak of pale yellow over the face not prolonged into a crest behind as in the male.

This species inhabits Falkland Islands, and was likewise met with in Kerguelen's Land, or Isle of Desolation, as well as at Van Diemen's Land, and New Holland, particularly in Adventure Bay. They are called hopping penguins, and jumping Jacks, from their action of leaping quite out of the water, on meeting with the least obstacle, for three or four feet at least; and indeed, without any preceding cause, they often do the same, appearing chiefly to advance by that means. This species seems to have a greater air of liveliness in its countenance than others, yet is in fact a very stupid bird, so much so as to argue that it is impotent of seeing the head with a stick when on land. Forster says he found them difficult to kill; and when provoked, he adds, they ran at the sailors in flocks, and pecked their legs, and spoilt their clothes. When angered too, they erect their crests in a beautiful manner. These birds make their nests among those of the pelican tribe, living in tolerable harmony with them; and lay seldom more than one egg, which is white, and larger than that of a duck. They are mostly seen by themselves, seldom mixing with other penguins, and often met with in great numbers on the outer shores, where they have been bred.

2. The second species mentioned by Latham is the Patagoton. It is distinguished by this name not only because it is found on that coast, but also because it exceeds in bulk the common penguins as much as the natives say to the common men of men. It was first discovered by captain Macbride, who brought one of them from Falkland Islands, off the Straits of Magellan. The length of the stuffed skin of this particular bird measured four feet three inches, and the bulk of the body seemed to exceed that of a swan.

This species, which was, as we have seen, first met with in Falkland Islands, has since been seen in Kerguelen's Land, the Society Islands, and New Guinea. Bougainville caught one, which soon became so tame as to follow and know the person who had the care of it; it fed on flesh, fish, and bread, but after a time grew lean, pinned away, and died. Their chief food, when at large, is thought to be fish; the remains of which, as well as crabs, shell-fish, and mollusces, were found in the stomach. This species is the fattest of the tribe; and therefore most so in January, when they moult. They are supposed to lay and sit in October. They are met with in the most desert places. Their flesh is black, though not very unpalatable. This has been considered as a military species, but has now and then been met with in considerable flocks.

3. The Magellanic species is about two feet, and sometimes two feet and a half, long, and weighs eleven pounds. The bill is black, having a transverse band across near its tip; the head and neck are black, having markings here and there; the upper parts of the body and wings are of the same colour, the under parts of both are white from the breast. This species, which is very numerous, inhabits the Straits of Magellan, Staten Land, Terra del Fuego, and Falkland Islands. Far from being timid, these birds will often attack a man, and peck his legs. As food they are not at all palatable. They swim without prodigious swiftness. They lay their eggs in collective bodies, resorting in incredible numbers to certain spots; which their long residence has freed from grass, and to which were given the names of town. Pennose observes, that they composed their nests of mud, a foot in height, and placed as near one another as possible. They may have different ways of nesting, according to the place they inhabit; or perhaps the manner of this may be blended with those of another.

Here, (says he; i. e. in the several colonies) during the same season, we were presented with a sight which conveyed a most dreary, and I may say, silent, idea of the desertion of these islands by the human species: a general stillness prevailed in these towns; and whenever we took our walks among them, in order to provide ourselves with eggs, we were regarded indeed with side-long glances, but we carried no terror with us. The eggs are rather larger than those of a goose, and laid in pairs. When we took them once, and sometimes twice in a season, they were as often replaced by the birds; but prudence would not permit us to plunder too far, lest a future supply in the next year's breed might be prevented. They lay some time in November, driving away the albatrosses, which have latched their young in turn beneath them. The eggs were thought palatable food, and were preserved good for three or four days.

**PINION**, in mechanics, an arbor, or spindle, in the body whereof are several notches, which catch the teeth of a wheel that serves to turn it round: or it is a lesser wheel which plays in the teeth of a larger.
PINITE, a mineral that has received its name from Philip Sydney, where it has been found in granite. It occurs in reddish-brown, or black; always in crystals, either rhombohedral prisms, or six-sided prisms; sometimes entire; sometimes having their after faces wedge-truncated; sometimes whole; surface smooth and brilliant; fracture uneven, passing to conchoidal; specific gravity 2.9. It melts at 153° of Wedgwood, into a black compact glass, the surface of which is red-burnished. It consists, according to Klaproth, of

63.00 alumina
29.50 silica
6.75 iron.

PINK, a vessel used at sea, painted and rigged like other ships, only that this is built with a round stern; the heads and ribs compassing so as that her sides bulge out very much. This disposition renders the pinks very swift, and also enables them to carry greater burdens than others, whence they are often used for store-ships, and hospital-ships, in the fleet.

PINK. See DIANTHUS.

PINNA, in zoology; a genus belonging to the order of vermian testacea. The largest and most remarkable species inhabits the Mediterranean. It is blind, as are all of the genus; but furnished with very strong calcareous valves. The cuttle-fish, an inhabitant of the same sea, is a deadly foe to this animal; as soon as the pina opens its shell, he rushes upon her like a lion; and would always devour her, but for another animal whom she protects within her shell, and from whom in return she receives very important services. It is an animal of the crab kind (see Cancer), naked like the hermit, and very quick-sighted. This cancer or crab, pinnata receives into her covering, and, when she opens her valves in quest of food, she hinders not to look for prey. During this the cuttle-fish approaches; the crab returns with the utmost speed and anxiety to his hostess, who being thus warned of the danger shuts her doors, and keeps out the enemy. That very sagacious observer Dr. Hasselquist, in his voyage towards Palestine, beheld this curious phenomenon, which although well known to the ancients, had escaped the moderns.

The pinnata may differ less from muscles in the size of their shells, than is the fineness and number of certain brown threads which attach them to the rocks, hold them in a fixed situation, secure them from the rolling of the waves, especially in tempests, and assist them in laying hold of time. See MOLLUSCA. These threads, says Rondelot, are as fine, compared with those of muscles, as the finest flax is compared with tow. M. de Reaumur says that these threads are nearly as fine and beautiful as silk, from the same reason, and hence he calls them the silk-worns of the sea. Stuffs, and several kinds of beautiful manufactures, are made of these threads at Palermo; in many places they are the chief object of fishing, and become a silk proper for many purposes. It requires a considerable number of the pinnata warping for one pair of stockings. Nothing can equal the delicacy of this singular thread. It is so fine, that a pair of stockings made of it can be easily contained in a small-box of an ordinary size. In 1754, a pair of gloves or stockings of these materials was presented to King Louis XIV, who was pleased with them, notwithstanding their extreme fineness, secured the leg both from cold and heat. A robe of the same singular materials was the gift of a Roman emperor to the seat of Armenia. A great many manufacturers are employed in manufacturing these threads into various stuffs at Palermo and other places.

The men who are employed in fishing up the pinna marine inform us, that it is necessary to break the tuft of threads. They are fished up at Toulon, from the depth of 15, 20, and sometimes more than 30 feet, with an instrument called a cramp. This is a kind of fork of iron, of which the prongs are perpendicular with respect to the handle. Each of these prongs is from 18 to 20 inches in length, and there is a space between them of about six inches; the length of the handle is in proportion to the depth of the water; the pinnae are seized, separated from the rock, and raised to the surface by means of the instrument. The tuft of silk issues directly from the body of the animal; it comes from the shell at the place where it opens, about four or five inches from the summit or point in the large.

PINNACE, a small vessel used at sea, with a square stern, having sails and oars, and carrying three masts, chiefly used as a scout for intelligence, and for scouting of men, &c. One of the boats belonging to a great man of war, serving to carry the officers to and from the shore, is also called the pinnace.

PINNACLE, in architecture, the top or roof of a house, terminating in a point. This kind of roof, among the ancients, was appropriated to temples; their ordinary roofs were all flat, or made in the plain way. It was from the pinnacle that the form of the pediment took its rise.

PIN EYES. See BOTANY.

PINUS, the pine-tree, a genus of the monadelphia order, in the monoecea class of plants. The male calyx is four-leaved; no corolla; stamina very many, with naked anthers; fem. cal. stigmas, with a two-flored scale; corolla none; pistil one; nut with a membranous wing. There are 21 species of this genus; of which the most remarkable are the following:

1. The pinea pincaster, or wild pine, grows naturally on the mountains in Italy and the south of France. It grows to the size of a large tree; the branches extend to a considerable distance; and while the trees are young, they are full of leaves, especially where there is air from those within; but as they advance in age, the branches appear naked, and all those which are situated below become unsightly in a few years; for which reason they are now much less esteemed than former years.

2. The pinus pinea, or stone pine, is a tall evergreen tree, native of Italy and Spain. It delights in a sandy loam, though like most others it will grow well in almost any land. Respecting the uses of this species, Hanbury tells us that the kernels are eatable, and by many preferred to almonds. In Italy they are served up at dessert. They are exceedingly wholesome, being good for coughs, colds, consumptions, &c., on which account only this tree deserves to be propagated.

The rubra, commonly called the Scots fir or pine. It is common throughout Scotland, whence its name, though it is also found in most of the other countries of Europe. M. du Hamel, of the Royal Academy of Sciences, mentions having received some specimens from St. Domingo in the West Indies; and thence concludes, that it grows indifferently in the temperate, frigid, and torrid zones. The wood of this tree is the red or yellow deal, which is the most durable of any of the kinds yet known. The leaves of this tree are much shorter and broader than those of the former sort, of a greyish colour, growing two out of one sheath; the cones are small, pyramidal, and end in narrow hooks. The wood of a light colour, and the seeds are small.

4. The pinus picea, or yew-leaved fir, is a tall evergreen, and a native of Scotland, Sweden, and Germany. This species includes the silver fir, and the balm of Gilead fir.

The first of these is the noble upright yew tree. Mr. Marsham says, "The tallest trees I have seen were spruce and silver firs in the valleys of Switzerland. I saw several large rock-yards in Venice 40 yards long; and one of 30 yards was 18 inches diameter at the small. I was told they came from Switzerland." The branches are not very numerous, and the bark is smooth and delicate. The leaves grow singly on the branches, and their ends are slightly indentured. Their upper surface is of a fine strong green colour, and their under has an ornament of two white lines running lengthwise on each side the midrib; on account of which silver fir looks this sort is called the silver fir. The cones are large, and grow erect; and when the warm weather comes on, they soon shed their seeds, which should be a caution to all who wish to raise this plant, to gather the cones before the seeds fall. The balm of Gilead fir has all of the sorts been most coveted, on account of the great fragrance of its leaves, though this is not its only good property; for it is a very beautiful tree, naturally of an upright growth, and the branches are so ornamented with their balsmy leaves as to exceed any of the other sorts in beauty.

The silver fir is very hardy, and will grow in any soil or situation, but always makes the greatest progress in rich loamy earth. The balm of Gilead fir must be planted in deep, rich, good earth; nor will it live long in any other. The soil may be a black mould, or of a sandy nature, if it is deep enough, and if there be room enough to strike freely.

5. The pines, sylvestris, or European spruce fir, a native of the northern parts of Europe and Asia, includes the Noræy spruce and long-beamed Cornish fir. The former of these is a very rich beauty when growing, as its timber is valuable in every respect, and is esteemed on that account. Its growth is naturally like the silver, upright; and the height it will aspire to may be easily conceived, when we say that the white deal, so much coveted by
the joiners, &c. is the wood of this tree; and it may perhaps satisfy the curious reader to know, that the pitch drawn from this tree is dark green, and the leaves are of a dark-green colour; they stand singly on the branches. They are very narrow, their ends are pointed, and they are possessed of such beauty as to excite admiration.

The cones are eight or ten inches long, and hang downwards.

6. The pinus Canadenesis, American or Newfoundland spruce, a native of Canada, Pennsylvania, and other parts of North America, includes three varieties; the white New-constancy spruce, the red Newfoundland spruce, and the black Newfoundland spruce. These, however, differ so little, that one description is common to them all. They are of a genteel upright growth, though they do not shoot so freely, nor grow so fast, with us, as the Norway spruce.

7. The pinus balancea, or hemlock fir, a native of Virginia and Canada, possesses little beauty as any of the fir tribe; though, being rather scarce in proportion, it is esteemed valued by some. The leaves of this fir are from the resemblance of the leaves to those of the yew-tree. It is a tree of low growth, with but few branches; and these are long and slender, and spread abroad without order. The leaves are very small and needle-sharply; they are about half an inch long, and the scales are loosely arranged. We receive these cones from America, by which we raise the plants; though the pitch given to the planter, that this tree is foun of moist rich ground, and in such a kind of soil will make the greatest progress.

8. The pinus Orientalis, or Oriental fir, a native of the East, is a low but elegant tree. The leaves are very short, and nearly square. The fruit is exceedingly small, and hangs downward; and the whole tree makes an agreeable variety with the other kinds.

9. The strobus, lord Weymouth's pine, or North American white pine, grows sometimes to the height of 100 feet, and upwards; and is remarkable for the beauty of its branches. The bark of the tree is very smooth and delicate, especially when young; the leaves are long and slender, five growing out of one sheath, and in a fine appearance. The cones are long, slender, and very loose, opening with the first warmth of the spring; so that, if they are not gathered in winter, the scales open, and let out the seeds. The wood of this sort is esteemed for making masts for ships. In Queen Anne's time there was a law made for the preservation of these trees, and for the encouragement of their growth in America. Within these last 50 years they have been imported in Britain in considerable quantity.

The soil the Weymouth pine delights in is a sandy loam; but it likes other soils of an inferior nature; although it is not generally to be found on any lands like the Scotch fir. On stony and slaty ground, likewise, there are some very fine trees; so that whoever is desirous of having plantations of this wood, need not be too curious in the choice of soil.

10. The pinus sylvestris, or swamp-pine, is a tall evergreen tree, a native of the swamps of Virginia and Canada. There are several varieties of this genus which Hanbury enumerates and describes, as, 1st, The three-leaved American swamp-pine. 2d, The two-leaved American pine. 3d, The yellow American, the yellow tough pine, and the tough pine of the plains: among which there is but little variety. 4th, The bastard pine. 5th, The frankencise pine. 6th, The dwarf pine.

11. The native cedar is that popularly called by its the cedar of Lebanon; by the ancients cedrus magna, or the great cedar.

It is a coniferous evergreen, of the bigger sort, bearing large roundish cones of smooth scales, standing erect, the leaves being small, and of a dark blue. They sometimes counterfeit cedar, by drying a wood of a reddish hue: but the smell discovers the cheat, that of true cedar being very aromatic. In some places, the wood of the cedar tree passes under the name of cedar, on account of its reddish colour and its aromatic smell, which somewhat resemble that of sinital. Cedar wood is reputed almost immortal and incorruptible; a prerogative which it owes chiefly to its bitter taste, which the worms cannot endure. For this reason it was that the ancients used cedar tablets to write upon, especially for things of importance, as appears from that expression of Persius, "E Cedræ / Lettatur," that is, "It is written from cedar, with which they smeared their books and writings, or other matters, to preserve them from rottenning.

Solomon's temple, as well as his palace, were both of this wood. The statue (says Hanbury) of the great goddess at Ephesus was made of this material; and if this tree abounded with us in great plenty, it might have a principal share in our most superb edifices. It is remarkable that this tree is not to be found as a native in any other part of the world than mount Libanus, as far as has yet been discovered. What we find mentioned in Scripture of the lofty cedars, can be nowise applicable to the common growth of this tree; since, from the experience we have of those now growing in England, as also from the testimony of several travellers who have visited those few remaining trees on mount Libanus, they are not inclined to grow very lofty, but on the contrary extend their branches very far.

Maundrel, in his Travels, says there were but 16 large trees remaining when he visited mount Libanus, some of which were of a prodigious bulk, but that there were many more young ones of a smaller size: he measured one of the largest, and found it to be 12 yards six inches in girth, and yet sound, and 37 yards in the spread of its boughs. At about five or six yards from the ground it was divided into five limbs, each of which was equal to a great tree. What Maundrel has related was confirmed by a gentleman who was there in the year 1728, with this difference only, viz. in the dimensions of the branches of the largest tree; which he measured, and found to be 22 yards diameter. Now whether Mr. Maundrel meant 37 yards in circumference of the spreading branches, the dimensions of the branches as determined by his words: yet either of them well agrees with this last account.

12. The larch, or larch-tree, with deciduous leaves, and oval oblong cones. It grows naturally upon the Alps and Apennines, and of late has been very much propagated in Britain. It is of quick growth, and the trunk rises to 20 feet or more; its branches are slender, their tips generally hanging downward. In the month of April the male flowers appear, which are disposed in form of small cones; the female flowers are collected into oval oblong cones, which have bright purple tops, and in others they are white: these differences are accidental; the cones are about an inch long, obtuse at their points; the scales are smooth, and lie over each other; under each scale there are generally lodged two seeds, which have wings. There are two other varieties of this tree, one of which is a native of America, and the other of Siberia. The cones of the American kind which have been brought to Britain, seem in general to be larger than those of the common sort.

From the larch-tree is extracted what we erroneously call Venice turpentine. This substance, or natural balsam, flows at first without incision; and when it has done running, the poor people who wait in the fir woods make incisions at about two or three feet from the ground into the trunks of the trees, into which they fix narrow troughs, about 10 inches long. The end of these troughs is hollowed like a ladle; and in the middle is a small hole bored for the turpentine to run into the receiver which is placed below it. As the gummy substance runs from the trees, it passes along the sloping gutter or trough to the ladle, and from thence runs through the holes into the receiver. The people who gather it visit the trees morning and evening from the end of May to September, to collect the turpentine out of the receivers. When it flows out of the tree, Venice turpentine is clear like water, and of a yellowish-white; but, as it grows older, it thickens and becomes of a citron-colour. It is procured in the greatest abundance in the neighbourhood of Lyons; and in the valley of St. Martin, near St. Lucern, in Switzerland.

All the sorts of pines are propagated by seeds produced in hard woody cones. The way to get the seeds out of these cones is, to lay them before a gentle fire, which will cause the scales to open, and the seeds may be easily taken out. If the cones are kept entire, the seeds will remain good for some years; so that the surest way of preserving them is to let them remain in the cones till the time for sowing the seeds. If the cones are kept in a warm place in summer, they will open and emit the seeds; but if they are not exposed to the heat, they will remain close for a long time. The best season for sowing the pines is about the end of March. When the seeds are sown, the place should be covered with nets to keep off the birds; otherwise, when the plants begin to appear with the husk of the seed on the top of them, the birds will peck off the tops, and thus destroy them.

From the first species is extracted the common turpentine, much used by farriers, and from which is drawn the oil of that name. The process of making pitch, tar, resin, and turpentine, from these trees, is as follows: In the spring time, when the sap is most free in running, they pare off the bark of the pine-tree, to make the sap run down into a hole which they cut at the bottom to receive it. In the way, as it runs down, it leaves a white
matter like cream, but a little thicker. This is very different from all the kinds of resin and turpentine in use; and is generally sold to be used in the making of flambeces, in spirits of white beef-ew; The matter that is received at the bottom of the bottle is taken up with ladles, and put into a large basket; a great part of this immediately runs through, and this is the common turpentine. This is received into stone or earthen pots, and is ready for use. The thicker matter, which remains in the basket, they put into a common alembic, adding a large quantity of water. They distil this as long as any oil is seen swimming on the water. This oil they separate from the surface in large quantities, and this is the common oil or spirit of turpentine. The remaining matter at the bottom of the still is common yellow resin. When they have thus obtained all they can from the sap of the tree, and of this species thus extracted, and heating the wood into billets, they fill a pit dug in the earth with these billets; and setting them on fire, they run from them, and this is the tar, which is burning, a black thick matter. This matters runs down the side of the pit, and this is the tar. The top of the pit is covered with tiles, to keep in the heat; and there is at the bottom a little hole, out at which the tar runs out like oil. If this hole is too large, it set the whole quantity of the tar on fire; but if small enough, it runs quietly out.

The tar, being thus made, is put up in barrels; and if it is to be made into pitch, they put it into large boiling-vessels, without adding anything to it. It is then suffered to boil awhile, and being then set out, is found when cold to be what we call pitch.

A deconction of the nuts or seeds of the first species in milk, or of the extremities of the branches pulled in spring, is said, with a proper regimen, to cure the most invertebrate scurvy. The second species is not esteemed; but that of the Scots pine is superior to any of the rest. It is observable of the Scots pine, that when planted in bogs, or in a moist soil, though the plants make great growth, they turn yellow, and I have observed, but being planted in a dry soil, though the growth of the trees is very slow, yet the wood is proportionately better. Few trees have been applied to no use than these, and this, with the lightness, are formed by nature for masts to our navy. The timber is resinos, durable, and applicable to numberless domestic purposes, such as flooring and wainscoting of rooms, making of heds, chests, tables, boxes, &c. From the trunk and branches of this, as well as most others of the pine tribe, tar and pitch are obtained. By incisions, barks, Burgundy pitch, and turpentine, are acquired and prepared. The resinous knots are dug out of the ground in many parts of the Highlands, and being divided into small splinters, are used by the inhabitants to burn instead of candles. At Loch-Broom, in Ross-shire, the fishermen make ropes of the inner bark; but hard necessity has taught the inhabitants of Sweden, Lapland, and Kamtschatka, to convert the same into bread. To effect this, they, in the spring season, make choice of the tallest and fairest trees; then stripping off carefully the outer bark, they collect the soft, white, succulent, interior bark, and dry it in the shade.

When they have occasion to use it, they first toast it at the fire, then grind, and after steeping the flour in warm water to take off the resinous taste, they make it into this cakes, which are baked for use. On this strange food the people are sometimes constrained to live for a whole year, and we are told, through custom, become at last even fond of it. Linnaeus remarks, that this same bark-bread will latten wise; and humanity obliges us to wish, that men might never be reduced to the necessity of robbing them of such a food. The interior bark, of which the abovementioned bread is made, the Swedish boys frequently peel off the trees in the spring, and eat raw with a greatly appetite. From the cones of this tree are prepared a uricular oil, like the oil of turpentine; and a resinous extract, which has similar virtues with the balsam of Peru. An infusion or tea of the buds is highly recommended as an antiscorbutic. The inner bark, or yellow powder, of the male flowers, is sometimes in the spring carried away by the winds, in such quantities, where the trees abound, as to alarm the ignorant nations at the sight of its raining brimstone. The tree lives to a great age; Linnaeus affirms, to 400 years.

PIONEERS, in the art of war, are such as are commanded in from the country, to march with an army for mending the ways, for working on trenches and fortifications, and for making mines and approaches. The soldiers are likewise employed for all these purposes. Most of the foreign regiments of artillery have half a company of pioneers, who are placed in that important branch of duty. Our line of infantry and cavalry have about twenty pioneers each, provided with aprons, hatchets, saws, spades, and pickaxes. Each pioneer must have an ax, a saw, and an apron to cap with a leather crown, and a black hair-skin front, on which is to be the king's crest in white, on a red ground; and the number of the regiment is to be on the back part of.

PIE, or PEP, porp, a disease among poultry, of a white thin skin, or film, that grows under the tip of the tongue, and hinders their feeding. It usually arises from want of water, or from drinking puddle water, or eating filthy meat. It is cured by pulling off the films with tweezers, and rubbing the tongue with salt. Hawks are particularly liable to this disease, especially from feeding on stinking flesh.

PIPE, in building, &c. a canal, or conduit, for the conveyance of water and other fluids. Pipes for water, water-engines, &c. are usually of lead, iron, earthen, or wood; the latter are commonly made of oak or elder. Those of iron are cast in forges; their usual length is about two feet and a half; several of these are commonly fastened together by means of four screws at each end, with leather or old hat between them, to stop the water. Those of earth are made by the potters; these are fitted into one another, one end being always made wider than the other. To join them the closer, and prevent them, after breaking, they are covered with tow and pitch; their length is usually about that of the iron pipes. The wooden pipes are three bored with large iron augurs, of different sizes, beginning with a less, and the next proceeding with a larger successively; the first being pounded, the rest formed like spoons, increasing in diameter, from one to six inches or more: they are fixed into the openings of each other, and are sold by the foot.

PIPE-BORING. AA. Plate Perambulator, &c. fig. 4, are two beams laid on each side of the pit, into which the chips are to fall. Upon the edges of the wheels of a frame DE run. This frame has four pieces, dila, across it; and two windlasses, bb, which have chains round them, going over the piece of timber F which is to be bored. The two end-pieces dd have uprights or stands in them; between which the tree is laid, and is secured with wedges in different places as the occasion requires. G is a piece lying across the two beams AA &c is connected with the frame DB by two iron bars, g, which are fastened to it; and go through the piece in the piece d, and are held there by pins put through holes in both. The piece G has two uprights in it, between which is a brass pulley to support the boring-bar I, g, is a wheel, with handles on its circumference to turn it by; on its axis A a rope is coiled; one end of which goes over a pulley wh, and is fastened to the carriage DE. I, the other, is a similar pulley, and is tied to the other end of the carriage DB. The machine is put into some place where there is a crane, by which the tree can be lifted on to the carriage; first withdrawing the windlasses from the boring-bar, by turning the wheel from g to j, and separating it from the piece G by taking out the pins. It is then wedged into its place, and the windlasses bb. The wheel is next turned, and the carriage drawn up to the borer, and the piece G pinned in. The machine (either horses, water, steam, &c) which turns the borer is then set to work; and a man constantly attends at the wheel g, to draw the pipe up to the borer. The use of the wheel in the piece G is, to support the borer just where it enters the pipe, and make it work steadily. When the piece is bored through, it is withdrawn, and another tree is placed on the carriage as before.

PIES of an Organ. See Organ.

Pipes, tobacco, are made of various fabrics long, short, plain, worked, white, varnished, unvarnished, black, and various colours, &c. The Turks use pipes three or four feet long, made of rushes, or of wood bored, at the end whereof they fix a kind of pot of baked earth, which serves as a bowl, and which they take off after smoking.

Pipe also denotes a vessel or measure for wine, containing 126 gallons.

Pipe-Opfery is an office wherein a person called the clerk, takes out leases of crown lands, by warrant from the lord-treasurer, or commissioners of the treasury, or chancellor of the exchequer. The clerk whose pipe makes out also accounts of sheriffs, &c. and gives the necesary blanks of the quietest est. To this office are brought all accounts which pass the remembrancer's of office, and remain there, that if any stated debt be due from any person, the same may be drawn down into the great roll of the pipe; upon which the comptroller issues out a warrant, called the summons of the pipe, for recovery thereof; and if there be no goods or chattels, the clerk then draws down the debts to the lord-treasurer's remembrance, to write
extents against their lands. All tallies which vouch the payment of any sun contained in such accounts, are examined and allowed by the chief secondary of the pipe. Besides the chief clerk in this office, there are eight attorneys, and with them, are found, with great frequency, two private musketeers.

Piper, or pepper, a genus of the trigynia order, in the diandra class of plants. There is no calyx or corolla; the berry is one-seeded. There are 60 species, of which the most remarkable is the silex, with oval, heart-shaped, nerved leaves, and reclined spikes. This is the plant which produces the pepper so much used in food. It is a shrub whose root is small, fibrous, and flexible; it rises into a stem, which requires a tree or prop to support it. Its wood has the same sort of knots as the vine; and when it is dry, it exactly resembles the vine-branch. The leaves, which have a strong smell and a pungent taste, are of an oval shape; and bear fragrant, towards the extremity, and terminate in a point. From the flower-buds, which are white, and are sometimes placed in the midst, and sometimes at the extremity of the branch, the berries are suspended, bearing those of the currant. Each of these contains between 20 and 30 corns of pepper; they are commonly gathered in October, and exposed to the sun seven or eight days. The fruit is at first a green, and afterwards red, when stripped of its covering assumes the appearance it has when we see it. The largest, heaviest, and least shrivelled, is the best. The pepper-plant flourishes in the islands of the Cape of Good Hope, and more particularly on the Malabar coast. It is not sown, but planted; and great nicety is required in the choice of the shoots. It produces no fruit till the end of three years; but bears so plentifully the three succeeding years, that some plants yield between six and seven pounds of pepper. The bark then begins to shrivel; and the shrub declines so fast, that it is stunted and becomes worthless. Betel, or betel, is a species of this genus. It is a creeping and climbing plant like the ivy; and its leaves a good deal resemble those of the cinnamomum, though they are larger and narrower at the extremity. It grows in all parts of the East Indies, on the best market places. The natives cultivate it as we do the vine, placing props for it to run and climb upon; and it is a common practice to plant it along the sides of the roads. At all times of the day, and even in the night, the Indians chew the leaves of the betel, the bitterness of which is corrected by the areca that is wrapped up in them. There is constantly mixed with it the chudum, a kind of burnt lime made of shells. The rich frequently add perfumes, either to gratify their vanity or their sensuality.

It would be thought a breach of politeness among the Indians to take the betel for a second time, without presenting each other with a purse of betel. It is a pledge of friendship which relieves the pain of absence. No one dares to speak to a superior unless his mouth is perfumed with betel; it would even be rude to neglect this precaution with an equal.

The women of gallantry are the most lavish in the use of betel. Betel is taken after meals; it is chewed during a visit: it is offered when you meet, and when you separate; in short, nothing is to be done without betel. If it is prejudicial to the teeth, it assists and strengthens the stomach. At least, it is a general fashion that prevails throughout India.

The piper nigrum, or black pepper, and the piper longum, or long pepper, of Japan, and China, are indigeneous, and known by the names of joint wood, or peperocy cloris. The first bears a small spike, on which are attached a number of small seeds of the size of mustard. The whole of the plant has the exact taste of the East India black pepper. The long-pepper bush grows taller than the nigrum. The leaves are broad, smooth, and shining; the fruit is similar to the long pepper of the shops; but smaller. Some natural people in Jamaica season their messes with the black pepper. To preserve both, the fruit may be slightly scalded when green, then dried, and wrapped in paper.

PIPER, a genus of birds of the order of passeres. Latham describes 25 different species, and five varieties. The general character of the genus is, that the bill is short, strong, hard, and slightly incurved, with the base of the outer and inner being the forehead yellow, and is connected to the outer as far as the third joint; this character, however, is not altogether universal, some of the species differing in this particular. The tail is short. This feature, however, is of no consequence to the genus piper, or timotheus. They are supposed to inhabit South America only; but this is not true, for Mr. Latham assures us that he has seen many of these species which he has described which came from other parts, but which nevertheless certainly belong to this genus.

1. The pipra rupicola, or crested manakin, is not much larger than a manuka pigeon, in about ten or twelve inches long. The bill is about an inch and a quarter long, and of a yellowish colour. The head is furnished with a double round crest; the general colour of the plumage is orange, inclining to saffron; the wing-coverts are loose and fringed. The female is altogether brown, except the under wing-coverts, which are of a russet orange; the crest is neither so composed, nor so prominent in the female. Both males and females are at first grey, or of a very pale yellow, inclining to brown. The male does not acquire the orange colour till the second year, neither does the female the full brown. See Plate Nat. Hist. fig. 437.

This beautiful species inhabits various parts of Sariman, Caycune, and Guiana, in rocky situations; but is no where so frequent as in the mountain Laos, near the river Oyapock, and in the department of Couronne, near the river Apronack, where they build in the cavernous hollows and the darkest recesses.

2. The next species Mr. Latham calls the tuneful manakin. Its length is four inches; the bill is dusky, the forehead yellow, and the crown and nappe blue; the chin, sides of the head below the eyes, and the throat, are black; the upper part of the back, the wings, and the tail, are dusky black. It is a native of St. Domingo, where it has gained the name of organiste from its note, forming the complete octave in the most agreeable manner, one note successively after another. It is said not to be uncommon, but not easy to be secured; as, like the creeper, it perpetually shifts to the opposite part of the branch from the spectator's eye, so as to chide his vigilance.

3. The albifrons inhabits South America. See Plate Nat. Hist. fig. 339. There are about 30 species.

PIRATE. By stat 28 II. VIII. c. 13, all treasons, felonies, robberies, murders, and confederacies committed upon the sea, or in any harbor, creek, or place, the admiral has jurisdiction, shall be tried in such ships or places as the king shall appoint by his commission in like forms, as if such offence had been committed upon land, and according to the course of common law, and the offenders shall suffer death without benefit of clergy. And by stat. 6 Geo. I, made perpetual, it is enacted, that if any of his majesty's natural-born subjects, or denizens of this kingdom, shall commit any piracy or robbery, or any act of hostility, against other his majesty's subjects upon the sea, under colour of any commission from any prince or state, or pretence of authority from any person or power, shall be deemed to be a pirate, felon, and robber; and being duly convicted thereof according to this act, or the aforesaid act of 23 II. VIII., shall have and suffer such pains of death, loss of lands and goods, forfeiture to the crown, and penalties, as are imposed by the common law, and the offenders shall suffer death without benefit of clergy. And by 18 Geo. II. c. 50, persons committing hostilities, or aiding enemies at sea, may be tried as pirates. Pirates at sea are excepted from the general pardon, by 20 Geo. II. c. 52.

Pirate's goods, go to the admiral by grant; but not piratical goods, which go to the king if the owner is not known.

PISCES, in astronomy, the twelfth sign or constellation of the zodiac. The stars in Pisces, in Ptolemy's catalogue, are 38; in Tycho's, 33; and in the Britannic catalogue, 109.

PISCIDIA, a genus of the decandria order, in the daedalea class of plants. The stigma is acute; the legume winged four ways. There are two species, viz.

The erythrina or dogwood tree. This grows plentifully in Jamaica, where it rises to the height of twenty-five feet or more; the stem is almost as large as a man's body, covered with a light brown smooth bark, and sending out several branches at the top without order. The flowers are of a dirty-white colour; they are succeeded by oblong pods containing hard seeds. The Cattagrinia is, with oblong oval leaves, is also a native of the West Indies. It differs from the former in the shape and consistence of the leaves, which are more oblong and stiffer; but in other respects they are very similar. Both species are easily propagated by seeds; but require artificial heat to preserve them in this country. The negroes in the West Indies make use of the bark of the first species to intoxicate fish. When any number of gentlemen have an inclination to divert themselves with fishing, or, more properly speaking, with fish-hunting, they send each of them a negro slave to the woods, in order to fetch some of the bark of the dogwood tree. This bark is next morning pounded very small with stones, put into old sacks, carried into rocky parts of the sea, steeped till thoroughly soaked with salt water, and then well squeezed by the negroes to express the juice. This juice immediately colours the sea with a reddish hue; and, being of a
poisonous nature, will in an hour's time make the fishes, such as groppers, rock-fish, oldwives, Welsmen, &c., so intoxicated, as to swim on the surface of the water, quite heedless of the danger; the gentlemen then send in their negroes, who pursue, both on swimming and on horseback, the intoxicated fishes, till they catch them with their hands; their masters in the mean time standing by, on high rocks, to see the pastime. It is remarkable, that though this poison kills millions of the small fry, has never been known to impart any bad quality to the fish which have been caught in consequence of the intoxication. The wood of this tree, although pretty hard, is only fit for fuel.

PISCIS VOLANS, a small constellation of the southern hemisphere, unknown to the antients, and invisible to us in these northern regions.

PISOITE, a mineral found at Carlsbad in Bohemia. It has the form of round masses composed of concentric layers, and containing a grain of sand in their centre. Colour white, often greyish, reddish, or yellowish. The round bodies are collected together like a bunch of grapes.

PISONIA, a genus of the polygonia dicciae class of plants, the corolla whereof is of an infundibuliform shape; the tube is short; the limb is semiquinquefid, acute, and poutou, with a slightly oval quinquangis or capsule, formed of five valves, and containing only one seed; the capsule is linear, smooth, and ovato-oblong. There are five species, native of the West Indies.

PISTACHIA, turpentine-tree, pistachia-nut, mastich-tree; a genus of the pendandria order, in the dicciae class of plants. The male is an anem.; cal. five-cleft; cor. none; r. distinct; cal. trifid; cor. none; styles two; drupe one-seeded. There are six species; of which the most remarkable are: 1. The terebinthus, or pista-chia-tree. This grows naturally in Arabia, Persia, and Syria, where the nuts are annually brought to Europe. In those countries it grows to the height of 25 or 30 feet; the bark of the stem and old branches is of a dark russet colour, but that of the young branches is of a light brown. 2. The lentisch, or common mastich-tree, grows naturally in Portugal, Spain, and Italy. Being an evergreen, it has been preserved in this country in order to adorn the green-houses. In the countries where it is a native, it rises to the height of eighteen or twenty feet. 3. The orientalis, or true mastich-tree of the Levant, from which the mastich is gathered, has been confounded by most botanical writers with the lentisch, or confused, mastich-tree, above described, though there are considerable differences between them.

The first species is propagated by its nuts; which should be planted in pots filled with light kitchen-garden earth, and plunged into a moderate hothub to bring up the plants. The second sort is commonly propagated by tying down the branches, though it may also be raised from the seed in the manner already directed for the pistachia-nut tree; and in this manner also may the true mastich-tree be raised. But this, being much more tender than any of the other sorts, requires to be constantly sheltered in winter, and to have a warm situation in summer.

Pistachia-nuts have a pleasant, sweet, unctuous taste, resembling that of almonds; and they abound with a sweet and well-tasted oil, which they yield in great abundance on being pressed after bruising them; they are reckoned amongst the anadecies, and are wholesome and nutritious, and are by some esteemed very proper to be prescribed by way of restorative, eaten in small quantities, to people emaciated by long illness.

PISTIA, a genus of the monadelphia acenia class and order. There is no calyx; the corolla is one-petalled, tongue-shaped, entire; anthers six or eight; style one; capsule one-seeded. There is one species, an aquatic of Senegal.

PISIUM, pea; a genus of the decandria order, in the diadelphia class of plants. The style is triangular, above one-celled, pubescent; calyx has the two upper segments shorter. The species are: 1. The sativum, or garden-pea. 2. The matthianum, or sea-pea; with footstalks which are plain on their upper side, an angular stalk, arrow-pointed stipule, and footstalks bearing many flowers. 3. The oculus, with membranaceous running footstalks, having two leaves and one flower upon a footstalk.

There is a great variety of garden-peas now cultivated in Britain, which are distinguished by the gardeners and seedsmen, and have their different titles; but as great part of these have been seminal variations, so, if they are not very carefully managed, by taking away all those plants which have a tendency to alter before the seeds are formed, they will degenerate into their original state; therefore all those persons who are curious in the choice of seeds, look carefully over those which they design for seeds at the time when they begin to flower, and draw out all the plants which they dislike from the others. This is what they call roguing their peas; meaning the taking out all the bad plants from the good, that the farina of the former may not impregnate the latter; to prevent which, they always do it before the flowers open. By thus diligently drawing out the bad, reserving those which come earliest to flower, they have greatly improved their peas of late years, and are constantly endeavouring to obtain other varieties; it would be to little purpose in this place to attempt giving a particular account of all the varieties now cultivated; we shall therefore only mention those of which they are commonly known, placing them according to their time of coming to the table, or gathering for use:

The golden hotspur. Nonpareil.
The charlton. Sugar dwarf.
The Reading hotspur. Sickle pea.
Master's hotspur. Marrowfat.
Esses hotspur. Button or crown pea.
The dwarf pea. Roundnose pea.


PIT, in vegetation, the soft spongy substance contained in the central parts of plants and trees. See PLANES, physiology of.
PITUITARY GLAND. See Anatomy.

PLACENTA. See Anatomy and Midwife.

P.L.A.

PLAGIANTHIUS, a genus of the class and order monadelphia dod RESERVED. The calyx is five-cleft; petals five; berry. There is one species, a native of New Zealand.

PLAGUE, Pestilence, or Pestilential Fever. See Medicine.

PLAGUE-WATER, one of the compound waters of the shops, distilled from mint, rosemary, angelica roots, &c.

PLAIN, in general, an appellation given to whatever is smooth and even, or simple, obvious, and easy to be understood; concretions, consequently, stands opposed to rough, rich, or labour'd.

A plain figure, in geometry, is an uniform surface; from every point of whose perimeter, right lines may be drawn to every other point in the same.

A plain angle is one contained under the two lines or surfaces, in contradistinction to a solid angle. The doctrine of plain triangles, as those included under three right lines, is termed plain trigonometry. See TRIGONOMETRY.

PLAIN, in joinery, an edged tool, or instrument for parting and shaving of wood. It consists of a piece of wood, very smooth at bottom, as a stock or shaft; in the middle of which is an aperture, through which a steel-edge, or chisel, may be inserted. Its use is to take off the greater irregularities of the stuff, and to prepare it for the smoothing-plane. 2. The smoothing-plane is short and small, its chisel being finer; its use is to take off the greater irregularities left by the fore-plane, and to prepare the wood for the jointer. 3. The jointer is the longest of all; its edge is very fine, and does not stand out above a hair's breadth; it is chiefly used for shooting the edge of a board perfectly straight, for joining tables, &c. 4. The strike-block, which is like the jointer, but shorter; its use is to shoot short joints. 5. The rabbit-plane, which is used in cutting the upper edge of a board, straight or square, down into the stuff, so that the edge of another cut after the same manner, may join in with it, on the square; it is also used in striking facings on mouldings; the iron or chisel of this plane is as broad as its stock, that the angle may cut straight, and it delivers its shavings at the sides, and not at the top, like the others.

The sum of the other two sides of a right-angled triangle, to find the triangle, as also to describe a trapezium that shall make a given area of four given lines. Such problems can only have two solutions, in regard a right line can only cut a circle, or one circle cut another, in two or four points.


PLAIN, in general, denotes the representation of something drawn on a plane; such as maps, charts, and engravings, &c. See Map, Chart, &c.

The term plan, however, is particularly used for a draught of a building, such as it appears, or is intended to appear, on the ground, the extent, division, and distribution of its area, or ground-plan, into apartments, rooms, passages, &c. See ARCHITECTURE.

PLANARIA, a genus of worms intestina; the larvae are distinguished as turbellaria, or flatworms, with a double ventral pore, mouth terminal; this genus contains many species, and is divided into sections.

The section A is without eyes; planaria glabra is a very long, slender, and delicate before; inhabits stagnant water, under duckweed; body grey; the margin all round is tesselate with very fine stripe; it swallows the cyclinda which inhabit the same waters, and accordingly discharges a similar solution. Planaria operculata inhabits the sandy shores, and among fields in the basins of Norway; something resembles a coffee bean; and moves by bending its margin, and by means of its mariane fijl's fixes itself and removes other bodies. The section B, with a single eye; C with two eyes; D with three eyes, and E with four eyes.

PLAIN, showing Geometry.

Plants, in joinery, an edged tool, or instrument for parting and shaving of wood. It consists of a piece of wood, very smooth at bottom, as a stock or shaft; in the middle of which is an aperture, through which a steel-edge, or chisel, may be inserted. Its use is to take off the greater irregularities of the stuff, and to prepare it for the smoothing-plane. 2. The smoothing-plane is short and small, its chisel being finer; its use is to take off the greater irregularities left by the fore-plane, and to prepare the wood for the jointer. 3. The jointer is the longest of all; its edge is very fine, and does not stand out above a hair's breadth; it is chiefly used for shooting the edge of a board perfectly straight, for joining tables, &c. 4. The strike-block, which is like the jointer, but shorter; its use is to shoot short joints. 5. The rabbit-plane, which is used in cutting the upper edge of a board, straight or square, down into the stuff, so that the edge of another cut after the same manner, may join in with it, on the square; it is also used in striking facings on mouldings; the iron or chisel of this plane is as broad as its stock, that the angle may cut straight, and it delivers its shavings at the sides, and not at the top, like the others.

6. The plough, which is a narrow rabbit-plane, with the addition of two staves, on which are shoulders; its use is to plow a narrow square groove on the edge of a board.

7. Moulding-planes, which are of various kinds, and are called the various forms and profiles of the several species of moulding; the plane, the hollow-plane, the ogee, the snake's bill, &c. which are all of several sizes, from half an inch to an inch and a half.

PLANET. See Astronomy.

PLANETARIUM, a terrestrial astronomical machine, made to represent the motions of the planets, and their satellites, as they really are in nature. We have in some degree explained the theory of the planetarium, under the article Orrery; we shall now give a view of the machine itself, and show the nature and structure of the wheels by which the motion of the whole is produced. See Plate Planetarium.

In the planetarium exhibited in the plate, A represents the Sun, which is fixed firmly to a wire a, and has no motion; B is the planet Mercury, revolving round the Sun; D is the planet Venus; E represents the Earth, and e the Moon; FCCC; we shall now describe a bridge under the board, and which carries the Sun; over this is put a tube, on whose lower end a worm wheel, worked by a worm on the arbor of the wheel L above mentioned, is fixed; and to the upper end the frame of wheels N, with the Earth and Moon. Over these is a conical tube, which has a flange at its lower end, and is fastened to the board M by three screws; the arms carrying the planets MAB, II, and the Herschel K are fastened stiffly upon this tube, so as not to turn unless they are moved. These planets do not move by turning the wheel, but are set by hand; as also their satellites. In the frame of wheels N (figs. 1 and 2) g is the first wheel, which is fixed to the wire a (fig. 1), and is without any motion: this works into another wheel h of the same size, fixed to the spindle e. The wheel h works upon another wheel k of the same size, on whose spindle y (fig. 1) the Earth is fixed. Besides the wheel h, the spindle i has three other wheels l m n, fixed on it. The wheel i turns, which works a pinion beneath the wheel g, carrying the planet Mercury B (fig. 1): this pinion has a hollow spindle, and goes over the wire a. The wheel m on the spindle f works into p; which gives motion to one g (spindle). Thus the spindle goes over the spindle of the pinion which carries Mercury, and has the planet Venus (D fig. 1) fixed to it. The large wheel n on the spindle i turns, by intermediate wheels, the pinion S, whose arbor goes over the spindle carrying the Earth; this has an arm for the Moon fixed to it. The wire t,
to which the Moon is fixed, slides up and down through a hole in the end of the arm; and the lower end of the wire rests on a circular ring g, whose plane is parallel to the plane of the Moon's orbit; so that as the arm turns round, the wire is pushed up by the inclination of the ring, and falls by its own weight. Beneath this is a ring with divisions on it, showing the Moon's age. When the winch I is turned, it works the worm-wheel beneath the board M, and moves the frame N (fig. 1) with the Earth round the Sun; and as the wheel g is fixed, the wheel h is turned up one revolution; and as k (which it works) is of the same size with the other two, it turns the Earth so that its axis always points to the pole. The wheel I, by means of the wheel o, turns the pinion which carries the Meridian, and its T-square circles on a plane, and makes the projection, and means the squares of long measures, as square inches, square feet, square yards, &c. that is, by squares whose sides are an inch, a foot, a yard, &c. So that the area or contents of any surface is said to be found, when it is known how many such square inches, feet, yards, &c. it contains.

**PLANISPHERE.** signifies a projection of the celestial sphere upon a plane, of which are exhibited the meridians, and other circles of the sphere, are planispheres. See Map, Projection, &c.

**PLANIMETRY** is more particularly used for an astronomical instrument used in observing the motions of the heavenly bodies. It consists of a projection of the celestial sphere upon a plane, representing the stars, constellations, their proper order, some being projected on the meridian, and others on the equator.

**PLANTAGO, plantain;** a genus of the monogynous order, in the tetrads class of plants. The calyx is four-cleft; corolla four-cleft; border reflex; stamina very long; capsule two-celled, cut transversely. There are 33 species, of which the most noted are: 1. The common broad-leaved plantain, called wheat or arrow, the ground is covered with lambs' tongues; 3. The narrow-leaved plantain, or ribwort; and the following varieties have also been found in England, which are accidental; the bosom-plantain and rose-plantain. The plantains grow naturally in pastures in most parts of England, and are frequently very troublesome weeds. The common plantain and ribwort-plantain are both used in medicine, and are so well known as to need no description. They are the more solid and substantial parts of a tree or plant, consists of three parts, the bark, the wood, and the pith.

1. The bark is protecting on the outside by a cuticle, epidermis, or scurf-skin, which consists sometimes of numerous layers, and differs in thickness in different plants. This cuticle or cuticle is an organized body, composed of very minute bodies, interspersed with longitudinal fibres, as in the barked, thistle, and the generality of herbs. It con-
3. The wood lies between the bark and the pith. Its substance is denser than that of the dark, glandular structure more difficult to be understood. It is however generally supposed to consist of two substances, the parenchymatous and cellular, and the ligneous. The ligneous parts are no more than a congeries of the lymph-duets. Between the bark and the wood a new ring of these ducts is formed every year, which gradually loses its softness as the cold season approaches, and towards the middle of winter is condensed into a solid ring of wood. These annual rings, which are visible in most trees when cut transversely, serve as marks to determine their age. They seem to decrease in breadth, as the tree advances in age; but as they are found to be very unequal in size throughout, their breadth probably varies according as the season is favourable or otherwise.

Dr. Darwin distinguishes the wood into two parts, the sap-wood or albumen, and the heart. The former is much less durable, and is most abundant in thriving trees. In an oak-tree the division between these parts is very gradual. The albumen is gradually converted into heart; but we do not recollect to have met with any observations which determine the number of years in which this conversion takes place.

Dr. Darwin attributes to the sap-wood the office of nourishing the embryos of young plants.

"We may conclude," says this author, "that the umbilical vessels of the new bud are formed along with a reservoir of nourishment; and in summer in the inner bark, which constitutes the long caudex of the parent bud, in the same manner as a reservoir of nourishment is formed in the root or broad caudex of the taproot or union, for the nourishment of the rising stem; and that these umbilical vessels of the embryo bud, and the reservoir of nourishment laid up for it, which is secreted by the glands of the parent bud, and now intermitted with the present bark of the tree, become gradually changed into albumen, or sap-wood, as the season advances, in part even before the end of the summer, and entirely during the winter months.

"That the albumen of trees, which exists beneath the bark both of the trunk and roots of them, contains the nutritious matter deposited by the mature leaves, or parent buds, for the use of the embryo buds, appears not only from the occurrence of a sap which oozes from the wounds made in the vernal months through the bark into the albumen of the birch and maple, betula et acer; but also from the following experiment, which was conducted in the winter, before the vernal sap-ice rose."

"Part of a branch of an oak tree in January was cut off, and divided carefully into three parts: the bark, the albumen, and the heart. These were shaved or raspèd, and separately boiled for two hours, and then set in a warm room to ferment; and it was seen that the decoction of the albumen or sap-wood passed into rapid fermentation, and became at length acetous, but not either of the other, which exhibits the existence of sugar and mucilage in the albumen during the winter months; since a modern French chemist has shown by experiments, that sugar alone will not pass into the vinous fermentation, but that a mixture of mucilage and sugar, as the result of this experiment, may be concluded, that in years of scarcity the sap-wood of those trees which are not accid to the taste, might afford nutriment by the preparation of being raised to powder and made into bread by a mixture of flour, or by extracting their sugar and mucilage by boiling water. These observations have been confirmed by the very accurate experiments of Mr. Linné, who has shewn that all the saccharine matter of fruit trees is elaborated in the leaves of the preceding year, and deposited in the albumen, whence it is drawn in the following spring for the perfecting of the flower and fruit. An essential caution (by the way) to unskilful pruners (such as the bulk of common gardeners) is, who in cutting off the new wood, or albumen, in the spring, just cut off so much of the fruit (see Figs. O, O) and when gardeners (falsely so called) pull off the leaves of vines, and other fruit-trees, they destroy the crop of the succeeding year. One striking difference between the wood and the bark is, that the former is possessed of spiral vessels which run from one end of the tree to the other. From the great resemblance of these vessels to the air-vessels of insects, they are supposed to be subserives, and to the same functions, and the stem of some plants is entirely hollow; partly, it is supposed, from these plants, which are generally of a quick growth, requiring a more than ordinary supply of air.

Dr. Darwin considers the spiral vessels above allotted to as lymphatics. He admits that air is observed to issue both from green and dry wood cut transversely, which is distinctly seen by plunging the wood in water, and removing the pressure of the atmosphere by the air-pump. This circumstance, however, he attributes to the rigidity of the fibres of wood, which, when divided, suffer the sap to escape, when, as the air escapes, the air consequently enters in its place. He illustrates and confirms his opinion with an accustomed ingenuity, and among other observations relates the following experiment; "I placed, in the month of July, some twigs of a fig-tree with leaves on them, about an inch deep in a décoration of mulder, and others in a décoration of log-wood, along with some spire cut off from a plant of pears. These plants were chosen because their blood is white. After some hours, on the next day, on taking out either of these, and cutting off from its bottom about an eighth of an inch of the stalk, an internal circle of red points appeared, which I believed to be the ends of absorbent vessels coloured red with the decoction, and which probably existed in the newly-formed albumen, or sap-wood; while an external ring of arteries was seen to bleed out hastily a milky juice, and at once evinced both the absorbent and arterial system."

Dr. Darwin admits the existence of air-vessels which pass through the bark to the sap-wood; but these run transversely, and not in the direction of the trunk, or arms.

Du Halde likewise observes to these vessels, some round and some oval, which in the birch-tree stand prominent, and pierce the outer bark.

4th. The pith is situated in the centre of the stem, and in young plants it is very abundant. It is said by some authors to consist of exactly the same substance as the parenchyma or cellular substance of the bark; and to be composed of small cells, or bladders, generally of a circular figure, though in some plants, as the borage and thistle, they are angular. In most plants the pith gradually dies away as they approach to maturity; and in old trees it is almost entirely destitute. The pith appears to be fatal to the life of the other parts in young shoots. In those plants which have hollow stems, this central cavity, though not filled with the pith or medulla, appears to be necessary for the growth of the other parts."

There is reason to believe that the proper entrance of the air to plants, is through the cuticle; which is proved to be a vascular substance, since, when under an exhausted receiver, it issues directly through the cuticle. That the air is necessary to the existence of plants, appears from the experiments of Dr. Bell. In the winter season he covered several young trees with varnish, leaving the tops of the branches only exposed to the air. They remained in this situation the following summer, when some of them lived, though in a languid state; but those from which the air had been more accurately excluded, died without a single exception. To this proof the same author adds, that trees overgrown with moss have few leaves, weak shoots, and scarcely any fruit; and that it is the common practice of all judicious gardeners to strip the moss from the barks of aged trees, which by admitting the air generally restores them to vigour and usefulness.

11. The root, which fixes the plant to the earth, and is the chief source of its nourishment, differs much in different species of vegetables. All roots agree in being fibrous at their extremities, and it is by their fibres chiefly that they are fitted to draw nourishment from the earth. The internal structure of the root, or rather of its three dilators, is not very materially different from that of the stem. It consists of a cuticle, bark, wood, and commonly of a small portion of

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though such of the plant, as it appears to the eye; and fig. 189, is the same magnified. AA, the skin with its vessels; BB, the bark; CCC, the lymph-dots of the bark; the other holes are small cells or sap-vessels. DDA, parenchymatous insertions from the bark; EEE, the rays of the wood, with the air-vessels. This root has no pith.

III. The leaves are organs essential to the existence of plants. Trees perish when totally defoliated; and it is generally supposed that any strait of any considerable proportion of their leaves, they do not shoot vigorously. The leaves exhibit a beautiful appearance when young, as the parenchymatous matter is consumed by putrefaction. Both surfaces of the leaf are covered with a membrane, which is a thin bark, continued from the scarfin-skim of the stalk.

IV. The flower consists of four parts, the calyx or corolla, the pistil, and the pistilium. The calyx or flower-cup is almost always of a green colour, and is that which surrounds and supports all the other parts of the flower. The corolla is of various colours, is variously shaped in different vegetables, and is that which constitutes the most conspicuous part of the flower. It sometimes consists of one continued substance, but more frequently of several portions, which are called petals. The stamens are supposed to be the male part of the flower. Linnaeus designes them to be an entwined of the plant, designed for the preparation of the pollen. Each stamen consists of two parts: the filament or fine thread, which supports the anther, and the anther itself, which contains within it the pollen, and when come to maturity bursts and discharges it for the impregnation of the germs. From the supposed function of the stamens, they afford the chief foundation of the distribution of the vegetable system into classes. Such flowers as want this part are called female; such love it, but want the pistilium, are male; such as have them both, hermaphrodite; and such as have neither, neuter.

The pistilium or pointal is supposed to be the female part of the flower; it is defined by Linnaeus to be an entwined of the plant, designed for the reception of the pollen. It consists of three parts, the germen, the style, and the stigma. The germen is the rudiment of the fruit accompanying the flower, but not yet arrived at maturity. The style is the part, which serves to elevate the stigma from the germen. The stigma is the summit of the pistilium, and is covered with a moisture for the breaking of the pollen. See Botany, fig. 189.

The pericarpium or seed-vest is the germen grown to maturity. Such are the constituent parts of the flower; they are how ever infinitely varied, and serve both to diversify the face of nature, and to interest and delight the curiosity of man. One curious fact it is necessary to notice, before we dismiss this branch of the subject; and that is, that in the perennial plants especially, every flower begins to form a bud, and remain many months before it makes its appearance. Thus the flowers which appear in this year are not properly the productions of this year; the mezereum flowers in January, but the flowers are completely formed in the preceding autumn; the same is obvious in the kalmia, and rhododendron. If the coats of the tulip-root also are carefully searched about the beginning of September, the nascent flower, which is to appear in the following spring, will be found in a small cell, formed by the innermost coats, as represented in plate fig. 190, where the young flower A appears towards the bottom of the root.

VI. The seed is a deciduous part of a vegetable, containing the rudiment of a new plant. The essence of the seed consists in the corculum or fruit consists of nearly the same parts as are found in the stem; of a skin or cuticle, which is a production or continuation of the skin of the bark; and of an outer parenchyma, which is the same substance continued forsooth that its vessels are larger and more succulent or juicy. Not the core there is commonly an inner pulp or parenchyma; and the core is no more than a hard woody membrane, which incloses the seeds. As observed, however, that the organization of fruit is very various; some the seeds are dissevered through the parenchymatous or pulpy substance; in some, instead of a core, we find a strong parenchymatous matter, which incloses the seed body within the seed shell, which from its great hardness is termed the stone; in some, there are a number of seeds; and in others, only a single seed, inclosed in a large mass of parenchymatous matter.

PLANTS.

M. Bonnet, in order to ascertain how far the lobes of the seed were necessary to the growth and health of the corculum, detached them with great dexterity without a vital injury to the infant plant. Some French trees are treated in this manner, and sowed in a light soil, grew; but the consequence was, that not only the first leaves were much smaller, but the plants were uniformly weaker in every part of their growth than those which, for the sake of comparison were sown at the same time without being mutilated.

The plants from the seeds which were degraded, into the stumps, bore few blossoms, and produced less seed. The seeds of mosses are naturally devoid of lobes. The first leaves which make their appearance, which are called seminal, appear not less numerous than those of the plant than the farinaceous lobes. If the seed be broken off, the plant experiences a proportional loss of vigour.

It is matter of curious observation, that seed, thrown up at random, should always come up in the proper direction.

M. Dodart has offered an ingenious explanation of this fact, which consists in supposing that the rosetum contracts by humides, and that the plants on the contrary contracts by dryness. According to this idea, when a seed is put into the ground the wrong way, the rosetum, which then contracts towards the plant, causes the seed to attach itself to the part where there is most humidity, and therefore turns downwards. The planula on the contrary points downwards, turns itself towards the part of the soil which is driest, and therefore rises towards the surface. This explanation, however, evidence receive no better basis than conjecture; the experiments in which the truly philosophical Mr. Knight is now engaged, will probably decide the question.

Independant of the seed, there are two other methods by which plants are propagated, by slips and suckers; and many plants naturally make an effort to propagate themselves in this manner. The bulbous-rooted plants in general increase by offsets. When a tulip is first planted in the spring, the stem issues from the inner part of the bulbous root; but when the tulip is taken up in the autumn, the stem proceeds from that part of the root, but seems attached to one side. The fact is, that the root which is taken up is only a part of that which was attached.
those of the flower. The greater number of plants close, either partly or entirely, their petals towards night, or on the approach of cold or wet weather. The hedyasarum gyrans whirls its leaves in various directions, when the air is still, by an apparently voluntary effort of the plant, as if it felt the approach of a fly-trap, clasping its leaves from the stimulus of insects which crawl upon them, and pierces them with its prickles. The phenomenon of the common sensitive plant, the most distant branches of which close their leaves on any violence being offered to any part of it, are commonly known and admired. Whether these appearances are the consequences of sensation in the vegetable, it is impossible to determine; but they are so similar to what we observe in animated beings, that the term sensitive plant is very appropriate. If the distant parts of the plant are affected through the medium of nerves, their action seems to be much less quick than those of animals, as the half or the whole of a minute generally elapses in this climate before the whole of the plant droops, but it is said to be otherwise in their native climate.

Fluids of plants. As the true course of the fluids in animals, and the power by which the circulation is performed, are modern discoveries, so we have still to learn a satisfactory explanation of the corresponding circumstances in vegetable life. But the juices of plants pass from one part to another, admits of no doubt; but the observations of naturalists have been so various and inconsistent, that no theory has hitherto been sufficiently conclusive to embrace their several conclusions. It may indeed be concluded, that as the life of a vegetable is more obscure, so we cannot expect the same energy of action which is manifested in the circulating organs of animals.

It is manifest to common observation, that there does not exist the same intimate union between the different parts of a vegetable as we find between those of animals; different parts of the insect will put forth and ripen fruit at very different seasons of the year, according to the particular temperature in which each branch is placed. A branch of a vine introduced into a hot-house will vegetate in the midst of winter; while the rest of the plant, which remains exposed to the vicissitudes of the climate, will evince little or no sympathy. We know of nothing like this in the animal kingdom, and therefore it seems reasonable to conclude that there is not in a vegetable any thing analogous to a heart, from which, as to a common centre, its fluids are directed.

It has been assumed by many botanists, that there is a succus proprius, or universal sap, diffusing the fluids of the plant, and the same in all plants. It seems more consonant, however, to observation, to conclude that the fluids differ in different genera of vegetables. There is an infinite variety in the obvious properties of the juices of plants, some of which, in taste of resembling water, are more of the consistency of milk. Grains only grow on kindred stocks, which may reasonably be attributed to an unfitness of the juices of other genera.

With respect to what has been called the succus proprius of plants, which alone has been said to be different in different plants, it seems to be nothing more than the product of a process analogous to that of secretion in animals; thus a plant of mint nourished by water alone, will still elaborate, by its vegetative power, an essential oil peculiar in odour to its own species.

The juices of many plants abound so much in a mucilaginous and saccharine principle as to be fermentable. The sap of the birch-tree drawn in spring by tapping has been long used by the species of the maple affords sugar; but no plant abounds so much in this vegetable product as the sugar-cane. The mucilaginous or gummy principle prevails more particularly in the different sorts of plum. By the experiment on the sap-wood of the oak, related above, it appears that there are both sugar and mucilage in the juices of a tree remarkable for its bitterness.

Mucilage and sugar seem to exist diffused in the general mass of fluids in vegetables; on the other hand, turpentine, resin, expressed and essential oil, and what is called the extractive principle, seem to be the product of the roots of plants; and these, when exposed in extracts are so often necessarily mixed with the other juices, by the processes of extraction, that there must remain considerable doubt as to the accuracy of this particular distribution. It is, however, generally believed that the products of secretion in plants are of an inflammable nature. The seeds of plants generally abound in a heavy oil which may be obtained by pressure, such as oil of almonds, instead, that the prophetic powers of the essential oils, or those obtained by distillation, are in general extremely acrid; so much so, that they produce a wound when inadvertent application to the tongue in an unwholesome state. Oil of cloves is employed to destroy the exposed nerve in decaying teeth, in order to cure the toothache; but its use requires considerable caution, as it is liable to injure the teeth adjoining to that which is diseased. The bitter, narcotic, and acid principles, are also to be considered as the products of secretion.

Few questions have excited, greater attention than those relating to the nature of the fluids in vegetables. When wounds have been made in trees, it is found that the sap flows more copiously from the upper side, or that part of the wound which is nearest the branches. From whatever cause this may proceed, it seems to be intimately united with another fact. If a wound is made through the bark of a growing tree, the efflux which takes place to heal the wound is made from above. The lower lip of the wound remains shrivelled and inactive; and if the wound has been extensive, seems from year to year rather to suffer decay; the upper lip, on the contrary, becomes turgid, and extends itself downwards. This effort is particularly remarkable in wood which has suffered compression from the embrace of the honeysuckle. Dr. Darwin, in his Phytologia, attempts to explain this and other effects by the ingenious idea, that a tree is a complex being composed of many individuals; for he considers every bud of a tree as having an independent vegetative power. The effort above-mentioned he considers as caused by the buds of the tree sending down their vessels, and propelling their fluids towards the root. Yet it seems generally to have been concluded, that the sap rises upwards in the spring from the root towards the branches. Early in the season Dr. Hope made incisions of different alitudes into the root and stem of a plant, and observed that the superior margin of the lowest incision, and the inferior margin of the higher incisions, till at last it reached the highest. It does not appear, however, whether after the sap in this experiment proceeded from the root, or whether it was successively put in motion higher and higher as the process of vegetation took place; for the upper part of a tree and the essence of a leaf, and vegetation may on that account be removed. Dr. Hales cut off the stems of vines in the spring, and then by fixing tubes on the stumps, was able to ascertain with what force the sap was propagated. Much trials the sap rose to the height of 35 feet. Tubes have been fixed to the large arteries of animals, as near as possible to the heart, in which the blood did not rise higher than nine feet. Since being the force with which the juices of vegetables are propelled, it can scarcely be doubted that their sap is contained in vessels. Yet differences of opinion have arisen as to whether this particular modification of vegetable fluids have not been satisfactorily traced, it has been advanced that there exists no other circulation than a transmission of fluids through cellular substance. A circulation, however, so vigorous as to be capable of being vegetable, cannot be conceived to be conducted, except through a limited and well defined channel. It must be confessed, that considerable difficulties attend this inquiry, but the evidence of the fact, at least in the leaves of plants, is proved by the following simple experiment, which may be satisfactorily tried on plants having coloured sap. Tear a slender leaf, for instance, and the white fluid will be observed to flow from certain points which are doubtless the extremities of broken vessels.

From the experiments of Dr. Hales above-mentioned it appears, that the sap of the vine flows in a tube to 35 feet height as a column of water equal in weight to the atmosphere. The pressure of the atmosphere is known to assist animals in sucking; and whether some modification of the same power may not assist vegetable absorption, may be the subject of future inquiry.

Dr. Hales, in his botanical experiments, mentions several, in which he tried to change the natural flavour of fruits, and to complicate those of several spirituous liquors, and of different odoriferous infusions. With this intention he plunged in different liquors branches loaded with fruit, and left them there for some time without being the least perceivable that the taste of the fruits was in the least altered, whether the experiment was made upon ripe or unripe. But he almost always perceived the smell of the liquor in the head, and in the wood. He conjectures, with much probability, that the vessels near the fruit become so fine as not to admit the odoriferous particles.

Dr. Hales made experiments on flowers, similar to those which Dr. Hales made on fruits. He chose such flowers as have natural...
In the experiments of Dr. Priestley, that plants will bear a greater proportion of hydrogen than of carbonic acid air, and that oxygen gas appeared generally injurious to plants. A sprig of mist growing in water, placed over a fermenting and heated mass of rice, of course exposed to carbonic acid air, became quite dead in one day; a red rose became of a purple colour in 24 hrs. Plants die very soon both in nitrous air, and in common air when saturated with it. Air appears uniformly to have been purified by healthy plants vegetating in it; but these experiments require great nicety, as the least degree of purefaction will injure the air.

Atmospheric air is restored, after being injured by respiration or combustion, by a plant vegetating in it. This restoration of air depends upon the vegetating state of the plant; for a number of mint-leaves fresh-gathered being kept in air in which candles had burned out, did not restore the air. Any plant will effect this purpose, but those of the quickest growth in the most expeditious manner.

That plants have a property of producing pure air from water, is evident from an experiment of Dr. Priestley's. The green matter which is to be observed in water is doubtless a vegetable production. Water containing this green matter always afforded oxygen in a dark room; but water which had it not afforded none. It has been frequently observed that vegetables do not thrive in the dark. A receiver was therefore filled with water, and kept till it was in a dark room; when after this it was removed into a dark room, and from that time the production of air entirely ceased. When placed again in the sun, it afforded no air till about ten days after, when it had more green matter; the former plants being probably all dead, and no air could be produced till new ones were formed.

From various experiments it appeared that different animal and vegetable putrescent substances afforded a very copious pabulum for this green vegetable matter, which produced so freely the oxygen air; whence the philosophic author of this discovery is led to the following conclusions: "It is impossible," says he, "not to observe from these experiments the admirable provision in nature, to prevent or lessen the fatal effects of putrefaction; especially in hot countries, where the rays of the sun are most direct, and the heat most intense. Vegetable substances, by simply putrefying, would necessarily taint great masses of air, and render it unfit for respiration, did not the same substances, putrefying in water, supply a most abundant pabulum to this noble vegetable substance, the seeds of which seem to exist throughout the atmosphere. By these means, instead of the atmosphere being corrupted, a large quantity of the purest air is continually thrown into it. By the same means also, stagnant waters are rendered much less offensive and unwholesome than they would otherwise be. That froth which we observe on the surface of such waters, and which is apt to excite disgust, generally consists of the purest air, supplied by aquatic plants. When the sun shines, this air may be observed to issue from them. Even when animal and vegetable substances putrefy in water, they generally some moisture in them, various other vegetable productions, in the form of mold, &c. find a proper nutriment in them, and by converting a considerable part of the noxious effluvia into their own substance, afford in its progress to corrupt the atmosphere."

The same vegetables which afford oxygen uniformly to have been purified by healthy plants vegetating in it; but these experiments require great nicety, as the least degree of purefaction will injure the air. The air contained in the buildings of marine plants was found considerably purer than common air.

In French gardens, plants were also tested in the same manner; but the experiments were not equally successful.
air very plentifully in the light of the sun, affixed in the shade, the measure is far less than that of the atmosphere. This striking effect of light on vegetables is a strong argument in favour of the opinion, that the motion of the juices of vegetables is produced by vessels, which, like those of animals, possess a kind of sap, and are excited to action by stimulating stimuli.

The effect of vegetation in producing the oxygen air which was afforded in the preceding experiments, seemed in some measure due to the transpiration, which extruded vital air by immersing in water a variety of substances, as raw silk, cotton, wool, eider-down, hair, sheep's wool, travellings of linen, and human hair. He was led, from the result of these trials, to suspect that the pure air was merely separated from the water; and that any substance which would act by a capillary attraction, so as to separate the component parts of the water, would effect the production of this gas. He therefore procured a quantity of spun glass, which consists of minute tubes, and immersed it in water, but the quantity of pure air produced was very trifling. Hence he concludes, that the lower those substances which operate in producing pure air, and that it is not merely a mechanical separation of the component parts of water.

The light of lamps produced the same effect as the sun's light; air in great quantities was produced, and perfectly pure. Vegetables will also, with any strong light, produce oxygen as well as with the light of the sun. The air from silk was much superior to that from vegetables.

Plants have a remarkable sensibility to light; they unfold their flowers to the sun, they follow its course by turning on their stems, and are closed as soon as it disappears. Vegetables placed in rooms where they receive light only in one direction, always extend themselves that way. If they receive light in two directions, they direct their course towards the strongest. Trees growing in thick forests, where they only receive light from above, direct their branches upwards, and therefore become much taller and less spreading than such as stand single. This affection for light seems to explain the upright growth of vegetables, a curious phenomenon, too complex to be much attended to. It has been ascertained by repeated experiments, that the green colour of plants is entirely owing to light; for plants reared in the dark are well known to be perfectly white.

If we take a succulent plant, and express its juice, the liquor appears at first uniformly green; but allow it to stand, and the green colour separates from the watery fluid, and falls to the bottom in a sediment. If we collect the supernatant liquor, it will be found to be an oil, nature, for it does not dissolve in water; but it will in spirit of wine, or oil, to which it imparts a green colour. As the sun produces the green colour in plants, and as this resides in an oil, it was formerly concluded that light produces the oily matter of vegetables, and that it effects this by furnishing the principle of inflammability. The new chemical doctrines, however, afford a much more satisfactory explanation of the effect of the sun's rays in producing the oily matter in vegetables. Vegetable matter consists in general of carbon, hydrogen, and oxygen; the sun's ray produce a disengagement of the latter principle in the form of vital air, and the two former are the constitutive principles of oil.

M. Boulot made a series of experiments in order to ascertain whether the superior or the inferior surfaces of leaves have a greater share in performing perspiration. From the trials which he made, he concludes that the inferior surface of the leaf is in general by far the most active in this respect, though in one or two species of vegetables this difference was much less remarkable. The malow was the only vegetable the leaves of which perspired more by the upper than the inferior surface. The method which he employed to ascertain the comparative effect of the two surfaces was, to cover first one and then the other surface with oil. The leaves were then immersed in tubes filled with water, and the quantity of perspired matter was measured by the length of the tube emptied in a given time. The oil, by stopping up the pores, shut off the access of the surface to which it was applied. Some large leaves of the white mulberry-tree being kept suspended on water with their upper surfaces in contact with the fluid, failed in this way, as if being in a similar state, but with the inferior surface touching the water, were preserved green for nearly six months.

The sexual system has been the prevalent system of vegetation, and is it well known that the palm is of that class of vegetables which have flowers of different sexes on different trees. The peasants in the Levant, whether acquainted with this fact, or whether directed to the practice by accident alone, have been accustomed to break branches from the male palm while in flower, and attach them to the female plant, which they find to be constantly productive of abundant fruit. This fact has also been proved by a most decisive experiment of M. Geditsch. There was in the royal garden at Berlin a beautiful palm-tree, a female plant, which, however, though 20 years old, had never been able to set any fruit, which was another palm at Leipsic of the male kind, which blossomed every year. The ingenious botanist undertook to fecundate the palm at Berlin from that at Leipsic, and laid hold of the blossom. The consequence was, that he produced that season excellent dates; and the experiment, prosecuted with some variation for several succeeding years, was attended with the same success.

It has been said, that the pollen was destined for the impregnation of the germens. This is performed in the following manner: The anthers, which open on the opening of the flower are whole, burst soon after, and discharge the pollen. Being dispersed about the flower, part of the pollen lodges on the surface of the stigma, where it is detained by the strum and stigma, which general defines the stigma, and is supposed to discharge the pollen. Being dispersed about the flower, part of the pollen lodges on the surface of the stigma, where it is detained by the moisture which the part that is covered. Each single grain or atom of the pollen has been observed by the microscope to burst in this fluid, and is supposed to discharge something which impregnates the germens. What the substance is which is so discharged, and whether it actually passes through the style into the germens, still undetermined, from the great difficulty of observing such minute parts and operations. In some vegetables, the stigma moves towards the pistil, and a very evident motion of oil is observed in the flowers of the common berbery, on touching them with the point of a pin.

As vegetables, like animals, are liable to decline, and ultimately to perish by age, the offices of the parts of vegetation are of the most important nature. If trees had been capable of increase only by grafts, layers, or cuttings, it seems probable that they would have long ago been lost. An ingenious and philosophical botanist, Mr. Knight, has particularized several sorts of apples, which a century ago were extremely thriving and in high repute, some of which are at this time wholly lost, and others are in such a state of decline and imperfection as to be little esteemed. By the fertility of seeds, however, new varieties of this as well as of all other fruits and trees are continually produced. A tree produced from a cutting exactly resembles the parent plant; not so one raised from a seed, which is derived from the origin of more than one parent, and in deciduous plants must always do so. Hence the endless variety which interest the florist. When this cause is considered as having operated for ages, we cannot wonder at the diversified appearances which we observe in a bed of seedling plants. Mr. Knight strongly advises to take grafts from individuals lately raised from seeds, which he asserts are possessed of a vigour and beauty, not to be found with old varieties. Strawberries and potatoes also become unproductive, unless the old varieties are replaced by others raised from seed.

The nourishment of vegetables, as it is so intimately connected with the important science of agriculture, has deservedly attracted considerable attention. Mr. Boyle dried in an oven a quantity of earth proper for vegetation, and after carefully weighing it, planted in the seed of a gourd; he watered it with pure rain-water, and it produced a plant which weighed fourteen pounds, though the earth had suffered no sensible diminution.

A willow-tree was planted by Van Helmont in a pot containing 100 pounds of earth. This was in general watered with distilled water, or sometimes with rain-water which appeared perfectly pure. The vessel containing the plant was covered in such a manner as to totally exclude the entrance of all solid matter. At the end of five years, upon taking out the plant, he found it to have increased in weight not less than 110 pounds, though the earth had lost only two ounces of its original weight.

These experiments would admit of some doubt, and must have remained in a great measure inexplicable, but for the experiments of Mr. Cavendish, and the facts related by Dr. Priestley, which place it beyond a doubt, that vegetables have a power of decomposing water, and converting it, with what they derive from the atmosphere, into almost all the essential matters found to exist in their substance.

All the proper juices of vegetables depend on the organization, as it is evident from the operation of grafting. From the materials of
simple water and air, are produced those wonderful diversities of peculiar juices and fruits, which the vegetable world affords; and the immense variety of tastes, smells, &c. In the same vegetable what a variety is found! The bark is different in taste from the wood, the peculiar juices have something different from them both, and the pith of some plants affords a matter which could not have been expected from their exterior qualities. This is often different from the stem, and the fruit from both, in all their sensible qualities.

In whatever way the nourishment of vegetables is received, it may fairly be said to consist principally of oxygen, which, in the plant, is contained in the earth, air, and water. The hypothesis is doubtless true to a certain extent, especially when it is considered that carbon forms a great part of many manures. However, this does not mean that manures act by bringing soils to such a condition as is favourable to the growth of the roots of vegetables, and to the affording of them water in a proper quantity. A third opinion is, that manures act chiefly by bringing soils to such a condition as is favourable to the growth of vegetables, and thus excite them to more vigorous action. Some authors think that manures act as solvents on matters previously contained in the soil, and thus fit them for entering the roots of plants; and others, that they act specifically, by forming combinations which are favourable to vegetation. Which of these hypotheses is best founded, it is difficult to determine; but the former does not seem unlikely that they may all have some foundation in fact.

When we attempt to discover the component principles of the objects around us, and the sources where they were supplied, we are lost in the greatness and diversity of the scenes presented to us. We see animals nourished by vegetables, vegetables apparently by the remains of animals, and fossils composed of the relics of both of these kingdoms. It seems certain, however, that vegetables preceded animals. A seed of moss lodging in a crevice of a bare rock is nourished by the atmosphere, and the moisture afforded by the rains and dew. It comes to perfection, and sheds its seeds in the mouldering remains of its own substance. Its offspring do the same, till a crust of vegetable mould is formed sufficiently thick for the support of several and other vegetables of the same growth. The same process going forward, shrubs, and lastly the largest trees, may find a firm support on the once barren rock, and bear the efforts of the tempest.

From the advantages derived from a change of crops in agriculture, it has been supposed that different vegetables derive different kinds of nourishment from the same soil, selecting what is best adapted to their own support, and leaving a supply of nourishment of another kind for vegetables of another genus. Was this, however, the case, vegetables would not so much impede each other's portion of the soil, as to contribute to the operation of grazing, we have a clear proof that the juices received by the root of a single tree may, by the organization of the inserted twig, be subservient to the growth of a plant of a different kind. The advantage derived from a change of crops may be better explained on other principles: some plants extend their roots horizontally on the surface of the soil, others send them down to a considerable depth. Some plants are found to bind or harden the soil, others to loosen it. Thus, for example, wheat and rye-grass render a soil stiff; while pulse, clover, and turnips, by permeating the crop, therefore, the soil is preserved in a middle state, between too much stiffness and too much friability. Nor is this the only good effect arising from this difference of roots. From this circumstance some vegetables draw their nourishment from the surface of the earth, while others derive it partly from a greater depth; so that by a change of crops, a larger portion of the soil is insured to derive the nourishment of plants than could have been effected by the cultivation of any single species. One other advantage to be derived from a change of crops is this: Some plants exhaust the soil more readily than others, and of course exhaust the soil of others, and may thereby very much contribute to the growth of vegetables, which thrive in the same soil, and hence become much exhausted. Other plants, which derive a large proportion of their nourishment from the air, by such means the soil will be much less exhausted, and under a crop of them will be so nourished as not to become exhausted. The good effects of a change of crops may therefore be sufficiently explained, without supposing that each particular species of vegetables is nourished by a different kind of soil. This is also necessarily attended with two great difficulties; one is, that there exists in every soil as many distinct kinds of nourishment as there are species of plants capable of growing in that soil; the other, that plants are endowed with the faculty of selecting, from all these kinds, their own proper nourishment. The former of these explanations is too absurd to merit the least attention; and the latter has been disproved by actual experiment, since plants are not able to prevent their roots from absorbing such matters as prove poisonous to them.

Other writers, however, have been more moderate; and though they have rejected the idea of specific nourishment in general, have nevertheless imagined that the hypothesis might be well founded with respect to particular species of vegetables. This is drawn from the existence of specific manures, as for salt, for saffron, ashes for white clover, and some others. It does not seem possible, however, to draw a line of distinction; and it is to reject the idea of a specific nourishment in general, we cannot admit it in particular instances.

In order to discover whether plants have an actual power of distinguishing matters presented to their roots, a gentleman of science made, among others, the following experiment.

A vigorous plant of mint was placed in a two-ounce phial, filled with filtrated well-water, to which were added four drops of a moderately strong solution of sulphate of iron. On examining the plant the following day, no other effect was observed, than that the very tips of the radicles were whitened and blackened. Four more drops of the solution were now added. On the third day the appearances were the same; a change taking place on the fourth, twelve more drops of the solution were added. On the fifth day the roots appeared of a yellowish-green colour, and the top dropped very much. The larger leaves were pretty much withered and blackened. The absorption of the water appeared to be in some measure impeded, but not entirely prevented. On the sixth day the whole plant was withering very fast; the roots became of a dark olive-green colour, and the larger leaves became very black, especially the footstalks and the projecting fibres. On the seventh day the blackness had made still further progress, and the plant was dead. A sufficient proof that some of the iron was absorbed by the plant, may be drawn from the following circumstance: its leaves, when macerated in distilled water, produced a black galls. The leaves of a plant of mint, which had been nourished by water alone, when tried by the same test, produced no colour whatever. This experiment proves two points; that plants have not the power of detecting even injurious matters when presented to their roots, and that other matters beside water and air are capable of being absorbed by them.

The benefit produced by the common custom of letting lands lie fallow, has not yet been satisfactorily explained. Some may doubt that it is attributed to the destruction of weeds, but more probably to some change produced in the soil by its being exposed to the action of the sun and air. The management of nitre-beds may tend to some light on this subject. These are composed of calcareous earth and dung cemented together. After being exposed for some months to the air, they are found to contain a quantity of nitric acid, which, uniting to the calcareous earth, forms a kind of salt, which is extracted by lixiviation. Now calcareous earth and dung are two of the most powerful manures known; and it does not seem improbable that their fertilizing powers may be in some manner connected with their property of affording nitric acid.
Vegetable substances. Plants contain various saline matters; such as the vegetable acids, and the three alkalies, ammonia, potash, and soda; also gun, sugar, fat oils, essential oils, balsams, camphor, resin, tar, fatma, narcotic, and colouring matters; all which the reader will find treated of under their respective heads. But different kinds of plants contain matters peculiar to themselves, which, an ingenious and profound chemist (2) has observed, can be reduced to a general term extractive principle, and to which he ascribes the following general properties: 1. Soluble in water, and the solution is always coloured. When the water is slowly evaporated, the extractive matter is obtained in a solid state, and transparent; but when the evaporation is rapid the matter is opaque. 2. The taste of extractive is always strong; but it is very difficult to precipitate from the plant from which it is obtained. 3. Soluble in alcohol, but insoluble in ether. 4. By repeated solutions and evaporations, the extractive matter acquires a deeper colour, and soluble in water which has been changed is considered as the consequence of the absorption of the oxygen of the atmosphere, for which the extractive principle has a strong affinity; but if the solution is left to itself, it becomes muriatic oxide, the extractive matter is totally destroyed in consequence of a kind of putrefaction which speedily commences. 5. When oxymuriatic acid is poured into a solution containing the extractive, a very copious dark-yellow precipitate is thrown down, and the liquid retains but a light lemon-colour. These flakes are the oxyzed extractive. It is now insoluble in water; but hot alcohol still dissolves it. 6. The extractive principle unites with alumina, and forms with it an insoluble compound. Accordingly, if sulphat or muriat of alumina is mixed with a solution of extractive, a flaky insoluble precipitate appears, at least when the liquid is boiled; but if an excess of acid is present, the precipitate does not always appear. 7. It is precipitated from water by concentrated sulphuric acid, muriatic acid, and probably by several other acids. 8. Extractive readily unites with extractive, and form compounds which are soluble in water. The greater number of metallic oxides form insoluble compounds with extractive. Hence many of them, when thrown into its solution, are capable of separating it from water. Hence also the metallic salts mostly precipitate extractive. Muriat of tin possesses this property in an eminent degree. It throws down a brown powder, perfectly insoluble, composed of the oxide of tin and vegetable matter. 10. If wool, cotton, or burlap is impregnated with alum, and then plunged into a solution of extractive, they are dyed of a fawn-brown colour, and the liquid loses much of its extractive matter. This colour is permanent. The same dye is obtained if muriat of tin is employed instead of alum. This effect is still more complete if the cloth is soaked in oxymuriatic acid, and then dip into the infusion of extractive. We see then that this extractive matter requires no other mordant than oxygen to fix it on cloth. 11. When distilled, extractive yields an acid liquid impregnated with ammonia. It cannot be doubted that there are many different species of extractive matters; though the difficulty of obtaining each separately has prevented chemists from ascertaining its nature with precision. Extracts in pharmacy are usually obtained by treating the vegetable substance from which they are to be derived with water, and then evaporating the watery solution slowly to dryness. All extracts obtained by this method have an acid taste, and reddened the infusion of litmus. They all yield a precipitate when mixed with liquid, if they are mixed with oxymuriatic acid. This precipitate is a compound of lime and insoluble extractive. Lime always causes them to exude the odour of ammonia. It has been ascertained that the extractive principle is more abundant in plants that have grown to maturity than in young plants.

As the extracts of vegetables prepared by apothecaries for medical purposes, besides the extractive principle, always contain other bodies, frequently to the number of eight or more, and as the greater number of them are still imperfectly examined, we shall satisfy ourselves at present with pointing out some of the vegetable substances which have been ascertained to have an extractive principle, and stating the constituents of such as have been analysed.

1. Extractive principle is not an uncommon ingredient in the sap of trees. Indeed, Deveaux and Vauquelin found it in almost all those which they examined. It is usually thrown down when the sap is mixed with oxymuriatic acid, and it precipitates in brown flakes while the sap is evaporating on a sand-bath.

2. It forms a constituent of the bark of all trees hitherto examined. This was evidently the case with all the barks which Mr. Davy subjected to experiment, namely, those of the oak, Leicester willow, Spanish chestnut, elm, common willow, and undoubtedly all barks which have an astringent taste; for tan and extractive seem scarcely ever to be found separate.

3. The infusion of catechu contains an extractive principle, which is chiefly to tan. It may be obtained in a state of purity by washing the catechu in powder repeatedly with water till the fluids obtained cease to precipitate gelatine. What remains is extractive. It is of a pale red-brown colour, and a slightly astringent taste, leaving in the mouth a sensation of sweetness. It has no smell. Its solution in water is at first yellow-brown; but it acquires a tint of red when left exposed to the air. The solution in alcohol is of a dirty brown. It does not affect vegetable blues. Alkalies brighten its colour; but neither these bodies nor the alkaline earths previous to the addition of extractive. Nitrate of alumina and muriat of tin render the solution slightly turbid. Nitrate of lead throws down a dense light-brown precipitate. It renders the oxyluplat of iron green, and throws down a green precipitate, becoming black by exposure to the air. Linen, when boiled in the solution, takes away almost the whole of the extractive, and acquires a light red-brown colour. When this solution is evaporated, it is exposed to heat, it softens, and if its extractive matter is dried, but it does not melt. When distilled, it yields carbonic and carbureted hydrogen gas, weak acetic acid, and a little unaltered extractive. A porous charcoal remains.

4. The infusion of senna contains a matter of a very peculiar nature, but which may be considered as a species of extractive. The senna of commerce consists of the dried leaves of the cassia senna, a shrublike annual, cultivated in Egypt. Water, at the ordinary temperature of the atmosphere, dissolves nearly one-half of the substance of these leaves. The infusion obtained has a brown colour, a bitter taste, and a peculiar aromatic odour. It contains a considerable proportion of carbonat of lime, sulphat of potas, and carbonat of magnesia, besides a little sili-

5. The infusion of Burman balsam, Phylica lancea, similar to the senna, is very abundant in extractive matter, which, as previous to the addition of extractive becomes a yellow-coloured precipitate: the same substance is thrown down immediately by muriatic acid and oxymuriatic acid. It appears also when a current of oxygen gas is made to traverse the infusion. This substance is the extractive altered by its combination with oxygen. It has a slight bitter taste. It is no longer soluble in water. Alcohol dissolves it, but lets it fall when diluted. The extractive is not precipitated by red-brown solution. On burning coals, it emits a thick smoke, exhalts an aromatic odour, and leaves a spongy charcoal. These properties indicate a very decided approach to the animal state. 6. Saffron yields extractive matter in great abundance. This substance consists of the summits of the spikes of the crocus sativus. Almost the whole of it is soluble in water.

7. The resemblance between extractive bodies and the colouring matter of plants is sufficiently striking. It is more than probable, that when this last set of bodies have been examined with more precision by chemists, they will be found to belong to the same class.
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for these at the deep distances, their places must be supplied with common stakes of dead wood, the trick in this is to: first, cut away all those shoots which are intended to be used either as stakes or the other work of the plashing; the ditch is to be cleaned out with hard balls and the noise dug at as first, with sloping sides each way; and when there is any cavity on the bank on which the hedge grows, or the earth has been washed away from the roots of the shrub, it is to be made good by facing it, as they express it, with the mould dug from the upper part of the ditch; the rest of the earth dug out of the ditch is to be laid upon the top of the bank, and the owner should look carefully into it that this is done; for the workmen, to spare themselves trouble, are apt to throw as much as they can upon the face of the bank; which being by this means overcharged, is soon washed out of the ditch again, and a very great part of the work undone; whereas, what is laid on the top of the bank always remains there, and makes a good foundation of an indifferent hedge.

PLASTER. See Pharmacy.

Plasters are combinations of oils and metals, designed to be spread upon leather or cloth, and in that state to be applied as a covering of ulcers, &c. They ought to be solid bodies, not so hard as to resist spread and equally, nor so soft as to run into oil when heated by the skin. They ought to admit of being easily kneaded when heated with the hand, to adhere firmly to the skin, but to be capable of being removed without leaving behind them any gum. Without these properties they do not answer the purpose for which they are designed, which is chiefly adhesion.

The only chemist who has hitherto examined plasters with attention is Deyouc, to whom we are indebted for some excellent observations on the method of preparing them.

The oxides hitherto employed for making plasters are those of lead, and litharge is now frequently considered as the best adapted for that purpose, of any of these oxides. But the oxides of several of the other metals, as bismuth and mercury, are also capable of forming plasters, and might perhaps in some cases be preferred with advantage, especially if metallic oxides, however, as those of iron, are not susceptible of that kind of combination with oils which constitutes plasters.

All the fixed oils are capable of forming plasters; but they do not all form plasters with the same properties. The drying oils, linseed-oil for instance, form plasters of a much softer consistence than the fat oils; but these last acquire the same properties as the drying oils, if they are combined with metallic oxidation. Thus olive-oil, boiled for some time with linseed or fenugreek, forms with litharge plasters as soft as those composed of linseed-oil and litharge. According to Deyouc, olive-oil answers better for plasters than any other.

There are three different ways of forming plasters. The first consists in simply mixing together the ingredients in proper proportion, and allowing the mixture to remain a considerable time in the common temperature of the atmosphere, agitating it occasionally. The oxide gradually loses its colour, and combines with the oil, and the mixture acquires consistence. This process is tedious, and does of chance. Plasters sufficiently solid to answer the purposes for which they are intended, is not therefore employed.

The second method consists in throwing the oxide into the oil with boiling. Plasters formed by this process have always a deep colour, and a peculiar odour, occasioned by the decomposition of a portion of the oil. This process is followed, it is necessary that the mixture be kept in a well-stirred state, and that they agitate it should be made to combine with the oil as fast as possible, otherwise the metal will be revived altogether, in consequence of the strong tendency which oil has to combine with oxygen when raised to a high temperature.

The third method is most frequently practised, because it is not liable to the same inconveniences as the other two. This method consists in boiling the oil and the oxide together in a sufficient quantity of water. By this liquid the heat is moderated at first till the oil and oxide combine, which prevents the revival of the metal which is marked. While the water is dissipated, the temperature is sufficiently high to give the plaster the requisite consistence.

Plasters, when long kept, become often too hard to be capable of using, especially if the requisite proportion of oil has not been employed at first. This defect is easily remedied, by melting them with a small portion of new oil.

Plasters, when long kept, likewise change their colour, and acquire unpleasant properties; owing either to the absorption of oxygen, or to some change produced in their component parts by the action of the air.

PLASTIC, the plastic art, a branch of sculpture, being the art of forming figures of men, birds, beasts, fishes, &c. in plaster, clay, stucco, or the like. See Sculpture.

Plastic differs from carving in this, that the figures are made by the addition of what is wanting; but in carving always by subtracting what is superfluous. The plastic art is now chiefly used among us in fret-work ceilings; but the Italians apply it also to the modeling of the heads of statues. See Sculpture, PLATANUS, the plane-tree, a genus of the polyandria order, in the monoecea class of plants. The male calyx is an amen, globular; corolla scarcely apparent; anthers growing out of the calyx, the calyx anem, globular; corolla many-petalled; stigma removed; seeds roundish, marcomate with the style, pappose at the base. The species are: 1. The orientalis, oriental or Eastern plane-tree, rises with a very straight smooth branching stem to a great height. It has palmated leaves, six or eight inches long and as much broad, divided into five large segments; having the sides cut into two smaller, green above, and pale underneath; and long pedunculous pedunculi, each sustaining several round heads of close-sitting very small flowers; succeeded by numerous downy seeds, collected into round, rough, hard balls, it is a native of Asia and many parts of the East, and grows in great plenty in the Levant.

2. The occidentalis, occidental or Western plane-tree, rises likewise to a smooth stem to a great height, branching widely round; it has lobated leaves, seven or eight inches long, and from nine to ten or twelve to fourteen broad, divided into three large lobes; and very wide; the round heads, succeeded by round rough balls of seed. It is a native of Virginia and other parts of North America, where it attains an enormous size, and is remarkable for having
its stem all of an equal girt for a considerable length, we have an account of some trees being eight or nine yards in circumference, and which, when felled, afforded twenty loads of wood.

The varieties of these two species are the Spanish or middle plane-tree, having remarkably large leaves of three or five, narrower segments; and the simple-leaved plane-tree, having smaller leaves, somewhat lobated into five segments, resembling the maple-tree leaf.

All these elegant trees are of hardy temperance, so as to prosper here in any common soil and exposure in our open plantations, &c. and are some of the most desirable trees of the deciduous tribe. Their propagation is by seed, layers, and cuttings. All the sorts will take tolerably by cutting off the strong young shoots; but the platinae occur at this time more freely than the oriental kind. Autumn is the best season: as soon as the leaf falls, choose strong young shoots, and plant them in a moist soil; in a year or two, they will grow and make tolerable plants by next autumn.

PLATBAND, or window, is used for the lintel, where that is made square, or not much arched: these platbands are usually made of a slice of timber when they have a great bearing, but it is much better to ease them by arches of discharge built over them.

PLATFORM, in the military art, an elevation of earth, on which cannon is placed to fire on the enemy; such are the mounts in the middle of courts. On the rampart, there is always a platform, where the cannon are mounted. It is made by the heaping up of earth on the rampart; or by an arrangement of matting, rising insensibly, for the cannon to roll on, either in a casemate or on attack in the outworks. All practitioners are agreed that no shot can be depended on, unless the piece can be placed on a solid platform; for if the platform shakes with the first impulse of the powder, the piece most likely shake, which will alter its direction, and render the shot uncertain.

PLATFORM, or ORLOP, in a ship of war, a place on the lower deck, abaft the main-mast, between it and the cockpit, and round about the main capstan, where provision is made for the wounded men in time of action.

PLATINA. See PLATINUM.

PLATING, is the art of covering base metals with a thin plate of silver either for use or for ornament. It is said to have been invented by a spur-maker, not for show but for real utility. Till then the more elegant spurs in common use were made of solid silver; and from the flexibility of that metal, they were liable to be bent into inconvenient forms by the slightest accident. To remedy this defect, a workman at Birmingham contrived to make the branches of a pair of hollow spurs, and to fill that hollow with a slender rod of steel or iron. Finding this a great improvement, and being desirous to add cheapness to utility, he continued to make the hollow longer, and of course the iron thicker, till at last he discovered the means of coating an iron spur with silver in such a manner as to make it equally elegant with those which were made wholly of that metal. The invention was quickly applied to all other purposes; and to numberless utensils which were formerly made of brass or iron are now given the strength of these metals, and the elegance of silver, for a small additional expense.

The silver plate was formerly made to adhere to the base metal by means of solder, which is of two kinds, the soft and the hard, or the tin and silver solders. The former of these consists of about a quarter of a part of silver and one of brass. When a buckle, for instance, is to be plated by means of the soft solder, the ring, before it is bent, is first turned, and then the silver plate is gently laid upon it, the hammer being employed always covered with a piece of cloth. The silver now forms, as it were, a mould to the ring, and whatever of it is not intended to be used is cut off. This mould is fastened to the ring of the buckle by two or three cramps of iron wire; after which the buckle, with the plated side underneath, is laid upon a plate of iron sufficiently hot to melt the tin, but not the silver. The buckle is then covered with powdered resin, or anointed with turpentine; and lest there should be a deficiency of tin, a small portion of rolled tin is likewise melted on it. The tin being thus melted, it is allowed to cool, and is then laid on a bed of sand; where the plate and the ring, while the solder is yet in a state of fusion, are more closely compressed by a smart stroke with a block of wood. The buckle is afterwards bent and finished.

The mode of plating at present, is to fasten plates of silver upon thicker plates of copper, and then rolling them together into thin plates of copper, which are closely worked with silver, and have a similar thickness to the silver, and one ounce of silver is rolled to a surface of three feet or more. The plates being thus made, they are then stamped by a single stroke into the size and form of buckles, buttons, spurs, &c.

PLATINUM, one of the perfect metals, has hitherto been found only in Peru, and in the mine Santa Fe, near Carthagena. The workmen of these mines must no doubt have smelted the custom of different metals, and have been in search of a metal which is more stable than the silver, and one ounce of silver is rolled to a surface of three feet or more. The platinum, being thus made, they are then stamped by a single stroke into the size and form of buckles, buttons, spurs, &c.

The Men of the Philosophical Transactions. These immediately attracted the attention of the most eminent chemists. In 1752, Mr. Scheffer of Sweden published the first accurate examination of its properties. He proved it to be a new metal, approaching very much to the nature of gold, and therefore gave it the name of aurum album, white gold.

1. Platinum, when pure, is of a white colour, but not so brittle. It has no taste or smell.

2. Its hardness is 8. Its specific gravity, after being hammered, is 23,000; so that it is more than double the weight of all the other metals. It is exceedingly ductile and malleable: it may be hammered out into very thin plates, and drawn into wires not exceeding 1/12 inch in diameter. In these properties it is probably inferior to gold, but it seems to surpass all the other metals.

3. Its tensity is such, that a wire of platinum 0.078 inch in diameter, is capable of supporting a weight of 274.31 lbs. without breaking.

5. It is the most insusceptible of all metals, and cannot be melted, in any quantity at least, by the strongest artificial heat which can be produced. Macquer and Boume met small particles of it by means of a blow pipe, and Lauron by exposing them on red hot coal, to a stream of oxygen gas. It may indeed be melted without difficulty when combined or mixed with other bodies; but then it is not in a state of purity. Pieces of platinum, when heated to whiteness, may be welded together by hammering in the same manner as hot iron.

6. This metal is not in the smallest degree altered by the weather.

11. It cannot be combined with oxygen and converted into an oxide by the strongest artificial heat of our furnaces. Platinum, indeed, in the state in which it is brought from America, may be partially oxidized by exposure to a violet heat, as numerous experiments have proved; but in that state it is not pure, but combined with a quantity of iron. It cannot be oxidized, however, that if reduced to a metallic state, platinum would burn and be oxidized like other metals: for when Van Marum exposed a wire of platinum to the action of his powerful electrical machine, it burned with a white flame, and was dissipated into a species of dust, which proved to be the oxide of platinum. By putting a platinum wire into the flame produced by the combustion of hydrochloric acid and oxygen, it would burn with all the brilliance of iron wire, and emit sparks in abundance. This metal may be oxidized in any quantity by boiling in 16 times its weight of nitro-muriatic acid, and in hot aqua regia without difficulty. It is probably not more than 0.67: it is in all probability 0.666.

This oxide may be decomposed, and the oxygen driven off, by exposing it to violent heat.

III. Neither carbon nor hydrogen can be combined with platinum; but M. Trousset has found it combined with sulphur in native platinum, and it unites without difficulty to phosphorus. By mixing together an ounce of platinum, an ounce of phosphoric glass, and a dram of powdered charcoal, and applying a heat of about 327° Wedgworth, M. Pelletier formed a phosphuret of platinum weighing more than an ounce. It was partly in the form of a button, and partly in cubic crystals. It was covered above by a blackish glass. It was of a silver-white colour, very brittle, and hard enough to strike fire with steel. When exposed to a fire strong enough to melt it, the phosphorus was disengaged, and burnt on the surface.

He found also, that when phosphorus was projected on red hot platinum, the metal instantly fused, and formed a phosphuret. As heat expels the phosphorus, M. Pelletier has proposed this as an easy method of purifying platinum.

IV. Platinum, as far as is known, does not combine with the simple incombustibles.
PLATONIC YEAR, or the GREAT YEAR, is a period of time determined by the revolution of the equinoxes, or the space wherein the stars and constellations return to their former places in respect of the equinoxes. The Platonic year, according to Tycho Brahe, is 25816, according to Riccioli 25920, according to Carter in years. PLATOON, in the military art, a small square body of forty or fifty men, drawn out of a battalion of foot, and placed between the squadrons of horse, to sustain them; or in ambuscades, straws, and defiles, where there is no room for whole battalions or regiments. Platoons are also used when they form the hollow square, to strengthen the angles. The grenadiers are generally posted in this manner.

PLATYLOBIUM, a genus of the diadelphi decandra class and order. The calyx is bell-shaped, five-elec, the two upper segments very large; legume pedicelled, compressed, winged at the back. There is one species, a shrub of South Wales. PLATYPUS, a quadrapled of the order of bruta. The generative is, mouth shaped like the bill of a duck; feet webbed. Of this extraordinary genus two specimens have been sent from New Holland to sir Joseph Banks by governor Hunter. Of all the mammalhia yet known, this seems the most extraordinary in its conformation; exhibiting the principal resemblances, the mouth, mouthparts and feet, of a duck or a swan. The body is depressed, and has some resemblance to that of an otter in miniature. It is covered with a very thick, soft, and beaver-like fur, and is of a moderately dark brown above, and of a subferruginous white beneath. The head is flatish, and rather small, the ears small, the nose very small, as before observed, so exactly resembles that of some broad-billed species of duck, that it might be mistaken for such: round the base is a flat circular membrane, somewhat deeper or wider below than above, viz. below nearly the fifth of an inch, and above about an eighth. The tail is flat, furry like the body, rather short and obtuse, with an almost bifid termination; it is broader at the base, and gradually lessens to the tip, and is about three inches in length. The colour is similar to that of the body. The length of the whole animal from the tip of the beak to that of the tail is 13 inches; of the beak an inch and a half. The legs are very short, terminating in a hoof. Each foot extends to a considerable distance beyond the claws; but on the hind-feets reaches no farther than the roots of the claws. On the fore-foet are five claws, straight, strong, and sharp-pointed; the two exterior ones somewhat shorter than the three middle ones. On the hind-feet are six claws, longer and more extending to a curved form than those on the fore-feet; in the lower part of each are imbedded the toes, and the interior six is seated much higher up than the rest, and resembles a strong sharp spur. All the legs are hairy above; the fore-feet are naked above and below; but the hind-feet are hairy above, and naked below. The internal edges of the under mandible (which is narrower than the upper) are serrated or channeled with numerous strig, as in a duck. The nostrils are, one on each side, round, and are situated about a quarter of an inch from the tip of the bill, and are about the eighth of an inch distant from each other. There is no appearance of teeth; the plate is removed, but seems to have resembled that of a duck; the tongue also is wanting in the specimen. The ears, or auditory foramina, are placed about an inch beyond the eyes, and are of the size of a pair of oval holes, of the eighth of an inch in diameter, there being no external ear. On the upper part of the head, on each side, a little below the beak, are situated two small oval white spots; in the lower part of each of which are imbedded the eyes, or at least the parts allot- ted to the animal for some kind of vision; for from the thickness of the fur, and the smallness of the organs, they seem to have been but weakly calculated for distinct vi- sion, and are probably like those of moles, and some other animals of that tribe; or perhaps even subcutaneous; the whole apparent diameter of the eye on which they were placed not exceeding the tenth of an inch.

When we consider the gener. I form.of this animal, and particularly its bill and webbed feet, we shall readily perceive that it must be a resident in watery situations; that it has the habits of digging or burrowing in the banks of rivers or under ground; and that its food consists of aquatic plants and animals. This is all that can at present be reasonably guessed at: future observations, made in its native region, will, it is hoped, afford us more ample information, and will make us fully acquainted with the natural history of an ani- mal whose habits are so widely from all other quadrapeds, and which verities, in a most striking manner, the observation of Buffon, viz. that whatever was possible for nature to produce, has actually been produced.

The platypus is a native of Australia or New Holland.

PLEA, that which either party alleges for himself in court. These are divided into pleas of the crown and common pleas.

The crown plea is by the king's name, against omissions committed against his crown and dignity, or against his crown and peace. Common pleas are those that are held between common persons.

Common pleas are either dilatory, or pleas to the action.

Pleas dilatory are such as tend merely to delay or put off the suit, by questioning the propriety of the remedy rather than by destroying the injury.

Pleas to the action are such as dispute the very materia; as 4 Black. 301. See Tolke K. B. Practice.

PLEADINGS, in general, signify the allega- tions of parties to suits when they are put into a proper and legal form; and are dis- tinguished in respect of the parties who plead them, by the names of bars, replications, sur-rejoinders, rebutters, sur-rebutters, &c. and through the matter in the bulk. There are five proper cases, of which properly come under the name of pleading, ye, being often comprehended in the extended sense of the word, it is generally considered under this head. See Tolke's K. B. Practice.

PLEBISCTITUM, in Roman antiquity, a large number of plebeians, or groups of people, at the request of the tribune, or other plebeian magistrates, without the intervention of the se- nate.

PLECRANTHUS, a genus of the gynopsmorpha order, in the diantha class of plants, and in the natural method ranking under the 42d order, verticillata. The calyx is monophyllous, short, and bilabiated; the upper lip of which is ovate, and bent upwards; the interior lip is quadrifid, and divided into two lacinia; the corolla is monopetalous, ringed, and turned back; the tube takes different ways, and from the base of the tube there is a gland, or like a spur; the filaments are in a declining situation, with simple anthera; the stylos filiform; the stigma bifid. It has four seeds, covered only by the calyx. It is a native of various species; the fruticosus is a native of the Cape of Good Hope; the punctatus is a native of Africa. The first flowers from June to September, the latter from January to May.

PLECTROMIA, a genus of the class and order penicillata, or the crown. There are five species; berry two-seeded, inferior. There is one species, a tree of the Cape.

PLEIADUS, in astronomy, an assemblage of stars in the neck of the constellation Tau- rus. See ASTRONOMY.

PLENE ADMINISTRAVIT, a plea pleaded by an executor or administrator, where they have administered the deceased's estate faithfully and justly before the action brought against them.

PLENUM, in physics, denotes, according to the Cartesians, that state of things wherein every part of space is supposed to be full of matter; in opposition to a vacuum.

PLENUS FLOS. See BOTANY, Vol. I. PLE.

PLETHORA. See MEDICINE.

PLEURA. See ANATOMY.

PLEURISY. See Medicine.

PLEURONECTES, r. A genus of fishes of the order thurosum, of which there are several species. Two unique comprises, one side representing the back, and the other the head.

The singular structure of this genus is justly considered as one of the most curious devia-
tions from the general uniformity or regularity observed by nature in the external figure of animals, in which (except in a very few instances) both sides of the body are perfectly similar; but in the genus Pleuronectes, the animal is considered as one side appearing to represent the back, and the opposite side the abdomen. They swim laterally, and the eyes are always placed on one side. It is from this circumstance that the division of the species is eviscerated, viz. into those which have the eyes destitute, or towards the right, when the fish is laid with its coloured side upwards with its abdomen towards the spectator; and sinistrius when the eye is turned to the left in the above situation of the fish. It is said, however, that instances have sometimes occurred in which this natural situation has been reversed; but such instances must be considered as extremely rare.

1. Pleuronectes hippocampus, holibut, with eyes towards the right. This species not only exceeds in size all the rest of the present genus, but may even be considered as one of the best of fishes; having been sometimes found of the weight of three, and even, according to some accounts, four hundred pounds. It is a native of the Mediterranean, and, appears to arrive at its greatest size in the latter. It is considered as the most voracious of its tribe; preying on a variety of other fishes, as well as on different kinds of crabs, shell-fish, &c. The holibut is, however, a larger or more slender form than most other flat fishes: its colour is deep-brown above, and white beneath; the body being quite smooth, and covered with moderately large scales. As a food it is considered as very coarse in comparison with many others of this genus. In the fisheries it is usually cut into large pieces when exposed to sale. The Greenlanders are said to cut it into thin slices, which they dry in the sun, and preserve for winter use.

2. Pleuronectes platessa, plaice. This species is, in general, easily distinguished at first sight from the genus by its shapeliness and the long hours of being regularly round and of a fine, pale brownish above, marked both on the body and fins by pretty numerous, but rather distant, round, and moderately large, orange-coloured spots; the side under side is white; the hind part of the fish is round; it is a row of six tubercles, reaching as far as the commencement of the lateral line; the mouth is rather small, the lower jaw longer than the upper, and both furnished with a row of small and rather blunt teeth.

The plaice is an inhabitant of the Mediterranean, Baltic, and northern seas, and is found in considerable plenty about our coasts. Mr. Pennant observes, that it is sometimes taken of the weight of 12 pounds; but its more general weight is far short of this, one of eight or nine pounds being reckoned a large fish. The best are said to be taken off Rye on the coast of Sussex, and about the Dutch coasts. They spawn in the beginning of May. Their general food consists of small fishes, sea-insects, and the smaller kinds of shell-fish.

The plaice is in considerable esteem as a food, though far inferior to the sole and turbot. Those are most esteemed which are of moderate size, the smaller ones being less firm than those of more advanced growth.

3. Pleuronectes limanda, dab. The dab is of a very broad oval shape, and a yellowish brown colour above, and white beneath. It is covered with moderately large round scales. The head is small, and the eyes large; the mouth small, and the teeth more numerous in the upper part of the jaw: the dorsal and anal fins are of moderate width, and the tail nearly even at the end; the lateral line curves downwards over the pectoral fins, and from thence runs straight to the tail.

This species is an inhabitant of the Mediterranean, the Baltic, and the northern seas, but is less common than either the plaice or flounder, to both of which it is superior as food, though inferior in its general size. It is in its highest season in the months of February, March, and April, after which it is observed to grow less firm. It spawns in May, and if the spring proves cold, in June.

4. Pleuronectes flusus. The flounder is allied to the plaice in shape, but generally of smaller size and of more obscure colours; the upper side being of a dull brown, marbled with white or black spots, and the under side of a dull white, sometimes obscurely variegated with brown; the body is covered with very small scales; and along the back, at the base of the dorsal fin, runs a row of small sharp spines; a similar row runs along the base of the anal fin: the lateral line is marked in a third row, continued almost to the base of the tail, which is slightly rounded at the end; at the commencement of the anal fin is a pretty strong spine.

The flounder is an inhabitant of the Northern, Baltic, and Mediterranean seas. About our own coasts it is extremely common, and even frequents our rivers at a great distance from the salt waters. It is in considerable esteem as a food, though much inferior to some others of the genus.

The Pleuronectes pallasii of Limarux, considered by Mr. Pennant and some others as a variety of the flounder, having the eyes on the left side, is at present allowed to constitute a distinct species.

5. Pleuronectes major. The sole is an inhabitant of the Northern, Baltic, and American seas, and grows to the length of more than two feet, and to the weight of eight pounds. Its general size, however, is much smaller. Its shape is that of a very long oval; its colour obscure brown above, and white beneath. It is covered with small rough scales of an oblong form, each terminated by numerous spines, and very strongly fastened to the skin. These scales, from the elegance of their structure, form a favourite microscopie object; and an erroneous idea sometimes prevails, that the spiny end of the scale is that by which it was inserted into the skin. The mouth of the fish is very small, the upper side, are commonly tipped with black.

Next to the turbot, this fish is considered as the most delicate of the genus, and is very much esteemed by connoisseurs; the flesh being remarkably firm, white, and well-flavoured: those of moderate size are in general most esteemed. The sole delights in lying at the bottom of the coasts, which it frequents, by employing small shell-fish, such as the shrimps, weas-insects, &c., and is generally taken by the trawl-net. The chief fishery, according to Mr. Pennant, is at Brigham in Torbay.

6. Pleuronectes tuberculatus, with eyes towards the right. This species is generally considered as superior to every other species as an article of food, of an inhabitant of the Mediterranean and Northern seas, where it often attains a very large size. It is, however, far inferior in this respect to the holibut, and is therefore not very happily distinguished by Limarux under the name of Pleuronectes maximus. It is of a broader and squarer form than any other of the genus, except the pearl; and is of a dark brown above, marbled with blackish spots of different sizes, and white beneath; the scales are so small as to be scarcely observable, but the skin is of a wrinkled appearance, and covered with pretty numerous and moderately large pointed tubercles or abrupt spines, those on the upper or coloured side being far larger than those on the under side: the lateral line forms an arch over the pectoral fins, and thence runs straight to the tail.

Like the rest of this genus, the turbot generally lies in deep water, preying on worms, shell-fish, and marine insects, as well as on various kinds of small fish. It has a great deal of organic matter, and the greatest quantities about the northern coasts of England, as well as on those of France, Holland, &c., and is baited with pieces of hermit crab, cock, &c., but particularly with the smaller or river lamprey, vast quantities of which are said to be purchased by our fishermen by the Dutch, to the annual amount of not less than 700 pounds. They are chiefly taken about Mont-Saint-Michel and sold to the Dutch as bait for the cod-fishery; but, that people are said to have the art of preserving them till the commencement of the cod-fishery.

The general manner in which the turbot-fishery is practised at Scarborough, is thus described by Mr. Pennant, in the British Zoology, from the communications of Mr. Travis of that place:

When they go out to fish, each man is provided with three lines. Each man's lines are fairly coiled upon a flat oblong piece of wicker-work; the hooks being baited, and placed in a row upon the line, and above each hook is a piece of cork. Each line is furnished with fourteen score of hooks, at the distance of six feet two inches from each other. The hooks are fastened to the lines upon小麦 of twisted horse hair 17 inches in length. When fishing there are always three men in each coble; and consequently nine of these lines are fastened together, and used as one line, extending in length nearly three miles, and furnished with 2920 hooks. An anchor and a buoy are fixed at the first end of the line, and one more at each end of each man's lines, in all four anchors, which are commonly perforated with four holes, and four large holes made of the black cork. The line is always laid across the current. The tides of flood and ebb continue an equal time upon our coast; and when undisturbed by winds, run each way about six hours; the tides being so rapid, that the fishermen can only shoot and haul their lines at each turn of the tide; and therefore the lines always remain on the ground about six hours. The same rapidity of the tide prevents their using hand-lines; and therefore two of the people commonly wrap themselves in the sail and sleep, while the other keeps a strict
look-out, for fear of being run down by ships, and to observe the weather; for storms often rise so suddenly, that it is with extreme difficulty they can escape to shore, leaving their lines behind, or in such a high wind that they are destroyed. It is about one ton burthen, rowed with three pairs of oars, and admirably constructed for the purposes of encountering a mountainous sea. T. S. Burrowes, when the winds suit."

PLICA POLONICA. See Medicine.

PLINIA, a genus of plants of the polyandra monogyne class. The emplacement is divided into five segments; the flower consists of five petals; the stamens are numerous, filaments, slender, and as long as the flower; the anthers are small, and so is the germen of the pistil; the style is subulate, and of the length of the stamina; the stigma is simple; the fruit is a large globose berry, of a striated or succulent surface, containing only one cell, in which is a very large, smooth, and globose seed. There are two species, trees of America.

PLINTH. See Architecture.

PLOCAMA, a genus of the monogyne order, in the pentandria class of plants. The calyx is quinquedentate; the fruit a berry and not a fleshy seed. In all this there is only one species, viz., the pendula, a native of the Canaries.

PLOTTING, among surveyors, is the art of laying down on paper, &c., the several angles and lines of a tract of ground surveyed by a theodolite, &c., and a chain. See Surveying.

PLOTUS, or DARTER, a genus of birds of the monotremas. The generic character is, bill straight, pointed, the legs short, a slit near the base; face and chin naked; legs short, all the toes connected. Of this genus there are three species.

P. anhinga: head smooth; belly white; inhabits Brasil; two feet ten inches long; builds on trees, and is hardly ever seen on the ground: when at rest, sits with the neck between in the shoulders; flesh oily and with a metallic glance.

P. melanogaster, inhabits Ceylon and Java; about three feet long: and the P. surinamensis, has its head crested, and belly white; it inhabits Surinam; is 15 inches long; is domesticated, and feeds on fish, rice, especially flies, which it catches with great dexterity, and is very active.

PLOVER. See Charadrius.

PLOUGH. See Husbandry.

PLOUGHING. See Husbandry.

PLUKKENETIA, a genus of the monogynia monadelphus class and order. The male and female flowers are produced separately on the same plant; the corolla is composed of four ovate or patent petals, and the stamina form a short pyramidal body; the fruit is a depressed quadrangular capsule, containing a single roundish and compressed seed. There is one species.

PLUM. See Prunus.

PLUMAGO, leadwort, a genus of the monogyne order, in the polyandra class of plants. The corolla is funnel-form; stamina inserted in scales, inclosing the base of the corolla; stigma five-cleft; seed one. There are seven species, the most remarkable of which are plumago and Zeyonica. The first grows naturally in the southern parts of Europe, and has a perennial root striking deep in the ground. There are many slender candelabra stalks, about three feet high, terminated by tufts of subul fungiform-shaped flowers of a fine yellow; each flower consists of two parts only, and grows naturally in both the Indies. The upper part of the stalk and emplacement are covered with a glaucous juice, which catches the small flies that light upon it. The former species is spread by parting the roots, and by seeds; but the latter is too tender to thrive in the open air in this country.

PLUMERIA, the art of casting and working lead, and using it in buildings.

As this metal melts very easily, it is easy to cast it into figures of any kind, by running it into moulds of brass, clay, plaster, &c. But the chief article in plumbery is sheets and pipes of lead; and as these make the basis of the plumber's work, we shall here give the process of making them.

In casting a sheet, a table or mould is made up, which consists of large pieces of wood well joined, and bound with bars of iron at the ends; on the sides of which runs a frame consisting of a ledge or border of wood, two or three inches thick, and two or three inches high from the mould, called the sharp: the ordinary width of the mould, within these sharps, is from three to four feet, and its length is 16, 17, or 18 feet. This should be a little longer than the sheets are intended to be, in order that the end where the metal runs off from the mould may be cut off; because it is commonly thin, or uneven, or ragged at the end. It must stand very even, with the same figures, and as falling from the end in which the metal is poured in, viz. about an inch or an inch and a half, in the length of 16 or 17 inches. At the upper end of the mould stands the pan, which is a concave triangular prism, composed of two planks nailed together at right angles, and two triangular pieces fitted in between at the ends. The length of this pan is the whole breadth of the mould in which the sheets are cast; it stands with its bottom, which is a sharp edge, on a form at the end of the mould, leaping with one side against, and on the opposite side is a handle to lift it, to pour out the melted lead; and on that side of the pan next the mould, are two iron hooks to take hold of the mould, and prevent the pan from slipping, when something is being poured into it into the mould. This pan is lined on the middle inside with moistened sand, to prevent it from being fired by the hot metal. The mould is also spread over, about two-thirds of an inch thick, with sand sifted and moistened, which is rendered perfectly level by moving over it a piece of wood called a strike, by trampling upon it with the feet, and smoothing it over with a smoothing-plane; which is a thick plate of polished brass, about nine inches square, turned up on all the four edges, and with a handle soldered into the upper or concave side. The sand being thus smoothed, it is fit for casting sheets of lead; but if they would cast a cistern, they measure out the size of the cistern, and having taken the dimensions of the former, they make mouldings by pressing long slips of wood, which contain the same mouldings into the level sand; and form the figures of birds, beasts, mould, &c., in some manner, like figures upon it, and then take them off; and at the same time smoothing the surface where any of the sand is raised up by making these impressions upon it. The rest of the operation is the same in casting either cisterns or plain sheets of lead. But before we proceed to mention the manner in which that is performed, it will be necessary to give a more particular description of the stroke.

The base is a plate about five inches broad, and something longer than the breadth of the mould on the inside; and at each end is cut a notch, about two inches deep, and at which it is used, it rides upon the sharps with those upon which it begins to cast, the stroke is made ready by lacking two pieces of an old hat on the notches, or by slipping a case of leather over each end, in order to make about one-eighth of an inch, or something more, above the sand, according as they would have the sheet to be in thickness; then they lower the edge of the stroke, and lay it across the sand, and bring the molten lead into the mould, which is paved over with earth, clay, &c., and poured into the pan, in which, when there is sufficient quantity for the present purpose, the scum of the metal is swept off with a piece of board to the edge of the pan, letting it settle upon the sand, which is thereby means prevented from falling into the mould at the pouring out of the metal. When the lead is cool enough, which is known by its beginning to stick to the hand, they take the sand round the pan, two men take the pan by the handles, or else one of them lifts it up by a bar and chain fixed to a beam in the ceiling, and pour it into the mould, while another man handles the sand on to the upper side; as soon as they have done pouring in the metal, puts on the mould, sweeps the lead forward, and draws the overplus into a trough prepared to receive it. The sheets being cast, nothing remains but to planish the edges, in order to render them smooth and straight; but if it is a cistern, it is bent into four sides, so that the two ends may join the back, where they are soldered together, after which the bottom is soldered up.

The method of casting pipes without soldering. To make these pipes, they have a kind of little mill, with arms or levers to turn, and consisting of two pieces, which open and shut, by means of hooks and hinges, their inward caliber or diameter being according to the size of the pipe to be made, and their length is usually two feet and a half. The iron, on the middle inside is placed a core, or round piece of brass or iron, somewhat longer than the mould, and of the thickness of the inward diameter of the pipe. This core is passed through two copper-rod, one at each end of the mould,
which they serve to close; and to these is joined a little copper tube about two inches long, and of the thickness the leaden pipe is intended to pass through. By this pipe the air is urged into the core, and the core is retained in the middle of the cavity of the mould. The core being in the mould, with the ruddles at its two ends, and the lead melted in the furnace, they take it up in a large pot and pour it into the mould by a little aperture at one end, made in the form of a funnel. When the mould is full, they pass a look into the end of the core, and turning the mould, draw it out; and then opening the mould, take out the pipe. If they desire to have the pipe lengthened, they put one end of it in the lower end of the mould, and pass the end of the core into it, then shut the mould again, and apply its tube and tube as before, the pipe just cast serving for ruddle, &c. at the other end. Things being thus prepared, they pour in fresh metal, and repeat the operation till they have got a pipe of the length required.

For making pipes of sheet-lead, the plumbers have wooden cylinders of the length and thickness required, and on these they form their pipes by wrapping the sheet around them, and drawing up the edges all along. See Pipe.

PLUMERIA, a genus of the pantropical monogynous class of plants, the corolla of which consists of a single funnel-like petal, with a long tube and divided into five oblong segments at the limb: the fruit is composed of two jointed and ventricose follicles, form d of a single valve each, and containing numerous oblong seeds. There are four species.

PLUMMET, plumb-rule or plumb-line, an instrument used by carpenters, masons, &c. in order to judge whether walls, &c. are upright, planes, horizontal, or the like. It is thus called from a piece of lead, plum- bium, fastened to the end of a cord, which usually constitutes this instrument. Sometimes the string descends along a wooden ruler, &c. raised perpendicularly on another, in which case it becomes a level. See Level.

PLUMBING, among miners, is the method of using a mine-dial, in order to know the exact place of the work where to sink down an air shaft, or to bring an adit to the work, or to know which way the sound inclines when any fissure happens in it.

It is performed in this manner: A skilful person, with an assistant, and with pen, ink, and paper, and a long line, and a small-dial, after his guess of the place above ground, descends into the adit or work, and there fastens one end of the line to some fixed thing in it; then the marked needle is let to rest, and the exact point where it rests is marked with a pen; he then goes on farther in the line still fastened, and at the next fissure on the adit he makes a mark on the line by a knot or otherwise; and then letting down the dial again, he there likewise notes down that point at which the needle stands in this second position. In this manner he proceeds, from turning to turning, marking down the points, and marking the line, till he comes to the place where he ascends and begins to work on the surface of the earth which he did in the adit, bringing the first knot in the line to such a place where the mark of the place of the needle will again answer its pointing, and continues this till he comes to the desired place above ground. This is certainly to be perpendicular over the part of the mine into which the air-shaft is to be sunk.

PLUNGER, in mechanics, the same with the former act of elastic fluids; such as their weight, density, compressibility, and elasticity. The other properties of elastic fluids are treated of under Chemistry and Physics.

The air is a fluid in which we live and breathe; it entirely envelops our globe, and extends to a considerable height around it. Together with the clouds and vapours that float in it, it is called the atmosphere. As it possesses gravity in common with all other fluids, it must press upon bodies in proportion to the depth at which they are immersed in it; and it also presses in every direction, in common with all other fluids.

It differs from all other fluids in the four following particulars: 1. It cannot be compressed into a much less space than it naturally occupies; 2. It cannot be condensed or fixed as other fluids may. 3. It is of a different density in every part upward from the earth's surface; decreasing in its weight, bulk for bulk, the higher it rises; 4. It is of a very elastic and springy nature, and the force of its spring is equal to its weight.

Few people who are acquainted with the principles of natural philosophy, suppose that the air by which we are surrounded is a material substance, like water, or any other visible matter. Being perfectly invisible, and affording no resistance to the touch, it must seem to them extraordinary, to consider it as a solid and material substance; and yet a few simple experiments will convince any one that it is really matter, and possesses weight, and the power of resisting other bodies that press against it.

Take a bladder that has not the neck tied, and you may press the sides together, and squeeze it into any shape. Fill this bladder with air, by blowing into it, and tie a string fast round the neck: you then find that you cannot, without breaking the bladder, press the sides together, and that you can scarcely alter the air pressure. Whence then arise these effects? When the bladder was empty, you could press it into any form; but the air with which it is filled, prevents this; the resistance you experience when you insert air, proves that that is real matter as well as any other substance that we are acquainted with.

We are accustomed to say, that a vessel is empty, when we have poured out of it the water which it contained. Throw a bit of cork upon a basin of water, and having put an empty tumblers over it with the mouth downwards, force it down through the water; the cork will show the surface of the water within the tumblers, and you will see that it will not rise so high within as without the glass; nor, if you press even so hard, will it rise to the same level. The water is, therefore, prevented from rising above the tumblers, by some other substance which already occupies the inside; which substance is the air that filled the tumblers when it was inverted, and which could not escape, on account of the superior pressure of the bladder, by those other substances which we are acquainted with.

In like manner, having opened a pair of common bellows, stop up the nozzle se-
curely, and you will find that you cannot
that the bellows, which seems to be filled
with something that yields a little, like wool; 
but if you stop the nozzle, the air will be
expelled, and may be felt against the
hand.
When the air is at rest, we can move in
it with the utmost facility; nor does it offer
a sensible resistance, except the motion
is quick, or the surface opposed to it is
considerable; but when that is the case, its
resistance is very sensible, as may be easily
perceived by the motion of a boat.

When air is in motion, it constitutes wind;
which is nothing more than a current or
stream of air, varying in its force, according
to the velocity with which it flows.

The invisibility of air, therefore, is only
the consequence of its transparency; but it
is possessed of all the common properties
of matter. When a vessel is empty, in the
usual way of speaking, it is in fact still
filled with air.

But it is possible to empty a vessel even
of the air which it contains, by which means
we might discover several properties
of this fluid. The instrument, machine,
by which this operation is performed,
is called an air-pump. As it is by means of
this useful instrument that all the mechani-
cal properties of air are demonstrated, it will
be necessary to describe its construction,
and the manner of using it, before we pro-
ceed to the experiments that are made with
it.

Plate I. Pneumatics. fig. 1, is the air-pump
that is now in most use. AA are two brass
barrels, each containing a piston, with
a valve opening upwards. They are
worked by means of the wheel B, which has a piston
that fits into the teeth of the rack C, which
are made upon the ends of the pistons, and
by this means moves them up and down al-
ternately.

On the square wooden frame DF, there are
placed a brass plate G, ground perfectly flat,
and also a brass tube, let into the wood,
communicating with the two barrels and the
clock I, and opening into the centre of
the brass plate at a. The glass vessel K, to be
employed, or exhausted, has the air drawn
ground quite flat, and rubbed with a little
pomatum, or hog's-lard, to make it fit more
closely upon the brass plate of the pump.
These vessels are called receivers. Having
shut the clock I, the pistons are worked by
the wheel; and the air being suffered to
escape when the piston is forced down,
because the valve opens upwards, but prevent-
ed from returning into the vessel for the
same reason, the receiver is gradually exhausted,
and will then be fixed fast upon the pump-
plate. By opening the clock I, the air rushes
again into the receiver.

"As light as air," is a common saying;
yet air can be shown to have more weight
than is generally supposed. Take a hollow
copper ball, or other vessel, which holds a
wine quart, having a neck to screw on the
place of the air, and after weighing it
when full of air, exhaust it, and weigh it
when empty; it will be found to have lost
sixteen grains, which shews that this is the
weight of a quart of air. But a quart of wa-
ter weighs 16071 grains; this divided by 16,
gives 914 in round numbers; so that water
is 914 times as heavy as air near the surface
of the earth. This surges over at a medium
temperature and density; for these, as will
be seen afterwards, are variable.

When the receiver is placed upon the
plate of the air-pump without exhausting it,
it may be removed from the most of air
under it, that resists by its elasticity the pressure
on the outside; but exhaust the receiver,
and it will be found the pressure-counter-pressure, and it
will be held down to the plate by the weight
of the air upon it.

When the pressure of the air amounts to,
its weight determined in the following man-
ner:

When the surface of a fluid is exposed to
air, it is pressed by the weight of the
atmosphere equally on every part; and
consequently remains at rest. But if the pres-
sure is removed from any particular part,
the fluid must yield in that part, and be
forced out of its situation.

Into the receiver (fig. 2) put a small
vessel with quicksilver, or any other fluid,
and through the tube B, suspend a
glass tube, closed, or hermetically
sealed, as it is called, over the small vessel.
Having exhausted the receiver, let down
the tube into the quicksilver, which will
not rise into the tube as long as the receiver
continues empty. But re-admit the air;
and the quicksilver will immediately
rise. The reason of this, is, that upon
exhausting the receiver, the tube is likewise emptied
of air; and therefore, when it is immersed in
the quicksilver, it is unable to resist the
air, which is in the tube; consequently, it must rise in the
tube, and continue so to do, until the weight
of the quicksilver presses so forcibly
on that portion which lies above the office
of the tube; and consequently, it must rise in the tube,
and be held down to the plate by the weight
of the air upon it.

A common syringe of any kind, and
having pushed the piston to the farthest end,
immerse it in water, then draw up the
piston, and the water will follow it. This is
owing to the same cause as the last: when
the piston is pulled up, the air is drawn out
of the syringe with it, and the pressure
of the atmosphere is removed from the part
of the water immediately under it; conse-
quently the water is obliged to yield in that
part to the pressure on the surface.

It is upon this principle that all those
pumps called suction-pumps act; the piston
fitting tightly the inside of the barrel,
by being raised up, removes the pressure of the
atmosphere from that part, and consequently
the water is drawn up by the pressure
upon the surface.

In the beginning of the last century, phi-
losophers were of opinion that the ascent
of water in pumps, was owing to what they
called "Nature's existence of a vacuum;" and
that, by means of suction, fluids might
be raised to any height whatever.

Galileo was the first who discovered that
it was impossible to raise water higher than
thirty-three feet by suction alone; and thence
concluded, that not the power of suction,
but the pressure of the atmosphere, was the
cause of the ascent of water in pumps; that
a column of water thirty-three feet high was
a counterpoise to one at high as the atmos-
phere; and that, for this reason, the water
would not follow the suction any farther.

His pupil Torricelli, considered that as
the mercury was floating in the wa-
ter, a column of that fluid must only be one-
fourteenth of the length of one of water,
to form an equal counterpoise to the pressure
of the air; and accordingly, having filled
with mercury a glass tube about three feet
low, hermetically sealed at one end, he in-
verted it into a small basin of mercury, and
found, as he expected, that the mercury
subided to the height of about twenty-nine
inches and a half, and there remained sus-
pended, leaving a space at the top of the
tube a perfect vacuum; which has been call-
ed, from the inventor, the Torricellian
vacuum.

It was, however, some time after this ex-
periment had been made, and even after it
had been universally agreed that the sus-
pension of the mercury was owing to the
weight of the atmosphere, before it was dis-
covered what had been called the name of weather-glass;
and from its also measuring the weight of the
atmosphere, it is called the barometer. It
is merely a tube filled with mercury, and in-
verted into a basin of the same, having a scale
fixed at the top to ascertain the rising
and falling of the mercury, by the changes
in the weight of the atmosphere. A more
particular account of the construction and
use of this instrument is given under Baro-
meter.

These effects arising from the weight
and pressure of the atmosphere, have been ab-
solutely attributed to suction; a word which
ought to be exploded, as it conveys a false
notion of this singular and similar phe-
nomena. To prove that an exhausted
receiver is held down by the pressure of
the atmosphere, take one open at top, and
ground flat, and seal it, as A, fig. 3, and covered
with a brass plate B, which has a brass ring
passing through it, working in a collar of leather,
so as to be air-tight; to this rod suspend a
small receiver within the large one, a little
way from the bottom, and place the receiver
A upon the pump-plate, and exhaust it;
it will now be fixed fast down; but the small
receiver may be pulled up or down with
perfect ease, as it is itself exhausted, and all
the air which the receiver removed, conse-
quently it cannot be exposed to any pres-
sure; then let the small one down upon the
plate, but not over the hole by which the
air is extracted, and re-admit the air into
the large receiver, which may then be re-
moved; it will be found that the small one
being itself exhausted, it held down fast by
the air, which is now admitted round the
outside. If the large receiver is again put
over it, and exhausted, the small one will
be at liberty; and so on, as often as the
experiment is repeated.
A square column of quicksilver twenty-five and a half inches high, and an inch thick, weighs just fifteen pounds, consequently, the air presses with a weight equal to fifteen pounds upon the surface of the earth’s surface; and 144 times as much, or 2160 pounds, upon every square foot.

The earth’s surface contains in round numbers, 209,000,000 square miles; and as every square mile contains 27,870,400 square feet, there must be 5,575,080,000,000 square feet on the earth’s surface; which multiplied by 2160 pounds (the pressure on each square foot), gives 12,043,468,800,000,000,000,000 pounds for the pressure, or whole weight, of the atmosphere.

Reckoning the surface of a middle-sized man to be about 14 square feet, he sustains a pressure from the air equal to 30,240 pounds Troy, or 11 tons 2 cwt. and 184 lbs. It may be asked, how it happens that we are not sensible of so great a pressure? The reason is, that such pressures only are perceived by us, as move our fibres, and put them out of their natural situations. Now the pressure of the air being equal on all parts of the body; it cannot possibly displace any of the fibres, but on the contrary, bends and keeps them all in their relative situations. But if the pressure is removed from any particular part, the pressure on the neighboring parts immediately becomes sensible. Thus, if you take a receiver open at the top, and cover it with your hand, exercising the receiver, and so taking off the pressure from the palm of the hand, you will feel it pressed down by the immense weight, so as to give pain that would be insupportable, and endanger the breaking of your hand.

If the top of the receiver is covered by a piece of flat glass, upon exhausting it, the glass will be broken to pieces by the incumbrant weight; and this would happen to the receiver itself, but for the arched top, that resists the weight much more than a flat surface.

This experiment may be varied, by tying a piece of wet bladder over the top of the receiver, and leaving it to dry till it becomes as tight as a drum. Upon exhausting the receiver, you will perceive the bladder rendered concave, and it will yield more and more, until it breaks with a loud report, which is occasioned by the air striking forcibly against the inside of the receiver, upon being re-admitted.

Air is one of the most elastic bodies in nature; that is, it is easily compressed into less compass, and when the pressure is removed, it immediately regains its former bulk.

Let mercury be poured into a bent tube ABCD (fig. 4), open at both ends, to a small height as BC; then stopping the end D with a cork, or otherwise, air-pressure the length of confined air DC, and pour mercury into the other leg AB, till the height above the surface of that in CD is equal to the height at which it stands in the manner at the bottom of the figure. Then, when it is plain, that the air in the shorter leg will be compressed with a force twice as great as at first, when it possessed the whole space CD; for then it was compressed only with the weight of the atmosphere, but now it is compressed by that weight, and the additional equal weight of the column of mercury. The surface of the mercury will now be at E; and if we, by the air be taken in, upon measuring it, that the space DE, into which the air is compressed, is just half the former CD. If another column of mercury was added, equal to the former, it would be reduced into one-third of the space it formerly occupied.

Hence the density of the air is proportional to the force that compresses it.

As all the parts of the atmosphere gravitate, or press upon each other, it is easy to conceive, that the air next the surface of the earth is more compressed and denser than what it is at some height above it; in the same manner as if wool was thrown into a deep pit until it reached the top. The wool at the bottom having all the weight of what was above it, would be squeezed into a less compass; the layer, or stratum above it, would not be pressed quite so much, the one above that still less, and so on; till the upper one, having no weight over it, is in its natural state. In this case with the air, or atmosphere, that surrounds our earth, and accompanies it in its motion round the sun.

On the tops of lofty buildings, but still more on those of mountains, the air is found to be considerably less dense than at the level of the sea.

The height of the atmosphere has never yet been exactly ascertained; indeed, on account of its great elasticity, it may extend to an immense distance, becoming, however,rarer, in proportion to its distance from the earth.

It is observed, that at a greater height than forty-five miles, it does not refract the rays of light from the sun; and this is usually considered as the limit of the atmosphere. In a rarer state, however, it may extend much farther. And this is by some thought to be the case, from the appearance of certain meteors which have been reckoned to be 70 or 80 miles distant.

Dr. Cotes has demonstrated, that if altitudes in the air are in geometrical proportion, the rarity of the air will be in geometrical proportion. For instance,

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<th>Height above the Earth</th>
<th>Air Density</th>
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And hence it is easy to prove by calculation, that a cubic inch of such air as we breathe, would be so much rarified at the altitude of 500 miles, that it would fill a sphere equal in diameter to the orbit of Saturn.

The elastic power of the air is always equivalent to the force which compresses it: for if it was less, it would yield to the pressure, and be more compressed; was it greater, it would not be so much reduced; for action and reaction are always equal; so that the elastic force of any small portion of the air we breathe, is equal to the weight of the incumbent part of the atmosphere; that weight being the force which confines it to the dimensions it possesses.

To prove this by an experiment, pour some quicksilver into the small bottle A (fig. 5) and screw the brass collar c of the tube BC into the brass neck of the bottle, and the lower part of the tube fixed by brass collars to the receiver, and is closed at top. This preparation being made, exhaust the air out of the receiver G, and its tube, by putting it upon the plate of the air-pump, and the air will, by the same means, be exhausted out of the inner tube BC, through its open top at C. As the receiver and tubes are exhausting, the air that is confine in the glass bottle A, will press so by its spring, as to raise the quicksilver in the inner tube to the same height as it stands at in the barometer.

Miscellaneous experiments.

There is a little machine, consisting of two mills, a and b, which are of equal weights, independent of each other, and turn equally free on their axles in the frame. Each will roll out this small ball of wax (fig. 6) fixed into the axes; those of the mill a, have their planes at right angles to its axis, and those of b have their planes parallel to it.

As the mill a therefore turns round in common air, it is but little resisted by it, because its sides cut the air with the opposite edges; but the mill b is much resisted, because the broad side of its sails moves against the air when it turns round. In each axle is a fine pin near the middle of the frame, which goes quite through the axle, and stands out a little on each side of it: under these pins a slider may be made to bear, and so hinder the mills from going, when a strong spring is set but against the opposite ends of the pins.

Having set this machine upon the pump-plate, fig. 1, draw up the slider to the pins on one side, and set the spring at bend on the opposite ends of the pins; then push down the slider, and the spring acting equally strong upon each mill, will set them both going with equal forces and velocities; but the mill a will run much longer than the mill b, because the air makes much less resistance against the edges of its sails than against the sides of the sails of b.

Draw up the slider again, and set the spring upon the pins as before; then cover the machine with the receiver upon the pump-plate; and having exhausted the receiver of air, push down the wire (through the collar of leathers in the neck) upon the
PNEUMATICS.

slider, which will disengage it from the pins, and allow the mills to turn round by the impulse of the spring; and as there is no air in the receiver to make any sensible resistance against them, they will both move more celerely than they did in the open air, and the moment that one stops the other will do so too. This shews that air resists bodies in motion; and that equal bodies move with equal velocities, in the same medium, in every direction, according as they present greater or less surfaces to the air.

Take a tall receiver A, covered at top by a brass plate, through which works a rod in a collar of leathers, (fig. 7.) and to the bottom of which there is a particular contrivance for supporting a guinea and a feather, and for letting them drop at the same instant. If they are let fall while the receiver is full of air, the guinea will fall much quicker than the feather; but if the receiver is first exhausted, it will be found that they both arrive at the bottom at the same instant: which proves that all bodies would fall to the ground with the same velocity, if it was not for the resistance of the air, which impairs most of the motion of those bodies that have the least momentum. In this experiment the observers ought not to look at the top, but at the bottom of the receiver; otherwise, on account of the quickness of their motion, they will not be able to see whether the guinea and feather fall at the same instant.

3. Take a receiver, having a brass cup fitted to the top with a hole in it; fit one end of a dry hazel-stick about an inch long, tightly into the hole, and the other end tight into a hole quite through the bottom of a small wooden cup; then pour some quicksilver into the cup, and exhaust the receiver of air; and the pressure of the outward air on the surface of the quicksilver, will force it through the pores of the hazel, whence it will descend in a beautiful shower, into a glass cup placed under the receiver to catch it.

Put a wire through the collar of leathers on the top of the receiver, and fix a bit of dry wood on the end of the wire within the receiver; then exhaust the air, and push the wire down, so as to immerse the wood into a glob of quicksilver on the pump-plate; this done, let in the air; and upon taking the wood out of the jar, and splitting it, its pores will be found full of quicksilver, which the force of the air, upon being let into the quicksilver, drove into the wood.

Join the two brass hemispherical cups A and B together (fig. 8) with a wet leather between them, having a hole in the middle of it; then having screwed off the handle at C, put both the hemispheres together and screw them into the pump-plate, and turn the cock E, so that the pipe may be open all the way into the cavity of the hemispheres; then exhaust the air out of them, and turn the cock; unscrew the hemispheres, and being both now open, let in the air, C, let two strong men try to pull the hemispheres asunder by the rings, which they will find had to do; for if the diameter of the hemispheres is four inches, through them, and both will move together by the external air with a force equal to 190 pounds; and to show that it is the pressure of the air that keeps them together, hang them by either of the rings upon the hook of the wire in the receiver A (fig. 3.) and, upon exhausting the air out of the receiver, they will fall asunder of themselves.

Screw the end A of the brass pipe AB (fig. 9.) into the pump-plate, and turn the cock of the pipe open; then put a wire leather on the plate c, fixed on the pipe, and cover it with the tall receiver G H, which is close at top; then exhaust the air out of the receiver, and turn the cork e to keep it shut; unscrew the pipe from the pump, and set its end A into a bason of water, and turn the cock e to open the pipe; on which, as there is no air in the receiver, the pressure of the atmosphere on the water in the basin will drive the water forcibly through the pipe, and make it play up in a jet to the top of the receiver.

Set a square phial upon the pump-plate, and having covered it with a wire cage, put a close receiver over it, and exhaust the air out of the receiver; in doing which, the cork will be blown from its socket, through a small valve in its neck. When the air is exhausted, turn the cock below the plate to re-admit the air into the receiver; and as it cannot get into the phial again, because of the valve, the phial will be broken into some thousands of pieces by the pressure of the air upon it. Had the phial been of a round form, it would have sustained this pressure like an arch, without breaking; but as its sides are flat it cannot.

To show the elasticity or spring of the air, tie up a very small quantity of air in a bladder, and put it under the receiver; then exhaust the air out of the receiver, and the air which is confined in the bladder (having nothing to act against it) will expand by the force of its spring, so as to fill the bladder completely. But upon letting the air into the receiver again, it will overpower that in the bladder, and press its sides close together.

If the bladder is fastened up into a wooden box and the other end tied out, and a pound of lead placed upon it, and the box is covered with a close receiver; upon exhausting the air out of the receiver, that which is confined in the bladder will expand itself so as to raise up all the lead by the force of its spring.

Screw the pipe AB (fig. 9.) into the pump-plate; place the tall receiver G H upon the plate c, as before, and exhaust the air out of the receiver; then turn the cock e to keep out the air, unscrew the pipe from the pump, and screw it into the mouth of the copper vessel C (fig. 10.), the vessel having been first about half filled with water. Then open the cock e; and the spring of the air which is confined in the copper vessel will force the liquid through the pipe AB into a jet into the exhausted receiver, as strongly as it did by its pressure on the surface of the water.

If a rat, mouse, or bird, is put under a receiver, and the air is exhausted, the animal will be at first oppressed with as great a weight as it feels upon the earth, and at last expire in all the agonies of a most bitter and cruel death. But as this experiment is too shocking to most spectators, it is common to substitute a machine called the long-glass in place of the animal.

If a butterfly is suspended in a receiver, by a fine thread tied to one of its horns, it will fly about in the receiver as long as it continues full of air; but it is exhausted, the wings cannot be restored; and if the animal is not discharged, but is allowed to flutter about, it cannot remove itself from the place where it hangs, in the middle of the receiver, until the air is let in again, and then the animal will fly away as before.

Put a cork into a square phial, and fit it with wax or cement; and put the phial on the pump-plate with the wire cage, and cover it with a close receiver; then exhaust the air out of the receiver, and the air that was corked up in the phial will break it outwards by the force of its spring, because in immemorial times the top of the phial to act against that within it.

Put a shrivelled apple under a close receiver, and exhaust the air; the spring of air within the apple will plump it out, so as to cause all the contents of the apple to be driven out, and the cork to come off the receiver, by the expansion of a small bubble of air contained in the great end, between the shell and film.

Take a fresh egg, and cut off a little of the shell and film from its smallest end, then put the egg under a receiver, and pump out the air; upon which all the contents of the egg will be forced out to the receiver, by the expansion of a small bubble of air contained in the great end, between the shell and film.

Put some warm beer into a glass, and having set it on the pump, screw it over at once, and then exhaust the air. Whilst this is doing, and the pressure more and more taken off from the beer, the air in it will expand itself, and rise up in a beautiful and circular motion, and be blown into the glass.

Put some water into a glass, and a bit of dry wood, and pump it out; then cover the glass with a close receiver, and exhaust the air; upon which all the water will gush out, and be blown into the glass.

Let a large piece of cork be suspended by a thread at one end of a balance, and counterpoised with a leaden weight, suspended in the same manner, at the other. Let this balance be hung to the inside of the top of a large receiver; which being set on the pump, and the air exhausted, the cork will preponderate, and shew itself to be heavier than the lead; but upon letting in air again the equilibrium will be restored. The reason of this is, that since the air is a fluid, and all bodies lose as much of their absolute weight in it as is equal to the weight of their bulk of the fluid, the cork being the larger
body, loses more of its real weight than the lead does; and therefore must in fact be heavier, to balance it under the disadvantage of losing some of its weight; which disadvantage being the loss of the heat of the corks, the bodies then gravitate according to their real quantities of matter, and the cork which balanced the lead in air, shows itself to be heavier when in vacuo.

Set a lighted candle upon the pump, and cover it with a tall receiver. If the receiver holds a gallon, the candle will burn a minute; and then, after having gradually decayed from the first instant, it will go out, which shows that a constant supply of fresh air is as necessary to feed flame, as animal life.

The moment when the candle goes out, the smoke will be seen to ascend to the top of the receiver, and there it will form a sort of cloud; but upon exhausting the air, the smoke will fall down to the bottom of the receiver, and leave it as clear at the top as it was before it was set upon the pump. This shows that smoke does not ascend on account of its being positively light, but because it is lighter than air; and its falling to the bottom when the air is taken away, shows that it is not destitute of weight. So sorts of vessels ascend or descend in water; and yet there are none who doubt of the wood's having gravity or weight.

Set a bell on the pump plate, having a contrivance so as to ring it at pleasure, and cover it with a bell receiver. If the clapper strike against the bell, and the sound will be very well heard; but exhaust the receiver of air, and then, if the clapper is made to strike ever so hard against the bell, it will make no sound; which shows that air is absolutely necessary for the propagation of sound.

Of condensed air. It has been shown, that air can be rared, or made to expand; we now proceed to show that it can also be condensed, or pressed into less space than it generally occupies. The instrument used for this purpose is called a condenser.

Fig. 12, represents a machine of this kind; it consists of a glass barre, containing a piston, which has a valve opening downwards; so that as the piston is raised, the air passes through the valve; but as the piston is pushed down, the air cannot return, and is therefore forced through a valve at the bottom of the barre, that allows it to pass through into the receiver B, but prevents it from returning. Thus, at every stroke of the piston, more air is thrown into the receiver, which is of very thick and strong glass. The receiver is held down upon the plate C by the cross piece D, and the screws EF. The air is let out of the receiver by the cock G, which communicates with it.

A great variety of experiments may be performed by means of condensed air, a few of which we shall here enumerate.

The sound of a bell is much louder in condensed than in common air.

A glass tube would hold the pressure of the common atmosphere, when the air is exhausted from the outside, will be broken by the condensing the air round it. A very beautiful form of light may be made by condensed air. Procure a strong copper vessel, fig. 13, having a tube that swells into the neck of it so as to be air-tight, and long enough to reach near the bottom. Having poured a quantity of water into the vessel, but not enough to fill it, and screwed in the tube, adapt it to a condensing syringe, and condense the air of the vessel; shut the stopcock, and unscrew the syringe; then, on opening the stopcock, the air acting upon the water in the vessel, will force it out into a jet of very great height. A number of tubes may be fixed on the outside of the tube, such as stars, wheels, &c. forming a very pleasing appearance.

Dr. Hooke invented the gage, or instrument for measuring the degree of rarefaction, or exhaustion, produced in the receiver, and which is a necessary appendage to the air-pump. If a barometer is included beneath the receiver, the mercury will stand at the same height as in the open air; but when the receiver begins to be exhausted, the mercury will descend, and rest at a height which is, in proportion to its former height, as the spring of the air remaining in the receiver, to its spring before exhaustion. Thus, if the height of the mercury, at the commencement of exhaustion, is the same as the barometer, and the remains of what it was before, we say that the air in the receiver is rared 1000 times. On account of the inconvenience of including a barometer in a receiver, a tube, of six or eight inches in length, is filled with mercury, and invested in the same manner as the barometer. This being included, answers the same purpose, with no other difference, than that the mercury does not begin to descend until the air is exhausted; it is called the short barometer-gage.

This is generally placed detached, but communicating with the receiver by a tube concealed in the frame, as is represented at fig. 1. Others place a tube of a greater length than the barometer, with its lower end in a vessel of mercury, exposed to the pressure of the air, while its upper end communicates with the receiver. Here the mercury rises as the air is rarefied, and the pressure of its remaining air is shewn by the difference between the height and that of a barometer in the room: this is called the long barometer-gage.

These gages are not often constructed so as to answer the purposes of great degrees of exhaustion; for the mercury, though at first boiled to clear it of the air and moisture that adhere to it, and render it sensibly lighter, gradually becomes again contaminated by exposure to the air in the basin of either gage. They cannot, therefore, in strictness, be compared to a good barometer, in which this does not happen.

If the tubes of the gages are less than half an inch in diameter, the mercury will be sensibly repelled downwards, so as to require a correction for the long gage when compared with a barometer whose tube is of a different bore, and to render the short gage useless in great exhaustions.

Thus, for example, if the short gage has a tube of one-tenth of an inch in diameter, the mercury will fall to the level of the basin, when the exhaustion is 150 times, and will stand below the level for all greater degrees of exhaustion. These difficulties may be all removed, by making the short gage in the form of an inverted syphon, with one leg open, and the other hermetically sealed.
PNEUMATICS.

The air-gun. This pneumatic instrument is an ingenious contrivance, which will drive a bullet with great violence, by means of condensed air, forced into an iron ball, by a condensed barrel, and will instantly fire the air into the barrel. At the end of this instrument is a male screw, on which the hollow ball D is screwed, in order to be filled with condensed air. The barrel is a valve, to hinder the air after it is injected from making its escape, until it is forced open by a pin, against which the hammer of the lock strikes; which then lets out as much air as will drive a ball with considerable force to a great distance.

When you condense the air in the barrel, place your feet on the iron cross h, to which the piston-rod d is fixed; then lift up the barrel c, by the handles i, until the end of the piston is brought between e and e; the barrel a c will then be filled with air through the hole e. Then thrust down the barrel a c by the handles i, until the piston e joins the back of the iron ball at a; being thus condensed between e and a, will force open the valve in the ball; and when the handles i are lifted up again, the valve will close, and keep in the air; so by repeating the stroke up and down, the ball will presently be filled; after which, unscrew the wall of the condenser, and screw it upon another male screw, which is connected with the barrel, and goes through the stock of the gun, as represented in fig. 15. Twelve dwts. of air have been injected into a ball of 3.75 inches diameter, which has discharged 15 bullets with considerable force.

There are many contrivances in constructing air-guns; some have a small barrel contained within a large one, and the space between the two barrels serves for the reception of condensed air. In this sort, a valve is placed at e (fig. 15.) with a condenser fixed to the other continued through the butt-end to e, where the piston-rod may be always left in. Place your feet on the pin, and the whole gun serves instead of the handles i (fig. 14.) to condense the air in the barrel.

Fig. 17 is a section of the gun, by which the principle of its action may be fully understood: the inside barrel K is of a small bore from which the bullets are shot, and a larger barrel CDSR is on the outside of it. In the stock of the gun is a spring S, which forces in the air through the valve EP into the cavity between the two barrels. The ball K is put into its place in the same way as in another gun. There is a valve at SL, which, being opened by the trigger Q, permits the air to come behind the ball, so as to drive it out with great force. If the valve is suddenly opened and closed, one charge of condensed air may make several discharges of bullets; because only part of the air will go out at a time, and a fresh bullet may be put into the place K.

The magazine air-gun differs from the common one, only by having a serpentine barrel, formed of very thin iron, or of valve, through which these are brought into the shooting barrel successively; by means of a lever; and they may be discharged so far as to be nearly of the same use as so many different guns.

Fig. 18. shews a section of the gun, or at least, as much of it as is necessary to give a complete idea of the whole. AE is part of the cored needle of the injection syringe, with its valve H, opening into the cavity FF between the barrels. KK is the small or shooting barrel, which receives the bullets, one at a time, from the magazine ED, which are condensed in a receiver, and then taken from the barrels and loaded and closed at the end D; the circular part is the key of a cock, having a cylindrical hole, K, through it, equal to the bore of the small barrel, and forming a part of it. When the lock is taken off, the several parts come in view, by means of which the discharge is made, by pushing up the pin Pp, which rises and opens a valve, V, to let in the air against the bullet I, from the cavity FF, which is immediately shut down again by means of a long spring of brass, NN. This valve V, being a conical piece of brass, ground very true, will be sufficient to confine the air. To make a dissimilar valve in the gun, which is screwed, is represented in fig. 19, which turns the cock so as to place the cylindrical bore of the key K in any situation required. Thus when the bullet is in the gun, the bore of the key coincides with that of the barrel KK; but when it is discharged, the hammer H is instantly brought down to shut the pan of the gun; by which motion the base of the key is turned into the situation in k, so as to coincide with the orifice of the magazine; and upon lifting the gun upright, the ball next the key tumbles into its cavity, and falling behind two small springs as fig. 18. is by them deposited.

American air-pump. It would not come within the limits of this work, to enumerate all the improvements, and different modes of construction, used in this instrument. The latest are the air-pumps made by Haas and Hürter, Cuthbertson, and Prince, each of which has particular advantages.

We shall however give a perspective view of the air-pump invented by Mr. Cuthbertson, which is so excellent in its structure, and so powerful in its effects, as to demand in the present improved state of science, a particular notice and description. See Plate II. Pneumatics, Cuthbertson's air-pump. The two principal gages of this pump are screwed in their places; but it is not necessary that these should be used together, except in the end of the winter, because they require great nicety, and very exact exhaustion. In common cases either of them may be taken away, and a stop-screw put into its place. When the pear-gage, which has been already described, is used, small round pieces, large enough for the receiver to stand upon, must first be screwed into a hole at a, but when this gage is not used this hole must be closed with a stop-screw. When all these gages are used,
and the receiver is exhausted, the stop-screw B, at the bottom of the pump, must be unscrewed, to admit the air into the receiver; but when the gages are not all used, the stop-screw at a, or either of the others in the place of gages, may be unscrewed for this purpose. The mechanism and object of the barrels D, D, the racks C, C, the plate G, and handle H, will be easily understood from the figure. CD fig. 2, represents a section of one of the barrels of the pump, F, the collar of leathers which renders it air-tight, G a hollow cylindrical vessel to contain oil; R is also a leather, which receives a cock that is driven with air through the hole a, when the piston is drawn upwards; and when this falls, the oil is carried over with the air along the tube T, into the oil-vessel G; c c is, and serves to press down the leathers of the hole a, by the passage of the oil, as soon as this is escaped, falls down again by its own weight, shuts up the hole, and prevents any air from returning by that way into the barrel L, and d is a screw of brass, to keep the wire e e in such a direction as may preserve the hole air-tight. H is a cylindrical wire, which carries the piston J, and is made hollow to receive a wire q q, so that when the piston L is opened, the air falls into the hole L, which forms the communication with the receiver standing on the plate: m is a pipe of a, end of which is screwed into the wire q q, that opens and closes the hole L; a, upon the plate O, is screwed into that, which, stopping in the smaller part of the hole, prevents the wire from being lifted too high. This wire and screw are more clearly seen in fig. 3; the whole, through a place of leathers r r (see figs. 3 and 5,) in the middle of the piston. Figures 5 and 6, are the two main parts which compose the piston; and when the pieces in figs. 7 and 4 are added to it, the whole is represented in fig. 3. Figure 5 is a piece of brass, turned in a conical form, with a shoulder or ledge at the bottom; a long female screw is cut into it, about two-thirds of its length; and the remaining part, in which no screw is about the same-sized diameter as the screw part; except a thin plate at the end, which is of a breadth exactly equal to the thickness of q q fig. 2. That part of the inside of the conical brass, in which no thread is cut, is filled with oil-leathers with holes in them, through which q q can slide air-tight; there is also a male screw with a hole in it which is fitted to q q, so that when this is driven into the oil-leathers, e e is a circular plate of brass of the size of the leathers, and d d is a screw which serves to press them down as tight as it is necessary. The male screw at the end of fig. 7, is made to fit the screw in fig. 5. If fig. 4, is put into fig. 5, and that again into fig. 6, and fig. 7 screwed into the end of fig. 5, these will compose the whole piston as represented by fig. 3. If in fig. 2, is that part to which the rack is fixed. If this, therefore, is drawn upwards, it will make fig. 5, shut close to fig. 6, and drive out the air above it; and when it is pushed downwards, it will open as far as the shoulders a a will allow, and suffer the air to pass through. AD fig. 8, is the receiver plate; B is a long square piece of glass screwed to the undermost side of the plate, through which a hole is drilled, corresponding with that in the piston, which receives the plate, and with the three female screws b b c.

To conceive how the rarefaction of the air is effected, suppose the piston to be at the bottom of the barrel, and a receiver to stand upon the plate; the inside of the barrel from the top of the piston to a is full of air, and the piston shut; when drawn upwards, by the cylindrical wire H, it will drive the air before it through the hole a into the oil-vessel R, and out into the atmosphere by the tube T. The piston will then be at the top of the barrel at c, and the wire q q will stand nearly as it is represented in the figure, just raised from the tube L, and prevented from rising higher by means of the nut a. While the piston is moved upwards, the air will expand in the receiver, and be driven along the bent tube m into the inside of the barrel. Thus the barrel will be filled with air, which, as the piston rises, will be rarefied in proportion as the capacity of the receiver, and pipes, and pressure of the barrel alone. When the piston is moved downwards again by H, it will force the conical part fig. 5, out of the hollow part fig. 6, as far as the shoulders a a, fig. 4. It will rest upon a, fig. 6, which will then be so far open as to permit the air to pass freely through it, while at the same time the end q q is forced against the top of the hole, and closes it in order to prevent any air from being drawn into the pump. Thus the piston, when moved downwards, suffers the air to pass out between the figs. 6 and 5, and when it is at the bottom of the barrel, will have the column of the air above it; and, consequently, when drawn upwards, it will shut and drive out this air, and by opening the hole L, give a free passage to more air from the receiver. This process being continued, the air will be exhausted out of the receiver as far as the valve-pump will permit: for in this instrument there are no valves, as in common air-pumps, to be forced open by the air in the receiver, which, when its elasticity is diminished, it becomes unable to effect; nor is there any other way to prevent the air from expanding to the greatest degree.

The oil-vessel G, fig. 2, must be always kept about half-full of oil; and when it has stood long without using, it will be right to draw a table-spoonful or more through it, by pouring it into the hole a, in the middle of the receiver-plate, fig. 1, when the piston is at the bottom of the barrel; then by moving the which H backwards and forwards, the oil will be drawn through all the parts of the machine, and the superfluous part will be forced out through the tube T, into the oil-vessel G. Near the top of the cylindrical wire H, fig. 2, is a square hole, which is intended to let in some of the oil from the vessel G, that the oil-leathers, through which the wire q q slides, may always be duly supplied with it. Fig. 9, is a representation of a condensing-apparatus used with this pump.

Mr. Cuthbertson has by many experiments shown the great powers of exhaustion of which this pump is capable. With the double syphon-gage, and also with the long gage, compared with an attached barrel in which the mercury was boiled, the difference between the heights of the mercurial column proved no more than \( \frac{1}{4} \) of an inch; the barometer standing at 30 inches, which is an exhaustion of 1200 times; and on one occasion, when the pump was very dry, he observed the difference to be as low as \( \frac{1}{5} \) of an inch, which gives more than double that degree of rarefaction.

We must omit the American air-pump, invented by Mr. Prince, which first took away the valves, which were long known to be a great check in the course of the pump, by the top plate of the barrel above the piston. His next attempt was to expel the air more perfectly out of the barrel than Mr. Smeaton had done, by making a better vacuum between the piston and the top plate of placing a few air-driven fittings, that the air, which serves to protrude itself into the barrel from the receiver. Mr. Prince also contrived to connect the valves on the top plate with the receiver occasionally by means of a pipe and cock, by the turning of which the machine might be made to exhaust or condense at pleasure. In order to remove the pressure of the atmosphere from the valve on the top of the barrel, when a few air-driven fittings, the piston-valve, which is solid, moving through a collar of leathers, and a valve near the top, through which the air is forced into the atmosphere. This pump with one barrel of the valve-pump is chiefly used in order to rarefy the air above the valves, or to remove the weight of the atmosphere from them. When this valve-pump is used, the passage through the cock is shut up; and, therefore, by means of placing three ducts at equal distances round the cock in the manner of Mr. Smeaton's, Mr. Prince divided the whole into five equal parts, leaving the distance of one-fifth part between the cock and the valves for connecting the lower hole through the cock opens the cistern to the atmosphere; but when the communication is made between the cisterns and the receiver for exhaustion, a solid part of the key comes against the duct leading to the valve and shuts it up, and the air which is forced out of the barrel, passes through the atmosphere into the valve-pump; for the valve of the small pump may be kept open, while the great one is worked.

Upon this construction, the pump with two barrels may be made like the common pump, which cannot be conveniently done where the lower valve is retained. In this pump, the pistons do not move the whole length of the barrels, but slide from the outside inwards, a little more than half-way from the bottom, where the top plates are inserted. The pump is thus made more convenient and simple; as the head of it is brought down upon the top of the barrels, in the same manner as in the common air-pump. The barrels
also stand upon the same plane with the receiver-plate, and this plane is raised high enough to admit the common gage of 32 or 33 inches to stand under it without inconvenience. The water, when it moves through a less portion of an arch at each stroke, than it would do if the pistons moved through the whole length of the barrels.

A gage for measuring the degree of condensation, having a free communication with the valves, cock, &c. is placed between the barrels in this pump; and the gage is so constructed that it will always serve to measure the rarefaction above the valves when the air is worked off by the valve-pump. It consists of a small ball, the die, which is made of glass, through which a cylinder for the mercury, a hollow brass pillar, and glass tube hermetically sealed at one end, which moves up and down in the pillar through a collar of leathers. When the pump is used as a condenser, the degree of condensation is shown by a scale marked on one edge of the pillar; while the other edge, through which a degree of rarefaction of the air above the valves, is shown by a scale on the other edge of the pillar. This gage will also show, when the valves have done playing, either with the water standing on them, or taken off, in the manner which the author has described. The degree of condensation may be also measured by the number of strokes of the which. For the purposes of great condensation, Mr. Cuthbertson has fitted a condenser of a smaller bore than the barrel of the great pump to the cylinder of the valve-pump, to be screwed on occasionally. Or, without this condenser, the valve-pump may be adapted to the purpose by being made a little larger, and by having a plate made to screw into the bottom of the cylinder, with a valve on it opening into the cistern; a hole must be made to be opened on the same occasion near the top of the cylinder, to let air in below the piston when this is drawn up above it.

The common gage, which is generally placed under the receiver-plate, is placed in the front of this pump; and it may be seen by the person who works it, and that the plate may be left free for other uses. The plate is so fixed to the pipe leading to the cock, that it may be taken off at pleasure, and used as a transfer; and it may also serve for other purposes.

The head of this pump is made whole, except a small piece on the back, where the wheel is let in; and the wheel is freed from the piston-rod by pushing it into the back part of the head, and it is kept in its place by a button screwed into the socket of the axis behind. By this apparatus, the piston-rods are disengaged from the wheel, and let down into the cistern, when the pump is not used; and in these positions they may also have the advantage of being covered with oil. The principal joints of this pump are sunk into sockets, that the leathers which close them may be covered with oil to prevent leaking. The lower part of the pump is fitted with drawers to contain the necessary apparatus.

We shall close our account of the two pumps of Prince and Cuthbertson, with the following judicious remarks of Mr. Nicholson on their respective merits and imperfections:

"There is no provision to open the upper fixed valve of Prince's greater barrel, except the difference between the pressures of the elastic fluid on each side of the strip of bladder; and this may reasonably be inferred to prevent the leak. In Cuthbertson's pump, the same valve is exposed to the action of the atmosphere, together with that of a column of oil in the oil-vessel. The mischief in either instrument is probably the same, but in both the valve might have been opened mechanically. If this were done, the small pump of Prince might, perhaps, be unnecessary in most states of the atmosphere.

With regard to the lower valves, Cuthbertson, by an admirable display of talents as a workman, has ensured their action. Prince, on the other hand, has, by the process of reasoning, so far improved the instrument, that no valves are wanted. In this respect, he has the advantage of simplicity and cheapness with equal effect. The mechanical combination of Cuthbertson's pump, reduces the operation to one simple act of the handle; but Prince's engine requires some manipulation of the smaller pump, though this might have been remedied by a more skilful disposition of the first mover.

"The most perfect scheme for an air-pump, to be found amongst the labours of these judicious operators, seems to be that in which two pistons of the construction of Prince should work in one barrel, one piston being fixed at the lower end of the rod, and the other at the upper end of the piston; one piston must come clear out of the barrel when down, and work air-tight through a diaphragm at an equal distance from the effective ends of the barrel. In the diaphragm must be a metallic valve of the form of Cuthbertson's lower valve, but with a short tail beneath, that it may be mechanically opened when the piston comes up. Above the diaphragm must work the other piston, similar to the first; but as it cannot see above the barrel when down, a small portion of the barrel must be enlarged just above the diaphragm, so that the leathers may be clear in that position. Lastly, the top of the barrel must be closed and fitted with a valve to correspond to the excellent contrivance of Cuthbertson.

"If we suppose the workmanship of such a pump to leave the space between the diaphragm and lower piston, when up, equal to the thousandth part of the space passed through by the stroke of that piston, the rarefaction produced by this part of the engine, in theory, bears the same proportion to that of the external air: and the same supposition applied to the upper piston, would increase the effect one thousand times more; whence the rarefaction would be one million times. How far the practical effect might fall short of this, from the imperfectness of workmanship, or the nature of the air, which, in high rarefactions, may not diffuse itself equally through the containing spaces, or from other, yet unobserved circumstances, cannot be deduced from mere reasoning, without experiment.

PNEUMORIA, a genus of insects of the order Heteroptera. The generic character is, legs six, for running; eyes two, composed of eight; tail forked, forked, for leaping, in-fected; antennae stictic, elongated. The podura are small insects which, in general, are found in damp places, and in the bark of trees, &c. When disturbed, they suddenly spring to a small distance by the help of a long, forked process, which is doubled under the abdomen, and which is suddenly thrown out during the act of leaping.

One of the most common of this genus is the podura aquatica of Linnaeus, measuring scarcely the twelfth part of an inch in length, and entirely of a black colour. This a singular species, and is occasionally seen assembled in large numbers, particularly near the brink of ponds, covering the ground to the distance of several feet, and sometimes even the surface of the water itself. On the ground its legsions, on a cursory view, have the appearance of scattered grains of gunpowder; and, if closely examined, will be found to be in an almost continual skipping motion.
POETRY is that kind of literary composition which is characterised by metre, harmony, and personifications, responding to the intellect and passion; it is the language of passion, or of elevated imagination, in which the terms from Burke and Gibbon in another, as brilliant combinations of thought as any that have been exhibited in verse.

The following passage from Shakespeare, though written in prose, is as rich in imagery as any part of his poetical compositions:

"This glorious frame, the earth, seems to me a sterile primitivity: this most excellent canopy, the air; this majestic roof, fitted with golden fire, why it appears no other thing to me than a foul and pestilential congregation of vapours. What a piece of work is man! How noble in reason; how infinite in faculties; in form and moving, how express and admirable; in action, how like an angel; in apprehension, how like a god!" The figures of rhetoric, therefore, (see Rhetoric) including all the varieties of metaphor, allegory, and simile, are common to all the higher orders of literary composition; the mechanism of verse being, as it were, the common base of decoration, by which the boundaries of prose and verse are distinguished from each other.

Antient poetry.

That the higher order of poetry is not attainable in an uncultivated age, is a truth that cannot be disputed. Admitting language to be, as Mr. Richardson ingeniously observes, the barometer of society, by which its comparative barbarism or civilization is indicated, it will be obvious that the bards of the ancient Hebrews, of the lothies for a primitive nation, tenacious of its customs and opinions, unilluminated by science, uncorrected by taste, and as little acquainted with the arts as the inhabitants of some of the earliest regions of the world. The simplicity and energy of the Hebrew language, accorded happily with the sublime nature of sacred poetry; and to the peculiarities in its constitution it is, perhaps, owing that the primitive character of its composition is tamely preserved to whatever language transferred, or with whatever idoms assimilated. The musical harmony of the Hebrew language is now but imperfectly known; its prose is, however, sufficiently understood to suggest a comparison between its rhymes, and the wild measures familiar to the Scythian nation. Alliteration was freely admitted in their verse, as were identical terminations and other artificial embellishments; but its distinctive feature was a symmetrical disposition of rhymes, which were cast into parallel verses of equal length, and correspondent in sound and sense; the sentiment expressed in the first distich being repeated and amplified in the second, as in the following example:

"The Lord rewardeth me according to my righteousness: according to the cleanliness of my hand he hath recompensed me. The statutes of the Lord are right, rejoicing the heart; the commandment of the Lord is pure, and enlighteneth the eyes. The fear of the Lord is clean, enduring for ever; the judgments of the Lord are pure and righteous altogether." This practice, which appears to have been peculiar to the Hebrews, was derived from their rites of worship; in which the sacred hymns were chanted by bands of singers, who alternately responded to each other.

The Hebrew bards employ few epithets; the brevity of their style renders its sublimity conspicuous; their imagery is bold and energetic; their magnificient conceptions issue from the mind in native majesty and strength; their imagination is sometimes wings of a figure, and to them, metaphor and figure take on every subject, in most exquisitely beautiful and fertile.

Although Hebrew poetry presents nothing that is not in the language of a poetical description, it affords innumerable examples of the lyric, the elegiac, and the didactic style. In the prophesies, the favourite figure is allegory; the Hebrews having, in common with other Oriental nations, a decided predilection for the parabolic species of writing. It would be injustice to the sacred bard, not to remember in what country he wrote, and with what people he lived. On examination, his images will be found to have been faithfully transcribed from nature, and beautifully to have harmonised with the scenes and manners familiar to his observation and experience; but the pure and uncorrupted German mind of the refined bard, is his most exalted attribute, and is evidently the cause of his pre-eminence in sublimity over all other Oriental writers.

The Arabs were not, like the Hebrews, a stationary people; they travelled from rest to rest of mankind. Alternately engaged in commerce and war, their errant chiefs visited distant regions; and in their intervals of leisure, were no less ambitious of obtaining the distinction, than they had been to secure military fame. Poetry, which constituted the sacred science of the Hebrews, became with the Arabs a polite accomplishment; and as the copiousness of their language supplied all the aptitudes for poetic poetry, the origin of painting is not early remote.

Many subordinate arts, concomitant with the progress of civilization, must have previously existed; and it is well known that poetry inspired enthusiasm and veneration, not only in antiquity, but in the Hebrews and the Arabs, to whom the delineation of the human form was an art prescribed by legislative authority, or esteemed by national prejudice. The first specimens of poetry in the society for which they were composed, was an initial character of verse; and the rudiments of rhyme are discernible in those similar or identical terminations, by the Celtic and Roman bards, and exemplified in the practice of Oriental antiquity. By the agency of metre, a poetical style was gradually produced; and in the humour of balancing and adjusting his sentence, the poet insensibly acquired vigour, discrimination, and taste.

Figurative language, which is familiar to a primitive state of society, has supplied to every people some of the purest elements of poetry. But this language is not the only source of poetry; it belongs to every writer of imagination; and though more essential to verse, is almost equally becoming in prose; nor would it be difficult to produce from Bacon and Jemmison, in the lowest ages, examples of the kind.

By a more judicious writer it is assumed to be the language of passion, or of elevated imagination, which words are burdened with figures of speech, numbers, and this definition, though not perfectly correct, is, perhaps, less exceptionable than any other which has been submitted to investigation.

Poetry is some kind of art, yet is not unfrequently classed with the sciences; a dignity perpetuated to it by traditional authority, from early ages, when the bard was a personage sacred as the priest, and all the knowledge or the wisdom extant was developed in fable, or unfolded in numbers.

In the progress of society from barbarism to refinement, it was impossible that the analogies subsisting between certain operations of intellect should be overlooked; and the mythology of Greece, which embodied even the abstractions of science, gave to these metaphysical relations a personal character corresponding with the sympathies and dependences of the necessities of human life. In these particular personifications, a remarkable predilection appears for the triple numbers. The Paracel, the Furies, and the Greeks, and originally the muses, were composed of sextet, like man; nature; poetry, and painting, from the instinctive connection observed between the two first of these arts, and their supposed affinity to the last, were united in the same bond of union; and the legitimacy of the relation on which this elegant allegory was founded, is yet recognized in popular language as an unepiscopal and undisputed truth.

Of these kinds of arts, music and poetry, issued from the same woods, cherub and respected by the rudest and most uncultivated generations of men. The metre of poetry is evidently borrowed from the simple melodies of music; and it may be presumed, was produced, in the first efforts to combine voice with instrumental sounds. The ambition of the primitive poet must have been limited to that artificial modulation of language which is now considered as the least and lowest of poetical attainments, but which unquestionably forms a radical part in the constitution of poetry. The theory of painting is not equally remote. Many subordinate arts, concomitant with the progress of civilization, must have previously existed; and it is well known that poetry inspired enthusiasm and veneration, not only in antiquity, but in the Hebrews and the Arabs, to whom the delineation of the human form was an art prescribed by legislative authority, or esteemed by national prejudice. The first specimens of poetry in the society for which they were composed, was an initial character of verse; and the rudiments of rhyme are discernible in those similar or identical terminations, by the Celtic and Roman bards, and exemplified in the practice of Oriental antiquity. By the agency of metre, a poetical style was gradually produced; and in the humour of balancing and adjusting his sentence, the poet insensibly acquired vigour, discrimination, and taste. Figurative language, which is familiar to a primitive state of society, has supplied to every people some of the purest elements of poetry. But this language is not the only source of poetry; it belongs to every writer of imagination; and though more essential to verse, is almost equally becoming in prose; nor would it be difficult to produce from Bacon and Jemmison, in the lowest ages, examples of the kind. By a more judicious writer it is assumed to be the language of passion, or of elevated imagination, which words are burdened with figures of speech, numbers, and this definition, though not perfectly correct, is, perhaps, less exceptionable than any other which has been submitted to investigation. Poetry is some kind of art, yet is not unfrequently classed with the sciences; a dignity perpetuated to it by traditional authority, from early ages, when the bard was a personage sacred as the priest, and all the knowledge or the wisdom extant was developed in fable, or unfolded in numbers. In the progress of society from barbarism to refinement, it was impossible that the analogies subsisting between certain operations of intellect should be overlooked; and the mythology of Greece, which embodied even the abstractions of science, gave to these metaphysical relations a personal character corresponding with the sympathies and dependences of the necessities of human life. In these particular personifications, a remarkable predilection appears for the triple numbers. The Paracel, the Furies, and the Greeks, and originally the muses, were composed of sextet, like man; nature; poetry, and painting, from the instinctive connection observed between the two first of these arts, and their supposed affinity to the last, were united in the same bond of union; and the legitimacy of the relation on which this elegant allegory was founded, is yet recognized in popular language as an unequivocal and undisputed truth. Of these kinds of arts, music and poetry, issued from the same woods, cherub and respected by the rudest and most uncultivated generations of men. The metre of poetry is evidently borrowed from the simple melodies of music; and it may be presumed, was produced, in the first efforts to combine voice with instrumental sounds. The ambition of the primitive poet must have been limited to that artificial modulation of language which is now considered as the least and lowest of poetical attainments, but which unquestionably forms a radical part in the constitution of poetry.
Persic language is found to possess an amenity and an elegance which render it eminently suitable of poetical location. As poets, like those of ancient Greece, have the power of rendering language subservient to their pleasure, and of clothing original conceptions in a new-created word.

Several Arabic and Persian poems are of the epic and dramatic cast; but the compositions most inviting to the European for translation, are of an amatory, elegiac, and lyric character. In general, Oriental poetry deviates from the primitive simplicity so conspicuous in the compositions of Homer, which degenerates into affectation and bombast. In their most admired authors indeed, a passion for the gaudy and the gorgeous is ever predominant. The magnificence of their materials is disguised by their fantastic arrangement; and the eye which has dwelt with delight on the chaste graces of classical literature, soon turns with disgust from the jewelled turban and the barbaric gold. There are, however, some passages, particularly in blemmatic poetry, which are perfectly simple and sublime. Of these a noble specimen is given by sir William Jones in the hymn to Narayana.

Of classical poetry.

The geniuses of genius scattered through Oriental compositions with wild luxuriance, appear in classical poetry displayed in full perfection and beauty. To what causes the pre-eminence of ancient Greece in this part of literature is to be attributed, it would here be futile to conjecture. From the susceptibility of his language, the poet was enabled to exhibit the same idea under a new aspect, and to give to every fluctuation of feeling a permanent expression. If the vivacity of his descriptions fascinated the imagination, his numbers dwelt with no less enchantment on the ear. The length and shortness of syllables in the Greek and Roman languages, which constituted their quantities, was determined by rules less accurate than the notes in music; and on the proper distribution of these quantities, the harmony of their metre depended. A stated interval of time was allowed to the pronunciation of every verse. To facilitate the labour of composition, artificial combinations of syllables by the name of feet, were invented; and by the number of these, and the quantities included in them, the character of the verse was ascertained.

To these combinations various names were given; the most important were the spondee, composed of two long syllables, and the dactyl, formed by one long and two short syllables. These were solely employed in the construction of the hexameter verse, of which an imitation has been vainly attempted in the English language. The pronunciation of the Greek and Latin languages is, indeed, almost as totally lost to us, as that of the Hebrew; but such is the exquisite mechanism of their metre, that their verses can not be read without producing a rich and often a melodious intonation, perceptible even to the unlettered ear.

In the happy regions of Greece, it is uncertain what species of poetry was first cultivated. Fables were compositions of great antiquity; the ode formed a part of religious worship; the pastoral must have been introduced in an age sufficiently refined to relish the simplicity. The immortal odes of Homer were composed at an early epoch of Grecian literature, and, as is well known, transmitted by oral tradition to a more polished age. Of this extraordinary man, so much has been said, and so much might appear difficult to say anything which should not now be trivial or impertinent. This arduous task the perseverance of modern criticism has, however, achieved; and a scholastic sect is now known to exist, which sacrilegiously remove the shrine of Homer from the temple of fame, and abandon to superstitions credulity a name sanctified by the enthusiasm and veneration of preceding ages.

It is pretended that the Iliad and Odyssey were composed at different eras, by various authors; and that these desultory tales of Troy were at length collocated and edited by some ingenious critic, who might possibly have been distinguished by the appellation of Homer. The novelty, and perhaps, the extravagance of this hypothesis, have obtained for it partisans among those professed sceptics and of scoffers, who can perceive no difference between vulgar errors and popular opinions, and whose name is in vogue as far as possible from all participation in the sentiments or convictions of other men. It is generally admitted that the excellence in which the supposed Homer stands unrivalled, is the energy of his conceptions, which gives to his personages, his scenes, and his descriptions, a real and individual existence. With such felicity is his characters cast, that no reader of feeling can be at a loss to conceive how Achilles would look, or Nestor speak, or Ulysses act, on any imaginary occasion. The unpredisposed will decide whether such exquisite harmony of design could have been the result of chance, or whether each book had its separate Homer, or whether they were all planned and executed by one.

In lyrical composition, the most popular was the heroic ode. The name of Pindar has descended to us with honour; but the poets who inspired in his compatriots the most exalted enthusiasm, and imperfectly understood by the student, and are almost impossible to translation. The public recitation of the ode was accompanied both by music and a dance, in a circumstance in which its structure was obviously adapted. The two first stanzas, called the strophe and the antistrophe, were of equal length. In the first part the performers approached the altars of their god; in the latter, the dance being inverted, they measured back their steps to their former place, whilst they sung the epode they stood still. It appears that this form was peculiar to the heroic ode. There were other lyric compositions of a different cast. Sophocles's poems require only tender, impassioned sentiment; those of Anacreon, whether amatory or convivial, are equally remote from the sublimity of Pindar, and the melting beauty of Sappho. The fervid imagination of Pindar is compared by Horace to the impetuosity of a mountain torrent:

Monte decurrens velut amnis, imbre
Quem super notas alius ripas,
Ferret, innomenusque ruit profunde
Pindarn orae:

Pindar, like some fierce torrent swarm with showers,
Or sudden cataracts of melting snow,
Which from the headlong deluge pour,
And labour and thunders o'er the vales below,
With desultory fury borne along,
Rolls his impetuous, vast, unshakable song.

WEST.

The heroic ode is evidently of a dramatic character, and was the primitive source from which the regular drama was produced. Tragedy originates from the passion sung in honour of Bacchus; and its name was derived from the goat, which was the victim consecrated to that deity. The invention of dialogue and action belongs to Eschylus; the original scene were preserved in the chorus, which constituted the popular part of the entertainment. The chorus, like the band of a modern orchestra, was composed of several persons who recited in a different manner from the other performers. It is learned from Horace that their business was to deduce from the passing scene some lesson of morality, or to calcule on the spectator some religious precept. The intervention of the chorus, which is now rejected by the most zealous votaries of Greece, is not more repugnant to our ideas of propriety than many other usages of the ancient stage: the performers appeared in masks; in their recitations they were constantly accompanied by musical instruments, by which the voice was sustained, and the melody of the verse rendered sensible to an immense audience. The rules of the stage were rigidly observed. The unities of time and place were necessary in a performance to which the auxiliary resources of modern machinery were wanting, and from which all the magical illusions of the theatre have been stolen. The tragedies of Euripides and Sophocles were masterpieces in their kind, but would now probably be little relished even by scholars and学者式elinists.

Comedies, like tragedy, originally consisted of a chorus, which derived its name from the god Comus. The rudiments of the comic art may, perhaps, be detected in the satyr, a sort of interlude annexed to tragedies, in which the scene was subterranean, and the characters were the gods, satyrs, or sylvan deities. In the plays of Aristophanes, living characters were introduced, and Socrates beheld himself ridiculed on the stage. This abuse a better taste corrected; and the comedies of Menander, which were imitated by Terence, exhibited only interesting pictures of domestic life. The chorus at first attendant on comedy, was gradually changed into the prologue, a personage who carried on the conversation with the spectators of all they were to see on the stage.

The Roman writers were modelled on those of Greece, and it was long before they attempted to emulate their masters; yet Ennius, one of their elder poets, produced the satyr, a species of miscellaneous poetry purely Roman, which was destined to receive perfection from Horace. With equal originality, Lucretius wrote his metaphysical poem, in which he developed the great system of his age; but it was not till the era of Augustus that the bards of Latium established their equality with those of Greece. It was then that Horace, not satisfied with having
POETY.

[Text content is not shown]
Wherein old dotes of deep wounds did remain,
Yet arnes till that tune did ever yield.
His angry steed did chide his foaming tact,
As much disdaining to the curb to yield:
A jolly knight he seem'd, and faire did sit,
As one for knightly guests and fierce en-
counters fitt.

A stanza more polished in its structure is adopted by Mr. Sotheby in his admirable translation of Wiclak's Oberon. The fol-
ing passage describes Rezia's first interview with the Hermit:

"Rezia, at once enchanted in holy bliss,
A'w'd by his look, that beams celestial grace,
Bows, as before the genius of the place,
And prays his wrinkled hand with pious kiss,
Touched by his gracious mien or friendly air,
His beat that breath his weapon with silver
hair,
Her soul this stranger as her sire revere;
A second look has banish'd all her fears.
Her heart, the other's heart, nor finds a
stranger there.

The most popular stanza is that appropriate
to the ballad, which is composed of four lines with interchanging rhymes. Such is the me-
asure of Goldsmith's beautiful tale of Edwin and Angelica.

"Turn, gentle hermit of the vale,
And guide my lonely way,
To where you taper cheer's the vale
With hospital ray.
And such, with the remission of rhyme in the first and third lines, is the measure of Chevy
Chase:

"God save the king, and bless the land,
In plenty, joy, and peace;
And grant henceforth that foul debate
Twixt noblemen may cease!"

The elegiac stanza consists of four alter-
nately responsive lines of ten syllables each:
it is well adapted to short poems; but in com-
position of any length, its slow monotonous
cadence becomes oppressive to the ear.
In the celebrated elegy of Gray, its defects,
however, are all concealed by a profusion of
poetical beauties; and by the graceful mien
of Hammond his letters are rendered elegant
and ornamental:

"Why should the lover quit his pleasing
home,
In search of danger on some foreign ground?
Or from his weeping fair ungrateful mum,
And love in every stroke a double wound?
All better far, beneath the spreading shade,
With cheerful friends to drain the sprightly
bowl,
To sing the beauties of my darling maid,
And on the sweet idea feast my soul."

The common anastropic verse, of eleven and
twelve syllables, in which the accent falls on
every third syllable, has generally been ap-
priopriated to humorous subjects; when
formed into the stanza, it assumes a different
character. In the noble song of Burns it is
however a strain truly sublime; and in the
following passage flows with equal sweetness
and pathos:

"'Tis night, and the landscape is lovely
No more:
I mourn; but, ye woodlands, I mourn not for
you;"
Poetry.

The name of Elegy was originally given to funeral monody, but was afterwards attached to all plaintive strains. In the Latin language it was always written in hexameter and pentameter verse. By the moderns an elegiac stanza was invented, assimilating as nearly as possible to those slow melodious numbers. Many elegies, and perhaps the best, are expressive only of soothing tenderness. Such are those of Tibullus, so happily imitated by Hammond. The Jesu of Shenstone, which has perhaps never been surpassed, is all pathos. The celebrated elegy of Gray combines every charm of description and sentiment. The elegiac stanza, the motto-phony of which soon becomes oppressive to the ear, is sometimes happily exchanged for a lighter measure, as in Cowper's Juan Fernandez:

Ye winds that have made me your sport,
Convey to this desolate shore
And some cordial endearment soft
Of a land I shall visit no more.

My friends do they now and then send
A wish or a thought after me?
Oh! tell me, I yet have a friend,
Though a friend I am never to see.

The Sonnet represents an abridged form of the ancient elegy; the same slow stanza is assigned to each, and the sentiments suitable to the one are appropriate to the other. The sonnet is derived from the Italian school, and was much cultivated in England during the seventeenth century. It is always limited to fourteen lines, an artificial character which should seem to indicate an oriental extraction. The following, by Milton, is a fine specimen of the English sonnet in the Italian manner:

"O nightingale, that on you leafy spray
Wast blest at eve, when all the woods are still
That with fresh hopes the lover's heart dost fill,
When the jolly Hours lead on propitious May.
Thy liquid notes, that close the eye of Day,
First heard before the shallow cuckoo's hill,
Poured success in love. Oh! if Jove's will
Have linked'd that amorous power to thy soft lay.
Now timely sing, ere the rude bird of late
Foretell my hopeless doom in some grove nigh,
As thou from year to year hast sung too late
For my relief, yet hast not reason why,
Whither the morn or Love call thee his mate,
Both them I serve, and of their train am I."

In the following sonnet, which is of a modern date, the stanza is happily accommodated to the English language:

Written in the church-yard of Middleton, Sussex.

Press'd by the moon, mute arbitress of tides,
With all the loud and unceasing powers,
The sea no more its swelling surge confounds,
But over the shrinking land sublime rides.

He touch'd the tender gorge of various quills,
With eager thought, surging his Doric
dand
And saw the sun had stretched out all the hills,
And now was dropt into the western bay.

At last he rose, and twitch'd his mantle blue,
To-morrow to fresh woods, and pastures new.

The primitive sources of modern poetry may be traced to the old romance; whence was derived the simple ballad so popular in England and Scotland, and under various names and forms universally adopted in Europe. On the revival of letters, when the study and imitation of the classics became the passion of all literary men, their nomenclature was eagerly assumed; and volumes of poetry were soon composed, which the high-sounding terms of odes, pastoral, satires, and epic poems, have not saved from oblivion; volumes of criticism were also compiled, to show how pastorals, odes, and satires, ought to have been written.

Pastoral poetry is, above all other, the most limited in its object; and when formed on the model presented to us by Virgil and Theocritus, should be a description of rural scenes and natural feelings, enriched with elegant language, and adorned by the most melodious numbers.

Few English pastorals will be recognized in this definition; the scenes they represent are artificial, and the sentiments fictitious, because they are imitated from other poets, the natives of a luxurious region, accustomed to varying ranks and growing luxury of a cloudless sky. From this censure, however, the pastoral drama of Allan Ramsey must be excepted, as should Shenstone's celebrated ballad. The ballad is perhaps the happiest vehicle of pastoral poetry, and there are in our language many ballads of exquisite beauty. Some of our pastorals are elegiac; such is Milton's sonnet on Lydick:

"Together both, ere the high laws appear Under the opening eyelid of the Morn, We drove afield; and both together heard What time the grey fly winds her sultry horn, Batt'ning our flocks with the fresh dews of night, Oft till the star that rose at evening bright, Towards heaven's descent had slid his westering wheel."

The conclusion of this poem is in the true spirit of elegant pastoral:

"Thus sung the uncouth swain to th' oaks and rills, When the still Morn went out in sandsal grey;"
The wild blast rising from the western cave,
Drives the huge billows from their heaving bed,
Tears from their grassy tombs the village dead,
And breaks the silent Sabbath of the grave.
Wild calls and sea-weed mingled on the shore,
Lo! their bones whiten on the frequent wave.
But vain to them the winds and waters rave,
They hear the barking elements no more;
While I am doom'd, by life's long storm oppressed,
To gaze with envy on their gloomy rest."

Pope's Elegy to an Unfortunate Lady, and his Eloisa, are in heroic verse; which, in the hands of that great master, is adequate to the expression of every feeling.

LYRIC poetry is versatile and miscellaneous, admitting almost every diversity of measure and of subject. Love and heroism, friendship and devotional sentiment, the triumphs of beauty and the praises of patriotism, are all appropriate to lyrical composition. The soul of enthusiasm, the spirit of philosophy, the voice of sympathy, may all breathe in the same ode. Of our lyrical writers, Dryden is confessedly eminent; Gray is distinguished by the majesty and delicacy of his expression, and the correctness of his style; Collins is occasionally animated by a portion of Pindaric spirit. Among our heroic odes there are, perhaps, none that breathe a loftier strain than the following patriotic invocation by Burns:

"Scots, who have with Wallace bled,
Scots, whose Bruce hath often led,
Welcome to the gory bed,
Or to glorious victory.
Now's the day, and now's the hour,
See the front of battle lower;
See approach proud Edward's power,
Edward's chains and slavery.
Who will be a traitor knave?
Who can a coward's grave?
Who so base to be a slave?
To Traitor, coward, turn and flee.
Who for Scotland, king, and law,
Freedom's sword will strongly draw,
Freeman stand, and freedom fit?
Caledonian, on wi' me.
By oppression, woes, and pains,
By your master's servile chains,
We will draw our dearest vein,
But they shall be, shall be free.

Lay the proud usurpers low;
Tyrants fall in every foe,
Liberty's in every blow:
Forward let us do, or die."

In the minor lyrics are included SONGS, a species of composition sedulously cultivated by English writers. The themes of songs are in general amatory or convivial; there are however some, of which the strain is purely patriotic and martial; and not a few are of the humorous cast. Shakespeare, Jonson, and our other elder bards, have bequeathed to us songs of exquisite beauty. In the last century the most popular songs were Gay. Allan Ramsay has left some enchanting airs. Percy's collection has restored many lyrical pieces of inimitable power and simplicity. In latter times, many songs of classical eminence have been supplied by Stevens, Sheridan, and Burns.

Didactic poetry is minutely preceptive, and professes to convey useful instruction on some particular subject. It is obviously not easy to discover situations in which an author can avail himself of his musical teaching, without being to the poet; and this difficulty is aggravated to the English writer, who has not the resources of the Greek and Roman in the metrical capacities of his language.

Virgil's georgic poems in the performance of the first master, operating with the best materials. In imitation of Virgil, a poem was composed by John Phillips on cypress, which is now little read. Towards the middle of the last century, when the didactic muse had most volatilized, polemics, politics, and metaphysics, were successively expended in verse. But verses is not the medium by which information can be communicated with most advantage; and is less nobly employed in elucidating a practical teacher, than in enforcing popular and acknowledged truths. The philosophy of Aesop is relished only for his imagery and harmonious language. The aphorisms of Armstrong are remembered with more sentiment than the maxims of the authors to the influences of Apollo Cimii and Lasciaui. The Economy of Vegetation, and the Loves of the Plants, are formed on a plan not only original, but new. It is probable that the primary idea of this work was suggested to the author by the perusal of Cowley's Garden; but that on that simple site he has erected a magnificent palace, in which no vestige of the antient edifice remains. With an imagination consuming as that of Ovid, and with powers of description scarcely less universal, he has invented a machinery appropriate to his subject, and which is also derived solely from the philosophy of modern times. From the extensive notes appended to his poems, it is however obvious, that though he might thus embody the principles of science to the eye of fancy, he despaired of rendering them intelligible without the aid of prose. Mr. Pope's Garden is more descriptive than didactic. Dr. Lillie's Jardins is a chef-d'oeuvr in its kind. In the Essay on Criticism, Pope has most happily enlivened didactic style with wit and satire.

Satirical poetry is descriptive of men and manners; its aim is to delineate the follies and chaste the vices of the age. Satire is evidently the offspring of poetical times; and, unlike other poets, the spirit finds its empire enlarged, and his influence extended, by the progress of society.

Satire is either pointed or oblique: eloquence is the soul of the one, ridicule of the other. The one is on its object in a torrent of vehemence and declamation; the other pursues a smooth tortuous course, occasionally reflecting to the mind the most monstrous truths in the playful aspect of wit and humour. In the Timon of Bucolik, the Latran of Balfe, and the Rape of the Lock, the effect of oblique satire is heightened by an assumption of the heroic style; the perversion of which produces an effect similar to that in the burlesque strain and (Greek's) Vers-vers-vers. Of this species, as do many of Voltaire's greater poems, and many of La Fontaine's tales. Small satire is commonly of a similar cast. The satire of

Young is always pointed and satirinize. Ir Churchill that the pointed and the oblique are happily united: the last, as in Dryden and Pope, the two great original masters of English satire, who both possessed wit and fancy, a knowledge of men and manners, and an intimate acquaintance with the temperament of characters, with the aptitude of describing them, which are its first requisits. The following extracts afford a specimen of the manner in each of delineation of character; it must, however, be remembered, that Pope moralizes whilst Dryden declaims:

"Some of their chief's were leaders of the land: In the first rank of these did Zimri stand; A man so various, that he seemed to be Not one, but all mankind's epitomiz."

"With something new to wish, or to enjoy."

"Railing and praising were his usual themes; And both to shew his judgment in extremes."

"That every man with him was God or devil."

"In squandering wealth was his peculiar art;"

"Nothing went unrewarded but desert:"

"Peggar'd by fools, whom still he found too late,"

"He had his jest, and they had his estate,"

"He laugh'd himself from court; then sought his chief."

"In forming parties, but would ne'er be chief."

"In the worst inn's worst room, with mat half-hung,"

"The walls of plaster, and the floor of dung;"

"On once a flock-bed, now repair'd with straw, With tape-tied curtains never meant to chase the wind."

"The George and garter dangling from his head,"

"Where tawdry yellow stove with dirty red;"

"Great Villiers lies: alas! how chang'd from him"

"The life of pleasure, and the soul of whim, Gallant and gay, in Clifden's proud above,"

"The bower of wanton Shrewsbury, and love; Or, just as gay at council, in a ring Of mimic statesmen and their penny king."

"No wit to flatter left of all his store;"

"No fool to laugh at, which he valued more,"

"The victor of his health, his fortune, friends,"

"And fame, this lord of useless thousand's ends."

"It would be amusing to pursue the comparison between those two great poets in the Dunciad and Mac Fleance; to observe the unpruned exuberance and careless vigour on the elder bard, and the exquisite judgment of his incomparable imitator.

"Epico poetry concentrates all that is sublime in action, description, or sentiment. In the structure a regular epic poem, criticism recognises that the table should be founded in fact, and that action should fill the picture of which the outline is traced by truth. In the conduct of the poem, it is exacted that the machinery be subservient to the main design,
and that the action should be simple and uniform. In the Iliad, the action is limited to the destruction of Troy, which is only incidentally affected by the conciliation of Achilles to the common cause. In the Odyssey, it is the establishment of Ulysses in Ithaca; an event which, after innumerable difficulties, he is finally enabled to accomplish. In the Aeneid, the hero is destined to found a Trojan colony in Latium. In the Jerusalem Deliver'd, the object of the poem from its commencement to its close, is the restoration of that city to the Christians. Criticism requires also that poetical justice should be dispensed to all parties, success being awarded to the virtuous, and punishment inflicted on the guilty. On these principles, three authors only, Homer, Virgil, and Tasso, have produced epic works. There are however many poems of the epic or heroic cast to which criticism has hitherto assigned no name. Such are the Lay of the Swordsmen, and the History of Voltaire; and in the Paradise Lost, Milton appears in solitary majesty and majesty. He maintains a lofty independence of rules and systems, and elevates to a distinction superior to all that criticism has hitherto bestowed. The Inferno of Dante, the Orlando of Ariosto, the Fairy Queen of Spenser, are romances; a species of composition purely fictitious, in which no other restriction is imposed on the poet's fancy than that he shall continue to interest and amuse his reader. Several romances of a recent date are intitled to praise, such as the Oberon of Wieland, ably translated by Mr. Sothren; the Thalaba of Southey; of which the characters would be more generally appreciated if the work was less tinged with gloom; and the Lay of the Last Minstrel, in which a fable of the most superficial texture is drawn out in a succession of scenes which perpetually amuse and delight the imagination. It is obvious, that the poetical nomenclature established on classical authority, is not sufficiently extensive to include all the compositions of modern times. To what classical school shall we assign the Poems of Pope, The Essay, Epistles, and Of Cowper in his Task? By what name shall we designate the Traveller and the Deserted Village, the Pleasures of Memory, the Pleasures of Hope, (either of which is, like that of Dryden, included in the didactic species), with many other exquisite productions? Ossian's poems have been classed with epic compositions, but are more analogous to the old heroic lays chanted by the scalds, bards, and minstrels. The relics of Scandinavian literature afford many specimens of poetry which, though inferior in beauty, are obviously of similar origin and execution. The original is the Drama was a metrical composition, and exhibited all the critical refinements of poetry. The title of poet is still given to every dramatic author, although he should have written in prose, and although the highest dramatic powers may exist without the smallest talent for poetry. The avowed object of the drama is to develop the passions, or to delineate the manners of mankind; tragedy, effects the one, and comedy the other. In the modern drama of a mixed character, which are written in verse, intermingled with prose, and which are called plays. The best pieces in Beaumont and Fletcher, and even Shakespeare, belong to this order. The English drama is distinguished from that of classical antiquity; and independent of the division of acts and scenes, there is little resemblance between them. The triple unities of time, place, and action, are seldom observed on the English stage. Many of the best writers have allowed, that between the acts any change of scene is admissible. In reality this operation is performed in most tragedies and all comedies, at any season, without either condition or restriction. Nor is it, perhaps, any change censurable, the cause and object of which is immediately comprehended by the audience. To the limitation of time more attention is paid. In many tragedies the action is included in one day. Unity of design is obviously an obligation imposed by good sense; and Shakespeare, guided only by his feelings of propriety, is in general careful to exclude from his plays a divided interest, an error perpetually committed by Beaumont and Fletcher, and which has disfigured dramatic comedies. To construct a truly dramatic table is no easy task. The author has to provide sources of constantly augmenting interest, to present characters, to suggest situations and incidents, and finally, to secure the active participation of the audience; above all, to supply a series of natural incidents, the springs of dramatic action, by which all the life and motion of the piece are produced. The poet who would imbibe its dramatic character from that of the individuals presented in the scene, and transmit the impression of every feeling which is there portrayed. On this excellence is founded the superiority of Shakespeare to all other dramatists; from him each passion receives its appropriate language. With a few masterly touches, he lays open the heart, exhibits its most secret moves, and excites in every bosom correspondent emotions. The poet who, next to Shakespeare, has excelled in the dramatic style, is Otway. The tragedies of Rowe possess extraordinary merit. In the plays of Beaumont and Fletcher, and Massinger, are manifestations of some noble beauty; and in those of Dryden are discovered the most brilliant combinations of thought and fancy; but the touches of nature are still wanting; that true dramatic idiom which is instantly understood by the heart, and the absence of which is not compensated by beautiful imagery, or by the most refined graces of composition. Dramatic blank verse, when flowing with freedom and facility, is more happily adapted than prose to the expression of strong emotion; it is not only more harmonious, but more concise; and being exonerated from that metrical precision which is expected in other poetry, is simply the language of impassioned feeling. Much of the imagery which might delight in the closet would offend on the stage; yet figurative language is often employed with great effect in describing the tempestuous passions. In a state of agitation, the mind becomes peculiarly susceptible of very combination. Grief is eloquent; and though the chain of thought is too tenacious to be broken by sensible impressions, it discovers in every external object some typical illustration of its own. From the spectacle of a kindred misfortune, by a kind of fictitious sympathy, seems responsive to its individual feelings. Thus Lear, though insensible to the storm, invokes the elements, reverting to the contumely he has experienced:—

"I tax not you, ye elements, with unkindness; I have given you kingdom, call'd you children; You owe me no subscription."

In impassioned language, even a mixture of metaphors is not indecisive; in a moment of distraction the mind is versatile, and indistinct in its perceptions; and consequently becomes liable to form abrupt, delusive, and even incongruous associations.

Of metrical harmony and poetical emotion.

Metrical harmony is but the medium by which the poet transmits his ideas and sentiments; it constitutes the fabric into which his conceptions are wrought, the form in which his sentiments are exhibited. Metrical harmony is common to all who assume the name of poets; from the humble versifier creeping through hedge-rows of rhyme at the foot of Parnassus, to the son of genius, who has drunk of inspiration at its source, and rides "Upon the seraph wing of ecstacy."

It has appeared difficult to suggest a proper mode of distinction between these two orders of writers; and it has been often asked, what the real difference is between the legitimate bard and a maker of pretty verses; their respective pretensions might, it should seem, be amicably adjusted, by leaving to the former an exclusive right to the character of poet, and assigning the rank of metrical poets to the latter. There is in metrical harmony a charm that often renders a trivial thought pleasing. There are also certain agreeable epithets which, if not egregiously misplaced, must always call to the mind grateful associations; and which when aided by melodious verse, will generally impart some transient sensation of pleasure. To awaken strong and permanent feelings of delight, is the prerogative only of the original bard. Poetical emotion springs from admiration or from sympathy, and may be awakened by the novelty or the renown of the poet; it may arise from combinations new to the fancy, or from recollections interesting to the heart. In the energy of his conceptions, and in the charm of his expression, resides the poet's power. There are features of sublimity and magnificence, no touches of tenderness or pathos, but may be traced to those two sources of poetical excellence. Sublimity originates in the amplitude of the poet's mind, and is discovered in the majesty of his images, or the grandeur of his sentiment; a sensation of terror, mingled with admiration, also belongs to the sublime. Such is the sensation awakened by Milton's awful description of the infernal powers:

"On a sudden open fly With impetuous roar, and jarring sound, Thy infernal doors, and on their hinges grating Harsh thunder, that lowers the bottom shroud Of Erebus."

What follows is in the true spirit of terribilis sublimity:—

"She opened; but to shut_est she could not. The gates wide open stood.

"That with extended wing a banished host,
Under spread emblems marching, might pass
Through
With horse and chariots rank'd in loose array:
So wide they stood, and like a furnace-mouth
Cast forth redounding smoke, and ruddy flame.
Before their eyes in sudden view appear
The secret of the heavy deep, a dark
Illimitable ocean, without bound,
Without dimension, whose length, breadth, and height,
And time, and place, are lost.
Sublimity is produced by grandeur of sentiment:
"Farewell, happy fields,
Where joy for ever dwells,
Hail, horrors! hail,
Inferring world! and thou, profoundest hell,
Receive thy new possessor, one who brings
A mind not to be chang'd by place or time.
The mind is its own place; and in itself
Can make a heaven of hell, a hell of heaven."
In sublime composition no image should be introduced which is not calculated to impress the mind with feelings of solemnity. The following description of Satan exemplifies the union of sublime imagery, with sublimity of sentiment. There is even something like pathos in the concluding passage:
"He, above the rest
In shape and gesture truly eminent,
Stood like a tower. His form had not yet lost
All her original brightness; nor appear'd
Less than arch-angel raved, and the excess
Of glory obscur'd; as when the sun, new-risen,
Looks through the horizontal misty air,
Shines on his beams; or from behind the moon,
In dim eclipse, disastrous twilight sheds
On half the nations, and with fear of change
Perplexes monarchs. Darkened, so yet shone
Above them all the arch-angel; but his face
Deep scars of thunder left entwined, and care
Sat on his faded cheek; but under brows
Of dauntless courage, and considerate pride
Waiting revenge; cruel, his eye, but vast
Signs of unchangeable passion, to behold
The fellows of his crime (the fellows rather)
Far other once beheld in bliss, condemn'd
For ever now to have their lot in pain.
Millions of spirits, for his fault, amerc'd
Of heaven, and from eternal splendour flung,
For his revolt; yet faithful how they stood;
Their glory wither'd, as when heaven's fire
Hath scathed the forest oak, or mountain pine,
With singed top their stately growth, though bare,
Stands on the blasted heath. He now prepare'd
To speak, whereas their double ranks they stood
From wing to wing, and half-cover'd him round
With all his peers; attention held them mute.
Thrice he assay'd; and thrice, in spite of scorn,
Tears, such as angels weep, burst forth: at last
Words, interwove with sighs, found out their way.
An energetic simplicity is essential to the sublime, which discards artificial ornament. Description includes many of the elements of poetry, and alternately produces emotions of sublimity and beauty. The figurative style is often assumed, in order to give more richness and vividness to description. The elements are thus embodied, and morning and evening are perpetually represented under some popular and pleasing image. Thus Milton personifies the morning:
"Now Morn, her early steps in the eastern plain
Advancing, sowed the earth with orient pearl."
And Shakespeare:
"But see, the Morn, in russet mantle clad,
Walks o'er the dew of yon high eastern hill."
Description is sometimes rendered more lively by the introduction of a figurative allusion. Thus, in the Allegro, Milton illustrates his description of sun-rise:
"Sometimes walking not unseen,
By hedge-row elms, or hillocks green,
Right against the eastern gate,
Where the great sun begins his state,
Rob'd in flames and amber bright,
The clouds in thousand livery's dight."
In Dryden's poem of the Flower and the Leaf is the following beautiful illustration of the spring:
"When first the tender blades of grass appear,
And buds, that yet the breath of Eurus fear,
Stand at the door of life, and ask to clothe the year."
Poeologic description is either general or local, and admits of artificial or simple imagery. In the two following passages Pope exemplifies the difference of general and local description:
"Thy trees, fair Windsor, now shall leave their wood,
And half thy forests rush into my flood;
Bear Britain's thunder, and her cross display
To the bright regions of the rising day;
Temp art icy seas, where scarce the waters roll,
Where clearer flames glow round the frozen pole;
Or under southern skies exalt their sails,
Led by new stars, and borne by spicy gales.
For me the balm and bliss, the amber flow,
The coral redden, and the ruby glow,
The pearly shell her lucid globe enfold,
And Phoebus warm the rising ore to gold."
Here the author dwells not sufficiently long on any object to leave a distinct picture on the mind. But in the ensuing lines the delineation is too bold to be missed:
"In genial spring, beneath the quivering shade,
Where cooling vapours breathe along the mead,
The patient fisher takes his silent stand,
Utter, his angle trembling in his hand;
With looks unmoved he hopes the scaly prize;
And eyes the dancing cork and bending reed.
Our plentiful streams a various race supply:
The bright-eyed perch, with fins of Tyrian dye;
The silver eel, in shining volumes roll'd;
The yellow carp, in scales bedizened with gold."
The two following extracts from Milton happily illustrate the difference of artificial and simple imagery:
"Now the bright morning-star, day's harbinger,
Comes dancing from the east, and leads with her
The flowery May, who from her green lap throws
The yellow cowslip, and the pale primrose.
Hail, beauteous May, that dost inspire
Mirth, and youth, and warm desire!"
Wood and groves are of thy dressing, hill and dale doth boast thy blessing."
"While the plowman near at hand,
Whistles over the furrow'd land;
And the milkmaid singeth blithe,
And the mower whets his stile,
And every shepherd tells his tale
Under the hawthorn in the dale."
In general description, it is the poet's object to force on the mind a variety of brilliant ideas and vivid impressions. In his local or individual delineations, he presents images palpable to the imagination, and almost to the senses; he stimulates latent feelings, or revivifies forgotten sensations. In the combination of artificial imagery, he employs the power of novelty; in that of simple images, he relies on the charm of truth. With the one the attention is awakened, by the other it is absorbed. The reader perceives in himself a capacity for forming associations till then unknown; but he is yet more pleased to retrace scenes and sentiments familiar to memory, and dear to the heart. In one instance he is astonished by the variety of the poet's conceptions, in the other he is enchanted by the fidelity of his imitations. The multiplication of figurative language and metaphorical description extorts admiration; the simplicity of natural images inspires delight. In local description the poet should introduce only such objects as harmonize perfectly with his design. Thus in his delicious landscape of Eden, Milton carefully avoids the intrusion of exotic imagery:
"Thus was this place
A happy rural seat, of various views:
Groves, whose rich trees wept odorous gums and balsam;
Others, whose fruit burnish'd with golden crown;
Hung amiable, Hesperian fables true
(If true), here only, and of delicious taste.
Betwixt them, lawns, or level downs, and rocks;
Grazing the tender herb were interposed.
Or palmy hilltop, or the flow'ry top
Of some irriguous valley, spreads her store;
Flowers of all hue, and without thorn the rose.
Another side unobtrusive grots and caves
Of cool recess, or'er which the mantling vine
Lays forth her purple grape, and gently creeps
Liberient: meanwhile, murmuring waters fall
Down the slope hill dispers'd; or in a lake
That to the fringed bank, with myrtle crown'd,
Her crystal mirror holds, unite their streams.

There is in local description a charm that renders objects, in themselves uncomeliness, engaging to the mind. The following passage presents few images of beauty: but in contemplating it, who does not feel, that without being removed from the common walk of nature, he is visited by the influences of poetry?

"The day is come, when I again repose
Here under this dark sycamore, and view
Those plots of cottage ground, the orchard tufts,
Which at this season, with their unripe fruits,
Among the woods and copses lose themselves,
Nor with their green and simple hues disturb
The wild green landscape. Once again I see
Hedge-rows, then hardly hedge-rows, little lines
Of sportive wood run wild. These pastoral frames
Green to the very door, and breathes of smoke
Sent up in silence from among the trees;
With some uncertain notice, as might seem,
Of vagrant dwellers in the faceless woods;
Or of some hermit's cave, where by his fire
The hermit sits alone."

It such is the charm of local scenery, yet greater is the captivation of that individual and characteristic sentiment, which, from its apposition to the drama, has been called dramatic. Such indeed is its enchantment, that it has been found capable of producing the most exquisite emotion, without any auxiliary embellishments from figurative language or picturesque imagery. We are never more delighted with the poet than when thus intimately admitted to his confidence, when we are suffered to commune with his heart, to explore his most retired thoughts, and partake his most sacred feelings. This charm of individuality was in some of his poems eminently possessed by Chaucer and some of our elder bards; it constituted the leading feature in Cooper's lays; it formed the signal of Burns; and it distinguished the author of the Lyrical Ballads. The pathetic, like the sublime, must be concise and simple. It depends not so much on the thought as the expression. Virgil's description of Andromache on recognizing Jason, and Chaucer's description of the tomb of Hector, is strikingly beautiful:

"Verane tua facies? & venus miri nunciatus
Note deh, vivisse aut, si lux arma cessisset,
Ubi Hector est?"

The whole passage is affecting, but the pathos dwells in the "ubi Hector est?" Figurative language is often happily employed in the description of insomniac feeling. Sometimes it appears to be the natural overflowing of tenderness:

"Thy care should be a lover's bower,
Though raging winter rest the air;
And she a broken flower,
That I would tend, and shelter there."

In general, however, the simple and unadorned style is most appropriate to pathos and tenderness. Thus Constance, in her touching appeal to the Cardinals, exclaims of her

"And so be thou; and rising to again,
When I shall meet him in the court of heaven
I shall not know him; therefore never, never,
Must I behold my pretty Arthur more."
Point is also an iron or steel instrument, used with some variety in several arts. Engravers, etchers, cutters in wood, &c. use points to trace their designs on the copper, wood, or other material, &c.

Point, in the manufacturers, is a particular term, used for all kinds of laces wrought with the needle; such are the point de Venice, point de Genoa, &c. which are distinguished by the particular economy and arrangement of their figures and designs.

Point-Blank, in gunnery, denotes the shot of a gun levelled horizontally.

Pointing the cable, in the sea-language, is注视ing it at the end, lessening the yarn, twisting it again, and making all fast with a piece of merline, to keep it from raveling out.

Poisons. Poisons are commonly divided into the animal, vegetable, and mineral kinds.

I. Poisons, animal. Several animals are furnished with liquid poisons of a poisonous nature, which when poured into fresh wounds, occasion the death or death of the victim. Serpents, bees, scorpions, and spiders are examples of such animals. The chemical properties of these poisonous juices deserve peculiar attention; because it is only from such an investigation that we can hope to explain the fatal changes which they produce in the animal economy, or to discover an antidote sufficiently powerful to counteract their baneful influence. Unfortunately the task is difficult, and perhaps surpasses our chemical powers. For the progress already made in the investigation, we are indebted almost entirely to the labours of Fontana.

1. The poison of the viper is a yellow liquid, which lodges in two small vessels in the animal's mouth. These communicate by a tube with the crooked fangs, which are hollow, and terminate in a small cavity. When the animal bites, the vesicles are squeezed, and the poison forced through the fangs into the wound. This structure was purely observed by Ray, in an Italian platanthrid; and his discoveries were completed and confirmed by the experiments and observations of Francini, Tyson, Mead, and Fontana.

This poisonous juice occasions the fatal effects of the viper's bite. If the vessels are perforated by the fangs, the liquid, prevented from flowing into the wound, the bite is harmless. If it is infused into wounds made by sharp instruments, it proves as fatal as when introduced by the viper itself. Some of the properties of this liquid were pointed out by Mead; but it was Fontana who first subjected it to a chemical examination, sacrificing many hundred vipers to his experiments. The quantity contained in a single vesicle scarcely exceeds a drop.

It has a yellow colour, has no taste; but when applied to the tongue, occasions numbness. It has the appearance of oil before the microscope, but it mixes readily with water. It produces no change on vegetable blues. When exposed to the air, the liquid is prevented from evaporation by a yellowish-white substance, which has the appearance of gum arabic. In this state it feels viscous, like gum, between the teeth; it dissolves readily in water, but not in alcohol; and a solid throws it down in a white powder from water. Neither acids nor alkalies have much effect upon it. It does not unite with volatile oils, nor sulphuret of potash. When heated, it does not melt, but swells, and does not inflame till it has become black. These properties are similar to the properties of gum, and indicate the gummy nature of this poisonous substance. Fontana made a set of experiments on the dry poison of the viper, and a similar set on gum arabic, and obtained the same results, an effect which is due to their figures and designs.

From the late observations of Dr. Russel, there is reason to believe that the poisonous juices of the other serpents are similar in their properties to those of the vipers.

This striking resemblance between gums and the poison of the vipers, two substances of so opposite a nature in their effects upon the living body, is a humiliating proof of the small progress we have made in the chemical knowledge of these intricate substances. The poison of the vipers, and of serpents in general, is almost entirely mixed with the blood. Taken into the stomach, it kills if the quantity is considerable. Fontana has ascertained that its fatal effects are proportional to its quantity, compared with the quantity of the body. Hence the danger diminishes as the size of the body increases. Smaller birds and quadrupeds die immediately when they are bitten by a viper; but to a full-sized man the bite seldom proves fatal.

Ammonia has been proposed as an antidote to the bite of the vipers. It was introduced in consequence of the theory of Dr. Mead, that the poison was of an acid nature. The numerous trials of that medicine by Fontana robbed it of all its celebrity; but it has been lately revived and recommended by Dr. Ramsay as a certain cure for the bite of the rattlesnake.

2. The venom of the bee and the wasp is also a liquid contained in a small vesicle, forced through the hollow tube of the sting into the wound inflicted by that instrument. From the experiments of Fontana, we learn that it bears a striking resemblance to the poison of the vipers. That of the bee is much longer in drying when exposed to the air than the venom of the wasp.

3. The poison of the scorpion resembles that of the vipers also; but its taste is hot and acid, which is the case also with the venom of the bee and the wasp.

4. No experiments upon which we can rely have been made upon the poison of the spider tribe. From the rapidity with which these animals destroy their prey, and even one another, we cannot doubt that their poisons are sufficiently virulent.

H. Poisons, mineral. They seem in general to prove fatal from an excess of narcotic matter; but this is a subject which requires still farther examination. See Narcotic Principle.

III. Poisons, mineral. In general these substances, as arsenic and antimonial, seem to attack the solid parts of the stomach, and to produce death by eroding its substance; but the antimonials seem rather to attack the nerves, and to kill by throwing the patient into convulsions.

Poison of copper. This metal, though when in an undissolved state it produces no sensible effects, becomes exceedingly active when dissolved; and such is the facility with which the solution is effected, that it becomes a matter of some consequence to prevent the metal from being taken into the human body even in its proper form. It does not, however, appear that the poison of copper is equally pernicious with those of arsenic or antimony. The cause of this is, that it excites vomiting so speedily as to be expelled, even though taken in considerable quantity, before it has time to corrode the stomach. Blue vitriol, which is a solution of copper in the vitriolic acid, has been used as a medicine in some diseases with great success. Verdigris also, which is another very active preparation of the metal, has been by some physicians prescribed as an emetic, especially in cases where other poisons had been swallowed, in order to procure the most speedy evacuation of them by vomit. Where copper is not used with this view, it has been employed as a tonic and antipyretic, with which view it is admitted into the Edinburgh Dispensatory under the title of cuprum ammoniacale. The effects of the metal, however, when taken in a large quantity, and in a dissolved state, or when the stomach abounds with acid juices sufficient to dissolve it, are very disagreeable, and even sometimes violent vomiting, pains in the stomach, fainting, and sometimes convulsions and death.

The only cure for these symptoms is, to expel the poison by vomiting as soon as possible, and then to drink a quencher of water; which purpose drinking warm milk will probably be found the most efficacious remedy. In order to prevent the entrance of the poison into the body, no copper vessels should be used in preparing foods or beverages, or other contents, whether well-tinned, or kept exceedingly clean. The practice of using a fine bate or green colour to pickish, or using them in copper vessels, ought not to be tolerated; for Dr. Falconer, in an article on this subject, assures us, that the sores are sometimes so strongly impregnated by this method of preparing them, that a small quantity of them will produce nausea. Mortars of brass or bell-metal ought, for the same reason, not to be used. It is evident, that a considerable quantity of the poisonous metal may be mixed with our food, or with medicines. In other cases, an equal caution ought to be used. The custom of keeping the mouth, and even the hands, of children to children with play, &c. ought to be avoided; as thus a quantity of the metal may be ingeniously taken into the body, after which its effects must be uncertain. It is proper to observe, however, that copper is much more easily dissolved when cold than when hot; and therefore the greatest care should be taken never to let any thing designed for food, even common water, remain long in copper vessels which have been used, that though the confectioners can safely prepare the most acid syrups in clean copper vessels without their receiving any detriment whilst hot, yet, if the same syrups are allowed to remain in the vessels till quite cold, they become impregnated with the pernicious properties of the metal.

Poisons of lead. This metal, when taken slowly into the stomach with our food, is casi- cally and obtundingly cold; for which reason it is sometimes called the Devonshire colic, which, after a length of time, is succeeded by palsy. Dr. Hutchinson, in his Essay on Poisons, has given a remarkable instance of a whole family who, having successively fallen a prey to paralytic dis-
orders, after a series of years, the cause was discovered to be their having used the water of a leaden pump, which had been dissolved, and which discolored the water poisonous. For the treatment of colic and palsy see Medicine. Calomel administered in small doses, till ptyalism is produced, is the most effectual way of restoring sensitivity to the nerves, which is lost from the cause. We cannot sufficiently express our abhorrence of the dread, the detestable experiments made by certain practitioners upon poor dumb creatures, to ascertain the effects of poisons; experiments made in general to gratify an idle curiosity, but which no motive can justify. We feel an honest pride in reflecting that few of these experimentists have been Englishmen; and as our work is addressed to that generous and humane nation, we have not outraged their feelings by the shocking detail.

POLE, in spheres, a point equally distant from every part of the circumference of a great circle of the sphere, as the centre is in a plane figure; or it is a point 90° distant from the plane, and in a circle called the axis, passing perpendicularly through the centre. The zenith and nadir are the poles of the horizon; and the poles of the equator are the same with those of the sphere. See Globe.

POLES. See Ecliptic.

POLE, or pole, in optics, the thickest part of a convex, or the thinnest of a concave glass. If the glass is truly ground, the pole will be exactly in the middle of its surface.

POLE, Perch, or Rod, in surveying, is a measure containing sixteen feet and a half.

POLE, or polar star, is a star of the second magnitude, the last in the tail of Ursa Minor. Its longitude Mr. Flamstead makes 24° 14' 41"; its latitude 66° 4' 11".

POLE-cat. See Viverra.

POLEMONION, a variety of valerian, or Jacob’s ladder; a genus of the monogynia order, in the pentandria class of plants; and in the natural method ranking under the 25th order, campanaceae. The corolla is quinquapartite; the stigma inserted in the bottom of the corolla; the stigmas trifid; the capsule bilocular superior. There are five species, of which the most remarkable is the camelianum, with an empanelment longer than the flower. It grows naturally in some places of England; its beauty, however, has obtained it a place in the gardens. There are three varieties; one with a white, another with a blue, and another with a variegated flower; also a kind with variegated leaves. They are easily propagated by seeds; but that kind with variegated leaves is preserved by parting its roots, because the plants raised from seeds would be apt to degenerate and become plain.

POLEMOSCOPE, in optics, a kind of reflecting periscope invented by Helvétius, who recommends it as useful in sieges, &c. for discovering what the enemy is doing, while the spectator lies hid behind an obstacle. Its description is this: The interval between the oblong glasses and the spectulum, is enlarged by a tube, of a length sufficient to project the spectulum beyond the obstacle that covers the observer. And for a further convenience of looking forward as it were, he proposes to place another plane spectulum at the other end of the tube, to reflect the rays through a hole in its side, in a direction parallel to the incident rays; and to place the object under observation there. By this means, the object will still appear upright, and magnified just as much as if the two specula were removed, and the same eye-glass was placed in the axis of the tube.

POLIANTHES, the tuberosae: a genus of the monogynia order, in the hexandria class of plants; and in the natural method ranking under the 16th order, campanaceae. The corolla is funnel-shaped, incurvated, and equal; the filaments are inserted into the throat of the corolla, in the bottom of which the germ men is situated. There is but one species, consisting of some varieties; all of which, being exotics of tender quality, require aid of artificial heat, under shelter of frames and glasses, &c. to bring them to flower in perfection in this country. As the common tuberose, with single flowers; double-flowered, dwarf-stalked, variegated-leaved. They all flower here in June, July, and August: the flowers are funnel or bell-shaped; on the upper surface of the stem is a long spike, consisting of from 10 to 20 or more separate in alternate arrangements, the lower flowers opening first, which are succeeded by those above, in regular order, making in the same manner the most beautiful appearance, highly enriched with a fragrant odour. The common single-flowered tuberose is the most commonly cultivated, as it generally blows the most freely, and possesses the finest fragrance. The double-flowered kind also highly merits culture, as when it blows fair it makes a singularly fine appearance. The dwarf and the variegated kinds are inferior to the other two, but may be cultivated for variety. All the varieties being exotics from warm countries, although they are made to flower in perfect perfection in our gardens by the assistance of hotbeds, they will not prosper in the open ground, and do not increase freely in England; so that a supply of plants may be imported from Genoa, and other parts of Italy. The principal season for planting them is March and April; observing, however, that in order to continue a long succession of the bloom, it is necessary to make three or four different plantings, at about a month interval; one in March, another in April, and a third the beginning of May, whereby the bloom may be continued from June until September; observing, as above mentioned, they may be flowered either by aid of a common dung or bark hotbed, or in a hot-house.

POLICY or ASSURANCE. The deed or instrument by which a contract of assurance is effected. The premium or consideration paid for the risk or hazard assured against, must be inserted in the policy, and likewise the day, month, and year, on which the policy is executed, and it must be duly stamped. Policies for assurance against the risks of the sea are distinguished into valued and open policies; in the former the goods or property assured are valued at prime cost at the amount of the principal sum, in the same manner as if the parties had admitted it at a trial; but, for every other purpose, it must be taken that the value was fixed in such a manner as that the insured might not be indemnified to no more. The practice of permitting the insured on a valued policy to recover the whole sum insured upon a total loss, though his interest is less than that sum, is against the policy. A valued policy on profits expected upon a voyage is not within the act, the object of an insurance being an indemnity. When a policy is once executed, it cannot be altered by either party, as this would open a door to an infinite variety of frauds, and introduce uncertainty into a species of contract, of which certainty and precision are the most essential requisites. If, however, a policy is filled up by mistake different from the original agreement, it may be altered after signing, by corrected by the consent of both parties. A valued policy may, however, shift the insurance, or any part of it, from himself to other insurers, by causing a re-insurance to be made on the same risk, and the new insurers will be responsible for the loss, the same as he. When the same which was adopted two hundred years ago; but Mr. Park remarks that its antiquity cannot preserve it from just censure; it being very irregular and confused, and frequently ambiguous, from making use of the same words in different senses. The policies generally used for assurances on lives, or against fire, are much more correct and intelligible.

POLERSHIEFER, a mineral body found chiefly at Meuffl Montant, near Paris. Colour grey; often reddish; sometimes spotted or stippled brownish-black, and lemon-yellow. Found in strata; texture earthy; fracture conchoidal; structure fibro-veined; very soft; easily broken; adheres strongly to the tongue; feel harsh; specific gravity 2.08; absorbs water into pustules; melts to a blackish slag; constituents, 66.50 silica, 7.00 alumina, 1.50 magnesia, 1.25 lime, 2.50 oxide of iron, 15.00 water.

POLISHER, or burnisher, among mechanics, an instrument for polishing and burnishing things proper to take a polish. The gilders use an iron polisher to prepare their metals before gilding, and the blood-stone to give them the bright polish after gilding.

The polishers among cutters, are a kind of wooden wheels made of walnut-tree, about an inch thick, and of a diameter at pleasure, which are used to round the wheel; upon these they smooth and polish their work with emery and putty.

The polishers for glass consist of two pieces of wood; the one flat, covered with old hat;
the other long and half-round, fastened on the former, whose edge it exceeds on both sides by the pitch upon which the work- 
men take hold of, and to work backwards and forwards by.

The polishers used by spectacle-makers are pieces of wood a foot long, seven or eight inches broad, and an inch and a half thick, 
coated with old beaver-hat, on which they polish the shell and horn frames their spec- 
tacles-glasses are to be set in.

POLISHING, in general, the operation of giving a gloss or lustre to certain substances, 
as metals, glass, marble, &c.

The operation of polishing optical glasses, after being properly-ground, is one of the most difficult points of the whole process. 
Before the polishing is begun, it is proper to stretch an even well-woven piece of linen over the tool, dusting upon it some very fine 
triopoly. Then taking the glass in your hand, run it round forty or fifty times upon the tool, to take off the roughness of the glass about the 
body of it. This cloth is then to be removed, and the glass being polished upon the naked tool, with a compound powder made of 
four parts triopoly mixed with one of fine 
violet lilton; six or eight grains of which 
mixture are sufficient for a glass five inches broad. This powder is mixed with eight or ten 
drops of clear vinegar, in the middle of the tool; being first mixed and softened thoroughly 
with a very fine small mullet. Then with a 
brush, having spread this mixture thinly and equally upon the tool, take some 
very fine triopoly, and strew it thinly and equally upon the tool so prepared; after which, 
take the glass to be polished, wiped very 
clean, and apply it on the tool, and move it 
gently twice or thrice in a straight line back- 
wards and forwards; then take it off, and 
observe whether the marks of the triopoly, 
sticking to the glass, are equally spread over 
the whole surface; if not, it is a sign that 
ether the tool or glass is too warm, in which 
case you must wait awhile and try again, till 
you find the glass takes the triopoly every 
where alike. Then you may begin to polish 
boldly, there being no danger of spilling the 
finishing mixture, which in the other case 
would infinitely happen. This is Mr. Hu- 
gens's method; but it ought to be observed, 
that almost every operator has a peculiarity 
of his own, and of which some of them make 
a mighty secret.

Sir Isaac Newton no where expressly de-
scribes his method of polishing optical glasses, 
but his method of polishing reflecting metals 
he thus describes in his Optics. He had two 
round copper plates, each six inches in di-

deram, the one convex, the other concave, 
ground very true to one another. On the 
convex one he ground the object-metal, or 
concave which was to be polished, till it had 
taken the figure of the convex, and was ready 
for a polish. He then pitched over the con-

vex plate, only, by dropping it into a little 
upon it, and warming it, to keep the pitch 
soft, while he ground it with the concave 
copper wattet, to make it spread evenly all 
over the convex, till it was no thicker than a 
great-piece; and after the convex was cold 
be ground it again, to give it as true a figure 
as possible. He then ground it with very 
the putty, till it made no noise; and then 
upon the pitch he ground the object-metal 
with a brisk motion for two or three minutes; 
when he had finished, he over the pitch, he 
ground it again till it had made a 
noise, and afterwards ground the object-
metal upon the pitch as before; and this 
operation he repeated till the metal was per-
fectly polished.

POLITICAL ARITHMETIC, calculations relating to the wealth of nations. Polit- 
ical arithmetic, as the doctrine in that 
national wealth truly consists, but estimates 
the value of whatever passes under this name, 
and distinguishes the proportions in which 
the component articles may be applied to 
usefulness conducive to the safety and pros- 
perity of the community. It must be admitted 
that in the application of arithmetic to the sub-
jects of political economy, it unavoidably 
loses much of its precision, from the fluctu-
ating nature of most descriptions of property, 
both with respect to distribution and value, 
the state of which it is one of its chief objects 
to estimate; it however retains a sufficient 
degree of certainty to become an interesting 
subject to be treated of; it therefore requires 
just a just idea of the strength and resources 
either of the community to which he belongs, 
or of other nations.

If the particulars which it is necessary to 
assume as facts could be obtained correct, 
the conclusions drawn from them would be nearly 
as determinate and invariable as in any other 
branch of arithmetic; but if the former 
are not strictly true, the latter will be but 
approximations, however near they may come to the truth. Such approximations, however, 
may be sufficient for most useful purposes; 
though it must be confessed that a greater 
degree of certainty, which would render our 
knowledge on this subject more valuable, 
would be highly desirable; at the same time it is 
difficult to attain, as it does not depend so much 
on the labours or investigations of individu-
als, as on the measures adopted by the go-

governments of different countries, who alone 
are able correctly to ascertain with greater 
precision the principal assumptions on which 
political computations are founded.

The strict amount of the wealth of a coun-
try cannot be known without an exact inven-
tory of all the particulars that compose it, 
a thing utterly impracticable in large, and par-
icularly in commercial states, and which, if 
it were possible to be obtained perfectly true, 
even in the most minute particulars, would 
not remain so during the time necessary to 
make out the account, and therefore might 
not be of more utility than a tolerable correct 
estimate, which, being considered as a mediu-
mm between small variations, will, for a con-
siderable time, furnish sufficient ground 
for political purposes, and perhaps be 
the best that is possible, after having 
extimate the accounts of the wealth of 
different countries, that even such of the ma-
terials necessary to form an estimate as we do 
present, though furnished pursuant to legisla-
tive enactments, are not always perfectly 
strictly correct, and being generally formed for 
purposes of publics, as with a view to 
some commercial or financial regulations, are 
frequently ill adapted to any other use; from 
which it follows, that the people of Great 
Britain, in drawing up these materials, 
intend to draw our principal information; and 
if the nature of the subject precludes strict 

demonstration, we may, at least, endeavour, 
by proceeding on rational grounds, to arrive 
at conclusions consistent with probability.

Political arithmetic has been much culti-
vated of late years in Germany, France, and 
parts of Europe; but as its application 
to the wealth and power of different states 
is very similar, we shall endeavour to 
illustrate it in an attempt to determine the 
increase and present state of the national 
wealth of Great Britain, which will be consi-
dered as conclusion of the land, and the 
stock, the latter term comprehen-
sing all the valuable resources of past indus-
try, except improvements of the soil, which 
make part of the present value of the land; 
and if the amount of the national capital 
can be ascertained, it will naturally lead to an 
investigation of the general income, both as 
arriving from such capital, and from the 
profits of labour.

In all inquiries of this kind, the state of 
the population of the country is an object of 
primary importance; for it is the number of in-
habitants which a country maintains, that 
gives the land itself the chief part of its 
value, of which we have many proofs in the 
former and present state of different parts of 
England, and in the value of land with the 
increase of population in our own island.

That Great Britain is now more fully 
inhabited than in the early periods of its his-
tory, few persons will doubt, whatever may 
be their opinion respecting its advance or de-
cline in this respect of late years. At the time 
of the Norman conquest, the people of Eng-
land are supposed to have been somewhat 
above 2,000,000; and from their depressed 
condition, the frequency of foreign and 
domestic wars, and of pestilential distempers, 
their increase during many of the succeeding 
years may be reasonably doubted, though 
there are no means of ascertaining with any 
precision the real state of the population at 
those periods. From an account of the pro-
duce of a poll-tax, an estimate has been 
formed by Mr. Chalmers of the number of in-
habitants in 1577, and as the additions which 
he has made to the return certainly do not 
appear too small, the total, which amounts to 
2,333,203, cannot be less than the whole number of the people of Eng-
land and Wales at that time, if the account on 
the census, which is very much depended on. 
Mr. Chalmers observes, that the civil wars 
during the greater part of the fifteenth cen-
tury must have caused a great waste of inhab-
nants; this loss, however, was soon recovered 
on their termination; and the suppression of 
monasteries by Henry the VIIIth, with the 
repeal of all positive laws against the marriage 
of priests by Edward the VIth, continued to 
promote mortality, and of course to increase 
the population. From documents in the 
British Museum, it appears, that during the 
reign of Elizabeth, accounts were often taken 
of the people. Harrison gives the result of 
the inquiries of 1575, when the number of 
fighting men was found to be 1,172,674, 
adding that it was believed a full third had 
been omitted. Sir Walter Raleigh ascerts 
that there was a general review in 1583 of all 
the men in England capable of bearing arms, 
who were found to be 1,312,000. 

These accounts evidently refer to the same 
enumeration, though they differ in the date; 
and if the number is multiplied by 4, it would
prove the total number of inhabitants to have been 4,088,000. This number increased during the seventeenth century, and was computed by Mr. Gregory King to amount in 1650 to 5,300,000; while Dr. Davenant estimated the same number to be as high as 7,000,000. This disagreement between two very accurate writers, speaks the great uncertainty which prevailed on this subject, and in fact there was scarce any particular relating to the state of the country on which such opposite opinions were held as on the actual number of inhabitants at particular periods, and their diminution or increase. The point has at length been determined by the results of an act passed the 31st of December, 1850, for ascertaining the population of Great Britain, and the increase or diminution thereof. From the returns thus obtained, it appeared, that the total population of Great Britain, including the army and navy, and seamen in the merchants’ service, was 10,942,646; but deducting the proportion of soldiers and seamen belonging to Ireland, it may be more correctly stated at 10,920,370.

Assuming this number as a sufficiently accurate return of the total population, it may not be very difficult to distinguish the proportion of those who subsist by the labour of others, to those by whom they are supported; and of the unproductive, though in most instances useful, labourers, to those on whose labour the nation produces, and consequently all additions to the national stock, depends.

From several accounts it appears, that of the whole number of persons living, more than one-fourth are children under ten years of age, who therefore contribute little or nothing to their own maintenance; for though in some few manufactories, children under this age are employed, they are more than counterbalanced by the greater number who remain unemployed (otherwise than in education) for several years beyond the age of ten. After deducting 2,705,092, the number of these future labourers, it will be found that about one in 28 of the remainder, or 280,831 are incapacitated by old age or infirmities from useful labour, including all persons in the different situations of life, and of this number, 127,000 are artisans and tradesmen, and 153,831 are house servants, and the like. Of the total number remaining, let us suppose half of those engaged in agriculture, and half in the commerce of the country; the one-half; of 1,042,646, are those who gain a subsistence by the produce of land; and the other half, 650,000, who derive their subsistence by the produce of manufactures.

It must be confessed that the number of some of these classes of persons cannot be ascertained with much precision; this, however, is of no great importance, if the total number of persons, whose subsistence is derived from the produce of land or manufactures, be not far from the truth, as the object is chiefly to show the proportion of productive to unproductive labourers; the latter may be distinguished according to the following statement:

<table>
<thead>
<tr>
<th>Class of Persons</th>
<th>Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>Merchants, brokers, factors, &amp;c.</td>
<td>25,000</td>
</tr>
<tr>
<td>Clerks to ditto, and in the offices of commercial companies</td>
<td>40,000</td>
</tr>
<tr>
<td>Seamen in the merchants’ service, &amp;c.</td>
<td>120,000</td>
</tr>
<tr>
<td>Lightermen, watermen, &amp;c.</td>
<td>3,500</td>
</tr>
<tr>
<td>Persons employed in the different manufactures</td>
<td>1,800,000</td>
</tr>
<tr>
<td>Mechanics not immediately belonging to the manufactures, as carpenters, blacksmiths, masons, wheelwrights, shipwrights, boatbuilders, &amp;c.</td>
<td>114,000</td>
</tr>
<tr>
<td>Painters, engravers, carvers, and the like</td>
<td>50,000</td>
</tr>
<tr>
<td>Shopkeepers, viz. butchers, bakers, publicans, fishmongers, poultereers, pastrycooks, grocers, chandlers, pawnbrokers, apothecaries, &amp;c.</td>
<td>5,000</td>
</tr>
<tr>
<td>Total</td>
<td>1,704,500</td>
</tr>
</tbody>
</table>

The total number of persons employed in agriculture, and all other persons employed in agriculture, including millers, mealmakers, farri- ers, horse-doctors, &c. | 2,000,000 |
| Wives and families of all the classes assisting in their occupations, or following other employments of profit | 1,738,447 |
| Total | 5,935,947 |

The whole population of the country will thus appear to consist of nearly the following proportion:

<table>
<thead>
<tr>
<th>Class of Persons</th>
<th>Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>Supported by labour</td>
<td>3,139,023</td>
</tr>
<tr>
<td>Unproductive labourers</td>
<td>1,704,500</td>
</tr>
<tr>
<td>Total</td>
<td>10,820,370</td>
</tr>
</tbody>
</table>

It thus appears that the whole of the people depend for subsistence, and all the conveniences of life, on the labour of little more than one-half; and the increase or decrease of this number, and of the effect produced by the individuals who compose it, is the measure of the increase or decline of national strength. Of the unproductive labourers, those who gain a subsistence by defending, instructing, or serving others, the greater part are highly useful to the community, and in the present state of society a nation could not exist without them; but as they do not contribute to the production of any of the necessary of life, or articles of commerce, it is evident that they depend entirely on the exertions of the productive labourers, who are the source not only of the general subsistence and of the means of commerce, but of all accumulations of stock, which is in fact the surplus of former produce beyond the consumption. The power of acquiring national wealth, therefore, depends principally on the proportion of productive labourers to the whole number of inhabitants; for though the population of a country should have greatly increased, if it had been chiefly by an addition of idle hands, the country would remain the same, and the consumption be much greater, the country must become poorer: but it likewise depends, in a great measure, on the facility with which labour is performed, and the general circumstances of industry, which is the same as having the number of labouring inhabitants, with the same number of other persons it had at a former period, but this half, by means of machinery and other improvements, could produce the same effect as the whole number before, such a country would become considerably richer, though the total population was diminished, and the proportion of unproductive to productive persons increased; and, by the same supply and a much less consumption, it might happen that the produce or supply exceeds the consumption, there will be an accumulation of stock; and, for less the surplus could be reserved for some useful or desirable purpose, it would soon cease to be produced, by the supply falling to the level of the demand for consumption. The surplus reserved or converted into stock, is a fund for supporting an increase of exertions, or for supplying the means of enjoyment.

It has been shown, that the whole number of the inhabitants of Great Britain is undoubtedly greater than at former distant periods; but the proportion of unproductive hands,
who subsist by the labour of others, has also probably much increased; the effect of this increase in the circumference of the agricultural industry is proportionally more than has been supplied by the great improvements in different arts and manufactures, by which the produce of the country has been increased in quantity, and rendered much superior in quality; so that the supply of all our new necessities wants, and enabling us to defray expensive wars, it has left a considerable surplus, which, gradually accumulating, has formed the present national stock or capital.

Previously to an inquiry into its increased amount, it may not be uninteresting to view its former computed value, according to the estimate of sir William Petty, who certainly cannot be suspected of having drawn an unfavourable statement:

Computation of the wealth of England and Wales in 1694.

Value of the land: 24 millions of acres, yielding 8 millions per cent, with 18 years purchase - £144,000,000

Houses, reckoning those within the bills of mortality equal in value to one-third of the whole - 30,000,000

Shipping: 500,000 tons, at 6l. per ton, including rigging, ordnance, &c. - 3,000,000

Stock of cattle on the 24 million acres, and the waste belonging thereto, including parks, fisheries, warrens, &c. - 36,000,000

Gold and silver coin, seare - 6,000,000

Wares, merchandise, plate, furniture, &c. - 31,000,000

Total - £250,000,000

In comparing this estimate with similar accounts at present, it must be remembered that a great alteration has gradually taken place in the nominal value of all commodities, which, with respect to the above period, appears from a table formed by sir G. S. Evelyn, to be in the proportion of about five to fourteen; the total of the wealth of England and Wales, in 1694, would therefore have amounted to 36,000,000l., or just 3s. 6d. per quarter, will amount to at least 7,000,000l. The value of hay and straw, and all kinds of fodder, and of all implements of husbandry, cannot be less than five or six millions, and with the former sum cannot be less than 12,500,000l. The total value of cattle and farming-stock is therefore 102,500,000l.

The value of the shipping belonging to Great Britain may be calculated with more accuracy from the accounts laid before parliament, that exclusive of Ireland and the plantations, the number of vessels in the merchants' service, belonging to Great Britain, on the 30th September 1804, was 8,201,909 tons; taking it at 2,000,000, at 8l. per ton, it makes 16,000,000l., which is certainly below the real value. The shipping of the navy may at least be estimated at 4,000,000l.; making with the former sum, 20,000,000l., to which some addition should be made for the value of ships building in all the dock-yards, and for small craft employed on the rivers and canals.

The quantity of money in the country has at different times been a subject of dispute, and has never been determined with precision. It was, however, pretty well ascertained by the re-coinage in the years 1773, 1774, and 1776. The value of the light gold delivered into the bank under the different proclamations, amounted to 15,583,503l.; and it was generally admitted that somewhere more than two millions of heavy guineas remained out in circulation, which, with the copper coin, made the whole at that time about 20 millions; at which sum Mr. Chalmers estimated it in the year 1786. Including the cash in the coffers of the bank

POLITICAL ARITHMETIC.

of land being brought into cultivation, and that which was before cultivated being increased. The whole landed rent of England and Wales, and the Lowlands of Scotland, was stated by sir W. Petty at about 9,000,000l.; and it cannot be supposed that, if he had included the Highlands of Scotland, he would have given more than the rental of the whole island more than 5,300,000l. G. King and Dr. Davenant, in queen Anne's reign, stated the rental of England and Wales at 14,000,000l.; and it may be presumed this was nearly the truth at the time; it began to appear too low; and between twenty and thirty years ago it was generally reckoned at 20,000,000l. At present, however, it considerably exceeds this sum.

The chief difficulty of forming an estimate of the land renting consists in assigning an average value to the different descriptions of land. The total number of acres in England and Wales has been computed by sir W. Petty to be 28,000,000; by Dr. Grew, 40,000,000; by Dr. Halley, 39,938,000; by Mr. Temple, 31,643,000; by Mr. Arith, 39,916,000; and by the Rev. H. Beecke, 38,498,572. Mr. Beecke's calculation appears to be by far the most accurate; it is therefore taken as the foundation of the following statement; the proportions cultivated for different purposes being nearly as given by Mr. Middleton, in his View of the Agriculture of the County of Middlesex:

<table>
<thead>
<tr>
<th>Product</th>
<th>Acres</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wheat</td>
<td>31,600,000</td>
</tr>
<tr>
<td>Barley and rye</td>
<td>3,881,000</td>
</tr>
<tr>
<td>Oats and beans</td>
<td>2,872,000</td>
</tr>
<tr>
<td>Clover, rye-grass, &amp;c.</td>
<td>1,149,000</td>
</tr>
<tr>
<td>Roots and eabages cultivated</td>
<td></td>
</tr>
<tr>
<td>by the plough</td>
<td>1,150,000</td>
</tr>
<tr>
<td>Turnips</td>
<td>2,970,000</td>
</tr>
<tr>
<td>Hop-grounds</td>
<td>36,000</td>
</tr>
<tr>
<td>Nursery grounds</td>
<td>9,000</td>
</tr>
<tr>
<td>Fruit and kitchen-gardens,</td>
<td>41,000</td>
</tr>
<tr>
<td>cultivated by the spade</td>
<td></td>
</tr>
<tr>
<td>Pleasure gardens</td>
<td>41,000</td>
</tr>
<tr>
<td>Land despoited by cattle</td>
<td>17,479,000</td>
</tr>
<tr>
<td>Hedge-rows, copes, and woods</td>
<td>1,641,000</td>
</tr>
<tr>
<td>Ways, water, &amp;c.</td>
<td>1,316,000</td>
</tr>
<tr>
<td>Cultivated land</td>
<td>32,027,000</td>
</tr>
<tr>
<td>Commons and waste lands</td>
<td>6,473,000</td>
</tr>
</tbody>
</table>

Total acres in England and Wales 38,498,572

If the commons and waste lands are considered as equal in annual value to only one million of cultivated acres, the whole may be taken at 33 millions. The average rent has been stated at 13s. per acre, which appears to be a moderate computation, and makes the rental amount to 24,750,000l.; the value of which, at 28 years purchase, is 683,000,000l. The number of cultivated acres in Scotland is upwards of 6,000,000; and of uncultivated, about 3,100,000; a great part of the latter is of very little use; but if it is wholly excluded, and the cultivated part rated at an average of 10s. per acre, which makes 4,845,000l.; per annum, the total rental of the island will be 30,500,000l., and the value of the land 829,650,000l. This must be understood as including the value of tythes, it being unnecessary in this point of view to distinguish between the rent paid to the landlord, and the part paid to the tythe proprietor.

The value of the houses of Great Britain is perhaps more difficult to ascertain than that of the land: but the following statement of their rent, founded on the number returned under the population act, will not be more than too light:

<table>
<thead>
<tr>
<th>Buildings</th>
<th>Number</th>
<th>Value</th>
<th>Rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>100,000 houses at 30l. per annum</td>
<td>3,000,000</td>
<td>£100,000</td>
<td></td>
</tr>
<tr>
<td>200,000</td>
<td>6l.</td>
<td>1,250,000</td>
<td></td>
</tr>
<tr>
<td>300,000</td>
<td>5l.</td>
<td>1,200,000</td>
<td></td>
</tr>
<tr>
<td>400,000</td>
<td>4l.</td>
<td>637,500</td>
<td></td>
</tr>
</tbody>
</table>

Total rent £11,037,500
it appears, that at the time of the re-coineage the whole money in the country was rather above than under the sum just stated: and from the sums annually coined since that time, it might be presumed that the quantity in circulation at present was considerably greater. Mr. Davenant, in his book, estimated the annual addition to the currency of Great Britain since 1664 at 32,600,000l., and the amount of the coineage in the years 1760 and 1761 at 44,000,000l. ; but though our commece has considerably increased, it will hardly be thought, considering the far greater quantity of small bank notes in circulation, that, if 29 millions of pounds were coined in the year 1760 or 1761, we can at present have occasion for more than 25 millions at the utmost.

Of the value of the merchandise and manufactures usually in the hands of the merchants, wholesale dealers, shopkeepers, and manufacturers, it is very difficult to form a satisfactory idea. The total amount of the imports in the year 1804 was 29,201,490l., and of the exports, 34,451,567l., according to the customs' house account; but it has long been known that these accounts are considerably below the true value, and particularly since passing the convoy act, in the execution of which it has appeared that the declared value of British manufactures exported is about 71 per cent, than that in the inspector-general's register; and, with respect to the foreign merchandise imported, the difference on the whole may not be much less; for it is certain that some of the articles are at present considerably more than 71 per cent, above the value at which they are rated. Taking the whole, however, as rated only 60 per cent, under the present values, the annual amount of foreign trade will be 101,844,577l., to which an addition should be made for smuggled goods. It was the opinion of a numerous meeting of merchants in the year 1797, that there is at all times at the least two months' supply of export and import merchandise in the custody of the merchants and traders, which, according to the above total, will amount to 16,074,095l. ; to which some addition should be made for property in the hands of foreign merchants, on account of which some of the merchants and traders, as a particular measure, generally giving longer credit than they are allowed from other countries. But though the value of goods in the hands of merchants and wholesale dealers appears so considerable, it must be remembered that the greater part of this wealth is not held for interest, but is otherwise richer than by the greater income he can make from the money than what he agrees to pay for it: as the capital, in whatever manner he invests it, still belongs to the owner, and is not in the possession of the country permitted to take possession of the property into which his money has been converted, may, if necessary, bring it to sale, for the purpose of re-converting it into the sum equivalent to what he had lent. If, therefore, the whole of the land, houses, cattle, and all other articles composing the wealth of the country, was in the hands of one half of the inhabitants, who had borrowed the above sum of 124,500,000l. from the other half, it is evident that the whole real capital of the country would in fact be the property, not of those in possession of it, but of those to whom they were indebted. This is the case with respect to a considerable part of the capital of Great Britain; and the debts of the government have greatly contributed to bring it into this state: for though these debts are not contracted under an obligation to repay the principal at any fixed period, they rest on the hands of the government, who possesses, to claim, if it should ever be necessary, a portion of the general property sufficient for this purpose, and till that time to raise sufficient contributions to pay an annuity equivalent in value to such principal.

The above estimate shows, that notwithstanding the expensive wars in which the country has been engaged, which, by drawing much money out of the country, has greatly diminished the profits that would otherwise have remained, there has been a great accumulation; though, at the same time, the people in general appear to live in a much more expensive manner than their ancestors. We have seen that in the year 1664, the whole national capital did not exceed 700,000,000l., according to the present value of money: there has therefore been an average gain since that time of nearly four millions per annum, a very considerable part of which must have arisen from foreign commerce; for commerce would not be carried on without gain; and whatever profits have been saved or converted into stock, must appear in the foregoing account: even the increase in the value of the land and houses is in a great measure owing to the assistance of capitals acquired in trade.

The great increase of the annual income is a further proof that there must have been such an accumulating surplus as is here stated. Mr. Petrie, in his estimation of the income of the country to be 42,000,000l.; Mr. G. King estimated it at 43,500,000l.; Dr. Davenant, in 1701, stated it at 49,000,000l. These accounts are exclusive of Scotland: but after making a sufficient addition on this account, it will appear that there has been a very considerable increase. Sir John Sinclair, in 1783, observed that the income of the country arising from lands, commerce, and manufactures, was commonly calculated at 100,000,000l., which he considered rather a low valuation; and there can be little doubt that of late years the profit derived from each of these sources has been greatly augmented.

A part of the national stock or capital produces no income; such as the money in circulation, furniture, apparel, &c.; and on the contrary much income arises without capital, being solely the recompense of labour. A very considerable proportion arises from capital and labour combined, which is that of most farmers, merchants, and retail traders, and the difficulty of distinguishing, in many cases, that part of the income of individuals which is the wages of their labour, from the part which should be considered as the profits of their capital, must render every attempt to particularize the amount of the different branches of income liable to objections. The following statement is, however, presumed to be not very inaccurate:

- From rent of lands: 29,585,000l.
- From rent of houses: 11,087,000l.
- Profits of farming, or the occupation of the land: 6,120,000l.
- Income of labourers in agriculture: 18,000,000l.
- Profits of mines, collieries, and inland navigation: 2,000,000l.
- Profits of shipping in the merchants' service, and small craft: 1,000,000l.
- Income of stockholders: 18,923,000l.
- From landed property, and other money lent on private securities: 2,500,000l.

Carried over: 89,227,000l.
Brought over - £50,027,000
Profits of foreign trade - 11,250,000
Ditto of manufactures - 13,500,000
Pay of the army and navy, and salaries in the merchants' service - 5,000,000
Income of the clergy of all descriptions - 2,000,000
Income of the judges, and all subordinate officers of the laws - 1,500,000
Professors, schoolmasters, tutors, &c. - 600,000
Retail trades not immediately connected with foreign trade, or any manufacture - 6,000,000
Various other professions and employments - 2,000,000
Male and female servants - 2,000,000

Total - £133,977,000

Of this annual sum, the part drawn from other countries by commerce is stated at 11,250,000l., which is founded on a supposition that the capital employed cannot be less than 75,000,000l.; and that the profits thereon, including those of all persons absolutely depending on foreign trade, may be taken at 15 per cent. It must not, however, be supposed that the nation receives an accession of wealth to the amount of 11,250,000l. annually from this source: whatever payments are made to other countries for the dividends on the share foreigners hold of the public debts, or as subsidies to their governments, or spent therein in the maintenance of troops, or by British subjects occasionally resident there, operates to the diminution of this profit in a national view. The actual wealth which the country acquires by its intercourse with other nations, may be very different from the profits of the individuals concerned in trade: as a sum equal to a great part, or even the whole, of such profits, may be sent abroad in the various ways just mentioned. The balance of trade in favour of the country has usually been estimated by the excess of the exports beyond the imports, and a comparatively small amount of the latter has been considered highly desirable. This is a concise mode of determining a very important point; but even if the customs house accounts were much better adapted to the purpose than they are, the justness of the conclusions thus drawn from them would be very doubtful: for it may be easily shown that in many cases, if the imports exceeded the exports, there might notwithstanding be a considerable gain. Thus, supposing the merchant of this country to purchase British manufactures for exportation on their own account, to the value of 20,000,000l., the net proceeds thereof in the countries to which they are exported cannot be considered as less than 22,000,000l.; and this sum being invested in foreign produce, and imported into this country, will amount, after paying the duties and all expenses, to at least 24,000,000l., returning the merchant the capital originally advanced, with a profit of 21 per cent. In like manner, whenever the merchandise imported in return for our manufactures is of greater actual value in this country, or yields a greater price, after allowing for all charges and the interest of the capital employed, the surplus must be an addition to the wealth of the country; and if the whole of the foreign trade was of this description, the excess of the imports would show the profit or the wealth acquired by the exchange of commodities with other nations.

It has been shown, that the total income of the country is at present upwards of 133,000,000l.; and that it cannot be less than this sum, may be inferred from the general expenditure. Sir W. Petty reckoned the average expense of every, woman, and child, in England and Wales, at 6l. 13s. 4d. per annum, for food, housing, clothes, and all other necessaries; Dr. Davenant took the average expense at 7l., which, according to the difference of the value of money, is equal to upwards of 16l. for each person at present. Mr. Jonas Hanway, about 33 years ago, estimated the expense of the people of England and Wales on an average about 9l. each; but this must be too low a present: and the following estimate will probably approach nearer to the truth, with respect to the mere expense of subsistence, or of eating and drinking, particularly as we are not to consider what is absolutely necessary for support, but what is actually expended in this way:

Persons.

<table>
<thead>
<tr>
<th>Amount</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>300,000 at 10d. per day</td>
<td>£7,300,000</td>
</tr>
<tr>
<td>700,000</td>
<td>12d.</td>
</tr>
<tr>
<td>1,500,000</td>
<td>9d.</td>
</tr>
<tr>
<td>2,000,000</td>
<td>4d.</td>
</tr>
<tr>
<td>2,000,000</td>
<td>2d.</td>
</tr>
<tr>
<td>1,500,000</td>
<td>1d.</td>
</tr>
</tbody>
</table>

10,500,000 | £82,429,165

When the price of most of the necessaries of life is considered, it will not be thought that the expense of subsistence is over-rated in the lowest classes; and if this is admitted, it cannot be too high in the other classes, as it leaves 11,087,500l.; and allowing for the rent of shops, warehouses, and other buildings appropriated wholly to trade, it may be taken at 9,500,000l. The expense of clothing, including every article of dress, or ornamentation, will, on a very moderate computation, amount to 26 millions, viz.

150,000 persons at 20l. per annum | £3,000,000 |
300,000 | 12l. | 3,600,000 |
600,000 | 8l. | 6,000,000 |
800,000 | 4l. | 8,000,000 |
2,800,000 | 30s. | 4,200,000 |
3,400,000 | 20s. | 4,000,000 |
1,500,000 | 0 | 0 |

10,800,000 | £26,000,000

With respect to superfluous expenses, when the sums spent by the nobility and people of fashion in plays, opera, concerts, routs, gambling, horses, carriages, and other amusements and luxuries, are considered, it will certainly be thought a very moderate assumption, that, including what is spent by others on objects more rational, though not absolutely requisite, there are half a million of persons who, one with another, spend 25l. per annum in unnecessary expenses, making 12,500,000l. The total expense will then be:

For subsistence | £82,429,165 |
For house-rent | 9,500,000 |
For clothing | 26,000,000 |
For miscellaneous expenses | 12,500,000 |

Total | £130,440,000

The difference between this expenditure and the general income shows the annual gain of the country, or the sum applicable to the extension of commerce, the reservation of a greater quantity of foreign articles, the increase of shipping and buildings, agricultural or mechanical improvements, or other augmentations of the general stock. Without such a surplus, few improvements could be carried on, nor could there be any increase of wealth; and if this latter circumstance is thought essential to national advancement, it becomes an object of much importance, that the expences of the government should be restrained within such bounds, and provided for in such manner, as to incur as little as possible on the annual surplus that would otherwise be converted into permanent capital.

POLJUM, poley-mountain, in botany, a species of Cennium, with oblong, obtuse, crested, and sessile leaves. See TEUCRIUM.

POLLO, a word used in ancient writings for the sea. The word POLLION is either to vote or to enter down the names of those persons who give in their votes at an election.

POLE-MONEY, a capitulation or tax imposed by the authority of parliament on the head or persons either of all denominations, or according to some known mark of distinction.

POLLLIA, a genus of the class and order hexandria monogyne. The corolla is inferior, six-petalled; berry many-seeded. There is one species, an herbaceous plant of Japan.

POLICLICHIA, a genus of the monoandria monogyne class and order. The calyx is one-leafed, five-toothed; corolla, five petals; seed solitary; receptacle succulent, aggregate scales. There is one species, of the Cape.

POLLUX, in astronomy, a fixed star of the second magnitude in the constellation Gemini, or the Twins. See ASTRONOMY.

POLYADELPHIA (from πολυς, many, and ἄδημπθος, brotherhood), many brotherhoods; the name of the 18th class of Linnaeus's sexual system, consisting of plants with hermaphrodite flowers, in which several stamens or male organs are united by their filaments into three or more distinct bundles.

POLYANDRIA (from πολυς, many, and ἄνδρας, a man or husband), many husbands; the name of the 13th class in Linnaeus's sexual method, consisting of plants with hermaphrodite flowers, which are furnished with several staminas that are inserted into the common receptacle of the flower.

POLYCARDIA, a genus of the class and order pentandra monogyne. The petals are five; stigma lobed; capsules five-celled; seeds arillate. There is one species, a shrub of Madagascar.

POLYNAPON, a genus of the class and order triandra trigynia. The calyx is five-leafed; petals five; capsule one-celled; seeds many. There is one species.

POLYCHENEMUM, a genus of the monotria monogyne order, the triandra class of plants,
and in the natural method running under the 15th order, holocraspe. The calyx is triplicate; and the petals are five calabar petals, with one seed almost naked. There are five species, of no note.

POLYCALA, milkwort, a genus of the octandra order, in the diadelphus class of plants, and in the class of wood running under the 33rd order, lomentaceae. This calyx is pentahedral, with two of its leaflets wing-shaped and colored; the legumen is obovate and bilocular. There are 45 species, of which the most remarkable are:

1. The vulgaris, or common milkwort, is a native of the British heaths and pastures. The root of this plant has a bitter taste, and has been found to possess the virtues of the American rattlesnake root. It purges without danger, and is also emetic and diuretic, sometimes operating all the three ways at once. A spoonful of the decoction made by boiling an ounce of the herb in a pint of water till one half has extracted, has been found serviceable in pleurisy and fevers, by promoting a diaphoretic and expectoration; and three spoonfuls of the same taken once an hour, has proved beneficial in the dropsy and anasarca. It has also been found serviceable in consumptive and dyspeptic patients.

2. The serenga, or seneca, rattlesnake-wort, grows naturally in most parts of North America. The root of this species operates more powerfully than the last; but besides the virtues of a purgative, emetic, and diuretic, it has been recommended as an antiscorbutic against the poison of a rattlesnake; but this opinion is now exploded. It still, however, maintains its character in several disorders. Its efficacy, particularly in pleurisy, is most fully established in Virginia; formerly near half out of a hundred died of that distemper; but by the happy use of this root hardly three out of the same number have been lost.

As the seeds of the rattlesnake-wort seldom succeed even in the countries where the plant is a native, the best method of propagating it is to procure the roots from America, and plant them the same season, if possible, in a sheltered situation, where they will thrive without any other culture than keeping them free from weeds. But though the plant will stand out ordinary winters, it will be proper to cover it during that season with old manure, or bark, or other matter, to keep out the frost.

POLYAMIA (under, many, and repous, marrying). This term, expressing an intercommunication of sexes, is applied, by Linnaeus, both to plants and flowers. A polyamous plant is that which bears both hermaphrodite flowers and male or female, or both.

POLYAMY, the plurality of wives or husbands, in the possession of one man or woman, at the same time. By the laws of England, polyamy is made felony, except in the case of abstinence beyond the seas for seven years; and where the absent person is living in England, Wales, or Scotland, and the other party has notice of it, such marrying is felony by the statute 1 Jac. 1. c. 11.

POLYGLOTT, among divines and erudits, chiefly of the study of Hebrew, is printed in several languages. In these editions of the holy scriptures, the text in each language is ranged in opposite columns.

The first polygott bic was that of cardinal Ximenes, printed in 1517, which contains the Hebrew text, the Chaldee paraaphrase, and the Greek, on which it was based, the second, and the LXX, and the ancient Latin version. After this, there were many others: as the bible of Justinius, bishop of Nebio, in Hebrew, Chaldee, Greek, Latin, and Arabic; and by John Pofkem, in Hebrew, Greek, and Latin. Plantin's polygott, in Hebrew, Chaldee, Greek, and Latin, on the Syriac version of the New Testament; M. Le Jay's bible in Hebrew, Samaritan, Chaldee, Greek, Syrian, Latin, and Arabic; Walley's polygott, which is a new edition of Le Jay's polygott, more correct, extensive, and perfect, with several new oriental versions, and a large collection of various reading &c.

POLYGON, in geometry, a figure with many sides, or whose perimeter consists of more than four sides at least: such are the pentagon, hexagon, heptagon, &c.

Every polygon may be divided into as many triangles as it has sides, if you assume a point in each side, as five points in the polygon, and from thence draw lines to every angle, making five polygonal triangles. For the polygon having six sides, is divided into six triangles; and the three angles of each, by 136° divided, equal two right ones; so that all the angles together make twelve right ones: but each of these angles has one angle in the point a, and by it they complete the space round the same point; and all the angles about a point are known to be equal to four right ones; whereas those taken from twelve, leave eight, the sum of the right angles of the hexagon.

So it is plain the figure has twice as many right angles as it has sides, except four.

Every polygon circumscribed about a circle is equal to a rectangle triangle, one of whose legs shall be the radius of the circle, and the other the perimeter (or sum of all the sides) of the polygon. Hence every regular polygon, whose sides are equal, is a rectangle triangle, one of whose legs is the perimeter of the polygon, and the other a perpendicular drawn from the centre to one of the sides of the polygon. And every polygon circumscribed about a circle is greater than it, and every polygon inscribed is less than it; as is manifest, because the thing containing is always less than the thing contained.

The perimeter of every polygon circumscribed about a circle is greater than the circumference of that circle; and the perimeter of every polygon inscribed is less. Hence, a circle is equal to a right-angled triangle, whose base is the circumference of the circle, and its height the radius of it.

For this triangle will be less than any polygon circumscribed, and greater than any inscribed; because the circumference of the circle, which is the base of the triangle, is greater than that of any inscribed, therefore it will be equal to the circle. For, if this triangle is greater than any thing that is less than the circle, and less than any thing that is greater than the circle, it follows that it must be equal to the circle. This is proved in the figure. For AD is equal to the circumference of the circle; that is, to a right-lined figure equal to a circle, upon a supposition that the basis given is equal to the circumference of the circle; but actually to find a right line equal to the circumference of a circle, and yet discovered geometrically. See CIRCLE.

Problems concerning polygons. 1. On a regular polygon to circumscribe a circle, or to circumscribe a regular polygon upon a circle. Bisect two of the angles of the given polygon A and B (Plate Miscell. fig. 192), by the right lines AF, BP; and on the point F, where they meet, with the radius AF, describe a circle which will circumscribe the polygon. Next to circumscribe a polygon, divide 200 by the number of sides required, to find E, which set off from the centre F, and draw the line de, on which construct the polygon as in the following problem.

2. On a given line to describe any given regular polygon. Find the angle of the polygon in the table, and from it, the angle equal thereto; then drawing EA = ED, through the points E, A, D, describe a circle, and in this applying the given right line as often as you can, the polygon will be described. To find the sum of all the angles in any given regular polygon. Multiply the number of sides by 180°, from the product subtract 360°, and the remainder is the sum required: thus, in a pentagon, 180° × 5 = 900°, and 900° − 360° = 540°, the sum of all the angles in a pentagon. 4. To find the area of a regular polygon. Multiply one side of the polygon by half the number of sides; and then multiply this product by a perpendicular let fall from the centre of the circumscribing circle, and the product will be the area required: thus, if AB (the side of a pentagon) = 54 × 1 2 = 135, and 135 × 29 (the perpendicular) = 3915 = the area required. 5. To find the area of an irregular polygon, let it be resolved into triangles, and the sum of the areas of these will be the area of the polygon.

The following Table exhibits the most remarkable particulars in all the polygons, up to the dedication of 12 sides, viz. the angle at the centre, the angle of the periphery, and the area of the polygon, when each side is 1.

<table>
<thead>
<tr>
<th>No. of sides polygon</th>
<th>Name of polygon</th>
<th>Angle at cent.</th>
<th>Angle of periphery</th>
<th>Area</th>
</tr>
</thead>
<tbody>
<tr>
<td>3</td>
<td>Trigon</td>
<td>90°</td>
<td>90°</td>
<td>0.3630127</td>
</tr>
<tr>
<td>4</td>
<td>Tetragon</td>
<td>90°</td>
<td>180°</td>
<td>1.0000000</td>
</tr>
<tr>
<td>5</td>
<td>Pentagon</td>
<td>108°</td>
<td>180°</td>
<td>1.7294774</td>
</tr>
<tr>
<td>6</td>
<td>Hexagon</td>
<td>120°</td>
<td>180°</td>
<td>2.9288630</td>
</tr>
<tr>
<td>7</td>
<td>Heptagon</td>
<td>120°</td>
<td>180°</td>
<td>3.6391294</td>
</tr>
<tr>
<td>8</td>
<td>Octagon</td>
<td>135°</td>
<td>180°</td>
<td>4.9248271</td>
</tr>
<tr>
<td>9</td>
<td>Nonagon</td>
<td>140°</td>
<td>180°</td>
<td>6.1818283</td>
</tr>
<tr>
<td>10</td>
<td>Decagon</td>
<td>144°</td>
<td>180°</td>
<td>7.2049388</td>
</tr>
<tr>
<td>11</td>
<td>Undecagon</td>
<td>147°</td>
<td>180°</td>
<td>9.3656539</td>
</tr>
<tr>
<td>12</td>
<td>Dodecagon</td>
<td>150°</td>
<td>180°</td>
<td>11.1961524</td>
</tr>
</tbody>
</table>

POLYGON, in fortification, denotes the figure of a town or other fortress.

The exterior or external polygon is bounded by lines drawn from the point of each bastion to the points of the adjacent bastions.

The interior or polygon is formed by lines joining the centres of the bastions.
is a line containing the homologous sides of the first nine regular polygons inscribed in the same circle; that is, from an equilateral triangle, up to a nonagon.

POLYGONAL NUMBERS, are so called because the units whereof they consist may be disposed in such a manner as to represent several regular polygons.

The side of a polygonal number is the number of terms of the arithmetical progression that compose it; and the polygonal number of angles is that which shows how many angles that figure has, whence the polygonal number takes its name.

To find a polygonal number, the side and number of its angles being given, the canon is this: the polygonal number is the semi-difference of the terms of the square of the side into the number of angles diminished by two units, and of the side itself into the number of angles diminished by four units.

The several sorts of polygonal numbers, viz. the triangles, squares, pentagons, hexagons, &c. are formed from the addition of the terms of the arithmetical series, having respect to the common difference 1, 3, 4, &c. viz. if the common difference of the arithmetical is 1, the sums of their terms will form the triangles; if 2, the squares; if 3, the pentagons; if 4, the hexagons. &c. Thus:

<table>
<thead>
<tr>
<th>Arith. Prog. 1</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tri. Nos. 1</td>
<td>1</td>
<td>3</td>
<td>6</td>
<td>10</td>
<td>15</td>
<td>21</td>
<td>28</td>
</tr>
<tr>
<td>Arith. Prog. 1</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
<td>6</td>
<td>7</td>
</tr>
<tr>
<td>Squ. Nos. 1</td>
<td>1</td>
<td>4</td>
<td>9</td>
<td>16</td>
<td>25</td>
<td>36</td>
<td>49</td>
</tr>
<tr>
<td>Arith. Prog. 1</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
<td>6</td>
<td>7</td>
</tr>
<tr>
<td>Hex. Nos. 1</td>
<td>1</td>
<td>6</td>
<td>15</td>
<td>28</td>
<td>45</td>
<td>66</td>
<td>91</td>
</tr>
</tbody>
</table>

The sums of polygonal numbers collected in the same manner as the polygonal numbers themselves are, out of arithmetical progressions, called pyramidal numbers.

POLYGONUM, knot-grass, a genus of the tragina order, in the octandria class of plants, and in the natural method ranking under the 13th order, holoxaneae. There is no calyx; the corolla is quinquepartite and calycesc, or serving instead of a calyx; there is one angulated seed. There are 39 species; but the most remarkable are:

1. The bistorta, bistort, or greater snakeweed.
2. The viviparum, or smaller bistort. Both these perennials flower in May and June, succeeded by ripe seeds in August. They grow wild in England, &c.; the first in moist, the other in mountainous situations.

3. Oriental polygonums, commonly called persicaria.
4. Fagopyrum, buck-wheat or brook, rises with a smooth, branched stem, from about a foot and a half to a yard high, heart-shaped sagittated leaves, and the branches terminated by clusters of white flowers, succeeded by large angular seeds, excellent for feeding piggins and most sorts of poultry.

The root of a kind of bistort, according to Gunell, is used in Siberia for ordinary food. This species is by Haller called bistorta folius and by some other botanists bistorta montana minor. The natives call it mokus; and so indolent are they, that, to save themselves the trouble of digging it out of the earth, they go in spring and pluge the holes of the mountain-rats, which they find filled with these roots. In our country, bistort is used as a medicine. All the parts of bistort have a rough aromatic taste, particularly the root, which is one of the strongest of the aromatic substances employed in all kinds of medicaments, external and internal.

POLYGYNIA, among botanists, denotes an order or subdivision of a class of plants; comprehending such plants of that class as have a large number of pistils, or female organs of generation. See BOTANY.

POLYGEDRON, in geometry, denotes a body or solid comprehended under many sides or planes. A gnomon of a polyhedron is a stone with several faces, whereas is described various ways.

POLYHEDRON, polyroscope, in optics, is a multiplying-glass or lens, consisting of several plane surfaces disposed into a convex form. See OPTICS.

POLYNYA, a genus of the polygonia necessaria order, in the syngnaea class of plants, and in the natural method ranking under the 49th order, composite. The receptacle is paeonaceous; there is no pappus; the exterior calyx is tetraxynous, or pentaxynous; the interior dicyanous, and composed of concave leaflets. There are five species.

POLYNYEUS, polygneum, a genus of fishes of the order abradanum. The generic character is, head compressed, covered with scales; snout very obtuse and prominent; gill-membrane five or seven-rayed; separate filamentous or setaceous processes near the base of the pectoral fins.

1. Polyneus parva. The genus polyneus may be considered as holding the same station among the abradanum fishes which the genus trigla does among the thoricaceae; being distinguished by a similar circumscription of the fins; and the ratio of the tail to each side, near the base of the pectoral fins, with several separate processes or articulated rays: these are, in general, much longer and more setaceous than in the trigla, and, in some species, even exceed the length of the whole body. The species of polynes are not very numerous, and are chiefly confined to the warmer latitudes.

The polyneus parva, or mango-fish, as it is generally called, which seems to have been one of the first of the genus known to the Europeans, is an inhabitant of the Indian and American seas, and grows to the length of about 12 or 15 inches. It is a fish of an elegant shape, moderately broad in the middle, and gradually tapering toward the tail, which is very deeply forked; its scales are of moderate size, those towards the head and tail smaller than the rest; the biconcave flabella are white, and of different sizes and forms. They are small outwardly often extending far beyond the tail; the others gradually shorten, the first or lowermost extending about half the length of the body. The colour of this fish is generally described as yellow, and its popular name of mango-fish is supposed to have been given from that circumstance, as resembling the colour of a ripe mango. Dr. Rus- sel, in his work on the Indian fishes, informs us that it is considered by many the most delicate of any found at Calcutta.

2. Polyneus plebeius. General appearance that of a mullet, but with the head very obtuse in front, the mouth appearing as if placed beneath; colour silvery grey, with a dusky tinge on the upper parts, and several dusky lines running from head to tail above the lateral line; scales rather large; all the fins small; to some distance from the base; tail forked; thoracic filaments five in number on each side; the first of these is said by Gunell to exceed the length of the body, the rest decreasing gradually.

This species is a native of the Indian and American seas, and is found about the coasts of several of the southern islands. It arrives at a very large size, measuring upwards of four feet in length. It is considered as an excellent fish for the table, and is in much esteem among the inhabitants of the coast, either boiled or fried in various ways, and is sometimes dried and salted for sale.

Dr. Bloch informs us, on the authority of a correspondent on whom he could rely, that this fish is commonly known in India by the name of the excellence, and lauds that Broussonet (who seems to have named it from its want of particular splendour) should have given it the title of P. plebeius.

POLYPOREOUS. This, according to Mr. Bruce, who describes and figures it in the Appendix to his Travels, is a large species, and may vie, for the elegance both of its form and taste, with any fish inhabiting the rivers running either into the Mediterranean or the ocean. The specimen from which Mr. Bruce's figure was taken weighed 32 pounds, but is said often to arrive at the weight of 70 or more. It is an inhabitant of the river Nile, where it is by no means uncommon as far up the river as Syene and the first cataract. The whole body is covered with scales of a brilliant silver-colour, so as to resemble spangles lying close together; and there is not a single scale on the fish, either on the head or on the sides, that is of red on the end of the nose, which is fat and flabby.

We are informed by Mr. Bruce, that in order to take this fish, the Egyptian peasants prepare a pretty large mass of cake, consisting of oil, clay, flour, honey, and straw, scattering it with their feet till it is well incor- porated. They then take two handfuls of dates and break them into pieces about the size of the point of a finger, and stick them in different parts of the mass; into the heart of which they put seven or eight books with dates upon them, and a string of strong whip-cord to each. This mass of paste is then conveyed by the fisherman or shepherd into the stream, the man sitting for this purpose on a blown up goat-skin. When arrived at the middle, he drops the mass in the deepest part of the stream; and cautiously holding the ends of each of the strings tight, so as to keep this fish out of the middle of the composition, he makes to shore again, a little below the spot where he has sunk the mass; and separating the ends of the strings, ties each of them, without straining, to a point planted in the shore, to the end of which is fastened a small bell,
He then goes and feeds his cattle, or digs his trenches, or lies down to sleep. In the mean time the cake beginning to dissolve, the small pieces of dry flour slowly sink to the bottom of the stream, are eagerly seized on by the fishes as they pass; they rush up the stream, picking up the floating pieces as they go, till at length they arrive at the cake itself, and voraciously falling to work at the dates which are buried in it, each fish, in swallowing a date, swallow also the hook in it, and feeling himself fast, makes off as speedily as possible: the consequence is, that in endeavouring to escape from the tackle, the fish in the process, or often more, with its lips unseated; the capsule is compressed, emargined, and bicocular. There is one species, an annual of Cusolin.

POLYPUS, the popular name for those fresh-water insects, which class under the last order of vernes zoophytes. The name of hydrogen was given by Linnaeus on account of the property they have of reproducing themselves when cut in pieces, every part soon becoming a perfect animal. Dr. Hill called them biota, on account of the strong physiologic life with which every part of them is endowed. See HYDRA.

POLYPUS, or POLYPUS of the heart. See MEDICINE.

POLYPASTON. See SURGERY.

POLYCODON, in botany, a genus of the order of filices, in the cryptogamia class of plants. The fructifications are in roundish points, scattered on the stems, and resemble those of filous or leaf. There are 137 species, of which the most remarkable is the filius mas, or common male fern. This grows in great plenty throughout Britain, in woods and stony uncultivated soils. The greatest part of the root lies horizontally, and has a great number of appendages placed close to each other in a vertical direction, while a number of small fibres strike downwards. The stalks are covered with brown diminutive scales. The fructifications are kidney-shaped, and covered with a permanent scaly shield or involucrium. The capsules are of a pale brown, surrounded with a saffron-coloured elastic ray.

This fern has nearly the same qualities, and is used for most of the same purposes, as the piers aquilina. They are both burnt together for the sake of their ashes, which are purchased by the horse-keepers, and used for raising打折s. In the island of Jura are exported annually 150l. worth of these ashes. Gunner relates, in his Flor. Nov. that the young curled leaves, at their first appearance out of the ground, are by some boiled and eaten like asparagus; and that the poorer Norwegian cut off these succulent lammas, like the nails of the finger at the crown of the root, which are the bases of the fronds, and brew them into beer, adding a third portion of molasses, and in times of great scarcity mix the same in their bread. The same author adds, that this fern cut green, and dried in the open air, affords not only an excellent litter for a cattle, but, if infused in hot water, becomes no contemptible fodder for goats, sheep, and other cattle, which will readily eat and sometimes grow fat upon it. But the anti-putrid nature and utility of the root of the male fern is for which it is chiefly to be valued, and of which an account is given in the French publications of Madame Noutier, who employed this remedy with great success. Dr. Sin-
A general hiring, without any particular time agreed upon, is construed to be a hiring for a year, and therefore sufficient. It is not the terms of the hiring, but the intention, that is the criterion; for though a servant may be agreed to on such terms, as if it is understood at the time, that he is to continue for the year if approved of, it is equal to a hiring for a year.

A woman marrying a husband who has a known settlement, shall follow her husband's settlement.

The act of 9 and 10 W. c. 11, does not require a person renting a tenement of 10l. a year, to occupy it; it is enough if he rents it and resides forty days in the parish.

POOR'S RATE, a tax levied in England and Wales, for the relief or support of such persons as from age, infirmity, or poverty, cannot themselves procure the means of subsistence. The first law made in England respecting paupers was in 1406; it directs, "that every beggar, not able to work, shall resort to the hundred where he last dwelt, is best known, or was born; and shall there remain upon pain of being set in the stocks three days, with only bread and water; and then shall be put out of town." The monasteries and nunneries with which the country then abounded, were the principal sources from which the poor obtained relief. In 1531 an act was passed, by which the justices of every county were empowered to grant licences to poor, aged, and impotent persons, to beg within a certain precinct; and such as should beg without licence or beyond their limits, were to be severely punished. This regulation was soon found ineffective; and in 1536, the officers of counties, towns, and parishes, were directed to provide for the support of paupers, who resided three years in one place, by means of voluntary contributions to be raised for this purpose in every parish. In 1547 and in 1545, acts were passed for providing for the poor, by means of weekly collections from the charitably disposed inhabitants of each parish; but this provision was found to be very insufficient, particularly as the number of beggars had increased considerably upon the suppression of the monasteries, from whence support was too much derived from their principal support. It was therefore found necessary in 1563, to a step further, by providing that if any parishioner shall refuse to contribute voluntarily towards the relief of the poor; the justices of the peace at their quarter-sessions, may tax him to a reasonable weekly sum, which if he refuses to pay, they may commit him to prison.

The commencement of the poor's rate, which was rendered more general in 1572, by an act directing, that assessments should be made of the parishioners of every parish, for the relief of the poor. In 1601, nearly the present mode of collecting this rate was established; the churchwardens and overseers of the poor of every parish, or the greater part of them (with the consent of two justices) being empowered to raise weekly, or otherwise, by taxation, every habitant, parson, vicar, and other, and of every occupier of lands or houses, materials for employing the poor, and assign competent sums for their relief. Notice to be given in church of every such rate, the last Sunday after it is allowed. The rate to be levied by distress, on those who refuse to pay it; but appeals against it may be made by those who think themselves aggrieved.

In 1735, a committee of the house of commons was appointed, to consider the existing laws, and settlement of the poor: who recommended the establishment of workhouses, hospitals, and houses of correction, to be under the management of proper persons, who should be one body politic, and the laws relating to the poor should be reduced into one act of parliament.

Return made to parliament of the money raised for maintenance of the poor, from Easter 1773 to Easter 1776.

Money raised in England £ 1,678,915 14 3
Ditto - Wales 40,114 1 0

£ 1,719,029 15 4

In 1803, a more particular account was obtained, in consequence of an act passed "for procuring returns relative to the expense and maintenance of the poor in England"; from which it appeared, that the number of persons receiving relief from the poor rate was as follows:

1. Persons relieved permanently:
   Out of any house of industry, workhouse, &c. 330,199
   In any house of industry, workhouse, &c. 83,468
2. Children of persons relieved permanently in the house, and other children maintained out of the house:
   Under 5 years of age 120,230
   From 5 to 14 years of age 194,914
   3. Persons relieved occasionally: 305,909

This number, great as it appears, is exclusive of 194,032 persons who were not parishioners, the greater part of whom are supposed to have been vagrants.

The total sum raised by the poor's-rate and other parish rates in England and Wales, in the year ending Easter, 1803, was, 5,346,935l.; of which 4,007,005l. was expended on account of the poor.

The average rate in the pound of the poor's-rate for the year 1803, was in all England 4s. 4d., in Wales, 7s. 6d.

POPE, the sovereign pontiff, or supreme head of the Roman church. The appellation of pope was antiently given to all christian bishops; but after the latter-end of the eleventh century, in the pontificate of Gregory VII, it was usurped by the bishop of Rome, whose peculiar title it has ever since continued. The spiritual monarchy of Rome sprung up soon after the decimation of the Roman empire. This sovereignty is addressed under the term holiness, and in the council of the Lateran held under Innocent III, he was declared ordinary of ordinaries. The pope was an absolute monarch in his Italian dominions, and his power very considerable; being able, in case of necessity, to put fifty thousand men into the field, besides his naval strength in galleys. The French revolution, which has reversed all order, and overturned every government where its power extended, and substituted a barbarous and military tyranny in its place, has greatly impaired the splendour, dignity, and power of the pope; nor shall we be at all surprised to see the papal throne entirely reversed, and the territories added to some of the subordinate states, which lately expired by the usurper of France.

POPLAR, PL. See Anatomy.

POPLITEUS. See Anatomy.

POPPY, PAPAVER, by POPULATION, the state of a country with respect to the number of inhabitants.

The greater number of persons any country contains, the greater are the means it possesses of carrying agriculture, manufactures, and commerce, to a great extent, and likewise of defending itself against any hostile attempts of other states; a high degree of population has therefore been generally considered as conducive to national prosperity and security; and almost all writers on political economy, have assumed an increasing population as one of the principal objects which the internal regulations of a country should be calculated to promote. A very just view of this has been lately given by Mr. Malthus, who, adopting as a principle, "the constant tendency in all animated life to increase beyond the nourishment prepared for it," traced to this source a great part of the vicissitudes of the state, and misery, and of that unequal distribution of the bounties of nature, which it has been the unceasing object of the enlightened philosopher in all ages to correct. The subject of population has hitherto been known, where the manners were so pure and simple, and the means of subsistence so abundant, that no check whatever has existed to early marriages, from the difficulty of providing for a family; and no waste of the human species has been occasioned afterwards by vice, intemperance, by towns, or other productions, or too severe labour; consequently in no state that we have yet known, has the power of population been left to exert itself with perfect freedom. In the northern parts of America, where the means of subsistence have been more ample, the manners of the people more pure, and the checks to early marriages fewer, than in any of the modern states of Europe, the population was found to double itself for some successive periods, every twenty-five years. In the back settlements, this effect took place in fifteen years. Sir W. Petty supposed a doubling possible in so short a time as ten years, not to be the surmise of being within the truth. Mr. Malthus takes the lowest of these rates of increase, and thus assumes that population, when unchecked, goes on doubling itself every twenty-five years, or increases in a geometrical proportion at the rate according to which the productions of the earth may be supposed to increase, is not so easily determined; but it is certain, that when acre has been added to acre, till all the fertile land is occupied, the yearly increase of food must depend upon the amelioration of the land already cultivated; this is a stream which, from the nature of all soils, instead of
increasing, must be gradually diminishing; but population, could it be supplied with food, would go on with unexhausted vigour, and the increase of one period would furnish the power of a greater one. To supply this without any limit. In order to illustrate this point, let it be supposed that by the best possible policy, and great encouragements to agriculture, the annual produce of Great Britain could be doubled in the first twenty-five years; in the next twenty-five years, it is impossible to suppose, that the produce could be quadrupled; it would be contrary to all knowledge of the properties of land. Let it then be supposed, that the yearly additions which might be made to the former average produce, instead of decreasing, which they certainly would do, were to remain the same; and that the produce of Great Britain might be increased every twenty-five years, by a quantity equal to what it is present produces. The most enthusiastic speculator cannot suppose a greater increase than this; in a few centuries it would make every acre of land like paradise, and fill the garden. If this supposition is applied to the whole earth, it will appear that the means of subsistence, under circumstances the most favourable to human industry, could not possibly be made to increase faster than in an arithmetical ratio.

Mr. Malthus shews the necessary effects of these two different rates of increase, and observes, that taking the whole earth, by which means of subsistence, supposing the present population equal to a thousand millions, the human species would increase as the numbers 1, 2, 4, 8, 16, 32, 64, 128, 256, and subsistence as 1, 2, 3, 4, 5, 6, 7, 8, 9. In two centuries, the population would be to the means of subsistence as 256 to 9; in three centuries, as 4096 to 13; and in two thousand years the difference would be almost insensible. In this supposition, no limits whatever are placed to the produce of the earth. It may increase ever, and be greater than any assignable quantity; yet still the power of population being in every period so much superior, the increase of the species must be kept down to the level of the means of subsistence, by the constant operation of the strong law of necessity, acting as a check upon the greater power.

From these principles, Mr. Malthus deduces the following propositions: 1. Population is necessarily limited by the means of subsistence. 2. Population invariably increases, where the means of subsistence increase, unless prevented by some very powerful and obvious checks. 3. The checks which repress the superior power of population, and keep its effects on a level with the means of subsistence, are all resolvable into moral restraint, vice, and misery.

Moral restraint, or the determination to defer or decline marriage from a consideration of the inconveniences or deprivations to which a large portion of the community would be subject, is in the hands of the whole human species, under the immediate dictate of nature, Mr. Malthus denominates the preventive check; and whatever contributes to shorten the natural duration of human life (as all wholesome occupations, severe labour, and bad health), and to increase the rate of mortality, extreme poverty, bad nursing of children, great towns, excesses of all kinds, the whole

POPULATION.

train of common diseases and epidemics, wars, pestilence, plague, and famine) are the positive checks to population. From a review of the former and present state of some of the petty nations, it appears, that in modern Europe, the positive checks to the population prevail less, and the preventive check more, than in past time, and in the more uncivilized parts of the world. In the actual state of every society, the natural progress of population has been constantly and powerfully restrained; and as no form of government, however excellent, can prevent the action of a great check to increase in some form or other; as we must submit to it as an inevitable law of nature; it becomes highly desirable to ascertain how it may take place with the least possible perturbation to the virtue and happiness of human society. Now, as it is clearly better that the check to population should arise from a foresight of the difficulty of finding a family, and the fear of dependant power, rather than from the consequences of pain and sickness; moral restraint is a virtue, the practice of which is most earnestly to be encouraged. If no man was to marry, who had not a fair prospect of providing for the prospective issue of his marriage, population would be kept within bounds by the preventive check; men and women would marry later in life, but in the full hope of their reward; they would acquire habits of industry and frugality, and insinuate the same in the minds of their children. Mr. Malthus does not go so far as to propose, that any restraint upon marriage between two persons for their own proper age should be enforced by law, but insists, that the contract of marriages between persons who have no other prospect of providing for their offspring than by throwing them on a parish, should not be, as it is at present, encouraged by law. One of the effects of the present system is to encourage marriage between persons of this description; who well know that, if they cannot provide for their own children, the parish might supply them off their hands. These laws thus create corrupted laws, and the effect of this is to make populous marriage between persons who have no other prospect of providing for their offspring than by throwing them on a parish, a very common practice; and it is a most important principle of moral science, that the moral restraint necessary to keep our numbers within bounds, is one of the effects of the present system. This is a part of the subject, which has been enumerating, to which Mr. Malthus has given a name, moral restraint. It is otherwise called the police, or the preventive check.

This, he remarks, would operate as a far, distinct, and precise notice, which no man could mistake; and without pressing hard upon any particular individual, would at once throw off the rising generation from that miserable and helpless dependence upon the government and the rich, the moral as well as the physical consequences of which, are almost incalculable.

The progress of the population of the world, and its present total amount, cannot be ascertained with much precision; as there are no sufficient grounds on which such a computation can be formed; till within a very late period, and that only in a few countries. Sir W. Petty, in 1685, stated the population of the world at only 530 millions; it has been estimated by some writers at about 730 millions, by others at upwards of 900 millions. Mr. Wallace, of Edinburgh, conjectured it might amount to 1000 millions; and this number has since been generally adopted by those who have noticed the subject. It is a point on which accuracy cannot be expected, but a nearer approximation to the truth appears by no means impracticable. A strong presumpion that the inhabitants of the earth at present exceed considerably a thousand millions, arises from the circumstance, that in almost every country where the people have been numbered, or sufficient data furnished for computing their number, it has been found considerably greater than it had been previously supposed. In Great Britain, the most correct estimates did not make the population exceed seven or eight millions; but in the latter enumeration, it appears to amount to very near eleven millions. France, the population of which was estimated by Mr. Sisnalch at sixteen millions, by M. Deslandes and by Mr. Gibbon at twenty millions, and which M. Masset endeavoured to prove amounted to near 24 millions, appeared from the returns of births and burials, to contain at the commencement of the revolution near 30 millions, and which Mr. Sisnalch supposed to contain about 25 millions of inhabitants; and according to the calculation given by Mr. Coxe, grounded upon an authentic list of the persons paying the poll-tax, they amounted to 30,756,366, and including the provinces not subject to the poll-tax, the calculation for the year 1790 amounted to 36,000,000 inhabitants. A great part of this vast empire is in Asia; but the number of inhabitants, which is usually supposed to be about 100,000,000, is considerably greater; and the following statement is probably not far from the truth:

Spain 3,500,000
Portugal 1,900,000
France 6,300,000
Italy and its islands 10,400,000
Switzerland 2,000,000
Germany 6,000,000
Holland 2,800,000
Flanders 4,000,000
Great Britain and Ireland 15,100,000
On these considerations, with a very moderate allowance for omissions in the returns, the total population of the united kingdom of Great Britain and Ireland, amounts to 12,700,000. 80% of the people inhabit the eastern and western possessions and colonies which contain many natives of the British isles.

The proportion of persons to a house appeared by the returns to be as follows:

In England - 25
Wales - 10
Scotland - 8
Great Britain - 7


Great Britain.

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</tr>
<tr>
<td>Norwich</td>
<td>31,740</td>
</tr>
<tr>
<td>Portsmouth</td>
<td>28,300</td>
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<tr>
<td>Sheffield</td>
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<td>Hull</td>
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<tr>
<td>Nottingham</td>
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<td>Newcastle</td>
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France.

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<td>Lyons</td>
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<td>Bourdeaux</td>
<td>33,500</td>
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<td>Dunkirk</td>
<td>18,600</td>
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<tr>
<td>Toulon</td>
<td>15,400</td>
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</table>

POPULUS, the Poplar, a genus of the angiospermous order, in the dicotyledonous class of plants; and in the natural method, ranking under the 5th order, anemaceae. The calyx of the anemaceae is a deciduous, oblong, and spathaceous leaf, the corolla is tubular, and entire. The female has the calyx of the anemaceae and corolla the same as in the male; the stigma is quadrifid; the capsule biconvex, with many pappose seeds. There are eleven species; the most noted are:

1. The alba, or able-tree, grows naturally in the temperate parts of Europe. Its leaves are large, and divided into three, four, or five lobes, indicated on their edges, of a very dark green colour. The heart-shaped leaf has a white and downy on the under side; standing upon footstalks an inch long. The young branches have a purple bark, and are covered with a white down; but the bark of the stem and older branches is grey, oblong, and furrowed, or white poplar, has its leaves rounder than the former, and not much above half their size; they are indented on their edges, and are downy on their under side, but not so white as those of the former, nor are their upper surfaces of such a deep green colour.

2. The nigra, or black poplar, has oval heart-shaped leaves, slightly indented on their edges; they are smooth on both sides, and of a lighter green colour. The tremula, or aspen-tree, has roundish, angular indented leaves; they are smooth on both sides, and stand on long footstalks, and so are shaken by the least wind; whence it has the title of the trembling poplar, or aspen-tree. The balsamifera, or Carolina poplar, is a native of Carolina, where it becomes a large tree. The shoots of this sort grow very strong in Britain, and are generally angular; with a light green bark like the willow. The leaves on young trees, and also those on the lower shoots, are very large, almost heart-shaped, and created; but those upon the older trees are smaller; as the trees advance, their bark becomes lighter, approaching to a greyish colour.

The wood of these trees, especially of the able-tree, is good for laying flowers, where it will last for many years, and, on account of its extreme whiteness, is much preferred by the engraver, and is also used in books, being subject to the impression of nicks, &c., it is less proper on this account than the harder woods. The able-wood likewise deserves particular notice, on account of the beautiful furrows and curving intercrossing furrows, as stated by the reverend Mr. Stone in Phil. Trans. vol. l. p. 195. This bark will also tan leather.

The inner bark of the black poplar is woody, and is used by the inhabitants of Palaestina as a material for bread; and paper has sometimes been made of the cottony down of the seeds. The roots have been observed to dissolve into a kind of glutinous substance, and to be converted over with a tubular crustaceous spar, called by naturalists osteocolla, formerly imagined to have some virtue in producing the callus of a fractured bone. The buds of the sixth species are covered with a glutinous resin, which smells very strong, and is the gum tamaracacetum of the shops. The best, called (from its being collected in a kind of gourd-shells) tamaracacetum sanguinum, is somewhat succulent and softish, of a pale yellowish yellowish-yellow, of a lighter or greenish colour, of a less grateful smell than the foregoing. This resin is said to be employed externally by the Indians for dissolving and maturating tumours, and abating pain in the limbs. It is an ingredient in some anodyne, hysteres, cephalic, and stomachic plasters; but the fragrance of the inner sort sufficiently points out its utility in other respects.

M. Tougerz de Fouras, from a set of experiments on the subject, gives an account of the uses of the several kinds of poplar wood, the substance of which is as follows: He finds that the wood of the black poplar is good and useful for many purposes; that the London poplar, is of very little value; that the Virginia poplar, populus Virginiana, affords a wood of excellent quality, that may be applied to many uses. The Carolina poplar, populus Carolinensis heterophylla, is beautiful in sound, but liable to be hurt by cold. Its wood appears to M. de Fouras to be of very little value; but M. Malesherbes, who co...
PORCELAIN, a fine kind of earthenware, chiefly manufactured in China, and thence called Ching-ware. All earthenware, which are white and semi-transparent are generally called porcelain: but amongst these so great differences may be observed, that notwithstanding the similarity of their external appearance, they cannot be considered as matters of the same nature. These differences are evident, that even persons who are not connoisseurs in this way prefer much the porcelain of some countries to that of others.

The word porcelain is of European derivation; none of the syllables which compose it can even be pronounced or written by the Chinese, whose language comprehends no such sounds. It is probable that we are indebted to the Portuguese for it; the word porcelain, however, in their language, signifies properly a cup or dish; and they themselves distinguish all works of porcelain by the general name of loca. Porcelain is called in China tsê-ki.

The art of making porcelain is one of those in which Europe has been excelled by China, entailing a vast amount of manufacture. The first porcelain that was seen in Europe was brought from Japan and China. The whiteness, transparency, fineness, neatness, and even magnificence of this pottery, which soon became the admiration of the famous artists of Europe, did not fail to excite the admiration and industry of Europeans; and their attempts have succeeded so well, that in different parts of Europe earthenwares have been made so like the Oriental porcelain that they have acquired the name of porcelain.

The first European porcelains were made in Saxony and in France; and afterwards in England, Germany, and Italy; but as all these were different from the Japanese, so each of them has its peculiar character.

The finest and best porcelain of China is made in a village called Kiang-tech in the province of Kiang-si. This celebrated village is a league and a half in length, and we are assured that it contains a million of inhabitants. The workmen of Kiang-tech, in the European trade, have established manufactories also in the provinces of Foo-kien and Canton; but this porcelain is not exported.

We are indebted to father d'Entrecolles, a Roman missionary, for a very accurate account of the manner in which porcelain is made in China; and as he lived in Kiang-tech, his information must have been the very best possible. We shall therefore give his account of the Chinese manner of making porcelain as abridged by him in his General Description of China. The principal ingredients of the fine porcelain are pet-ten-tse and kao-lin, two kinds of earth, from the mixture of which the paste is produced. The kao-lin is a very fine earth, composed of large particles; the other is purely white, and very fine to the touch. These raw materials are carried to the manufactories in the shape of bricks. The pet-ten-tse, which is so fine, is mixed with fragments of rock, taken from certain quarries, and reduced to powder. Every kind of stone is not fit for this purpose. The colour of that which is good, say the Chinese, ought to incline to a light brown. Large iron clubs are used for breaking these pieces of rock; they are afterwards put into mortars; and, by means of levers headed with stone round bound with iron, they are reduced to a very fine powder. These levers are put in action either by the labour of men, or by water, in the same manner as the hammers of our paper-mills. The dust afterwards collected is thrown into large vessels filled with water, which is strongly stirred with a ram, and it has been left to settle for some time, a kind of cream rises on the top, about four inches in thickness, which is skimmed off, and poured into another vessel filled with water. The top is stirred in the first vessel is stirred in the second, and the cream which rises is collected, until nothing remains but the coarse dregs, which, by their own weight, precipitate to the bottom. These dregs are carefully collected, and pounded anew.

With regard to what is taken from the first vessel, it is suffered to remain in the second until it is formed into a kind of crust at the bottom. When the water above it is of a decided clear, it is poured off by gently inclining the vessel, that the sediment may not be disturbed; and the paste is thrown into large moulds proper for drying it. Before it is entirely hard, it is divided into small squares, in cakes, which are said by the hundred. The colour of this paste, and its form, have occasioned it to receive the name of pe-ten-tse.

The kao-lin, which is used in the composition of porcelain, requires less labour than the pet-ten-tse; it serves as a great share in the preparation of it. There are large mines of it in the bosoms of certain mountains, the exterior strata of which consist of a kind of red earth. These mines are very deep, and the kao-lin is found in small lumps, that are formed into bricks after having gone through some processes of the potter's art. Father d'Entrecolles thinks, that the earth called terre de Malte, or St. Paul's earth, has much affinity to the kao-lin, although those small shining particles are not observed in it which are interposed in the latter.

It is from the kao-lin that fine porcelain derives all its strength; if we may be allowed the expression, it stands in the stead of nerves. It is very extraordinary, that soft earth should give strength and consistence to the pet-ten-tse, which is procured from the hardest rocks. A rich Chinese merchant told father d'Entrecolles, that the English and Dutch had purchased some of the pet-ten-tse, which they had sent to Europe with a design of making porcelain; but having carried with them none of the kao-lin, their attempt proved abortive, as they have since acknowledged. "They told me," said this Chinese merchant, "that to form a body, the flesh of which should support itself without bones.

The Chinese have discovered, within these few years, a new substance proper to China, and not for porcelain. It is a stone, or rather species of chalk, called hoa-che, from which the physicians prepare a kind of draught that is said to be detestable, or at least very unpleasant. They have thought proper to employ this stone instead of kao-lin. It is called hoa, because it is glutinous, and has a great resemblance to soap. Porcelain made with hoa-che is very rare, and never serves to more than any other. It has an exceedingly fine grain; and with regard to the painting, it is compared with that of the common porcelain, it appears to surpass it as much as velum does paper. This porcelain is always of a white colour, and it surprises those who are accustomed to handle other kinds; it is also much more brittle; and it is very difficult to hit upon the proper degree of tempering it.

Hoa is in a state of lignum vitae when removed from the body of the work; the artist is contented sometimes with making it into a very fine size, in which the vessel is plunged when dry, in order that it may receive a coat before it is painted. The vessel is stirred and watered in its proper manner; it keeps a superior degree of beauty.

When hoa-che is taken from the mine, it is washed in rain or river water, to separate it from a kind of yellow earth which adheres to it. It is then pounded, put into a tub filled with water to dissolve it, and afterwards formed into cakes like kao-lin. We are assured that hoa-che, when prepared in this manner, without the mixture of any other earth, is able to support the porcelain. It serves instead of kao-lin; but it is much dearer. Kao-lin costs only ten-pence sterling; the price of hoa-che is half-a-crown; this difference, therefore, greatly enhances the value of the common ware made with the latter.

To pe-ten-tse and kao-lin, the two principal elements, must be added the oil or varnish from which it derives its splendour and whiteness. This oil is of a whistful colour, and is extracted from the same kind of stones which produces the pet-ten-tse; but the whitest is always chosen, and that which has the greenest spots. The oil is obtained from
it by the same process used in making the pe-tun-tse; the stone is first washed and pulverised; it is then thrown into water, and when it has been purified it throws up a kind of cream. When all the cream is removed, the vase is rubbed on a stone by means of water, and the cream is spread over it, in order to make it receive the proper figure. This is a kind of clay, composed of a mixture of very fine sand, and of a pure white, and moderately dry; it is very liable to break, being about the same as porcelain, and is highly valued for the same reasons. It is used for the manufacture of porcelain, and is spoken of as porcelain-earth. It is made from the volcanic ashes, which are mixed with water, and then cast into a mould, and is afterwards dried, and put into a kiln, where it is fired, and then ground and mixed with other materials. The porcelain is then made by mixing it with a little water, and the mixture is put into a mould, where it is allowed to harden, and is then fired. The porcelain is then taken out of the mould, and the surface is polished with a soft cloth. The porcelain is then put into another mould, and the process is repeated until the desired thickness is obtained. The porcelain is then taken out of the mould, and the surface is polished with a soft cloth. The porcelain is then put into another mould, and the process is repeated until the desired thickness is obtained. The porcelain is then taken out of the mould, and the surface is polished with a soft cloth. The porcelain is then put into another mould, and the process is repeated until the desired thickness is obtained.
and printed many books; hence the name of Port-royalists was given to all their party, and their books were called works of Port-royal; hence we say the writers of Port-royal, messieurs de Port-royal, and the translations and grammars of Port-royal.

PORTA, or vena porta. See Anatomy.

PORTULACA. Calcaria, 1766, ed. 2, Geo. III. c. 58, nomin-keeper, warehouse-keeper, or other person, to whom any box, basket, package, parcel, truss, game, or other thing whatsoever, not exceeding fifty-six pounds weight, or any party or other person employed by such-man-keeper, warehouse-keeper, or other person, in portage, or delivery of any such box, parcel, &c. within the cities of London, Westminster, or borough of Southwark, and their respective suburbs, and other parts contiguous, not exceeding half a mile from the end of the carriage-pavement, in the several streets and places within the abovementioned limits, shall ask or demand, or receive or take, in respect of such portage or delivery, any greater rate or price than as follows:

Not exceeding a quarter of a mile
- half a mile
- one mile
- one mile and a half
- two miles

For every further distance, not exceeding half a mile, three-pence additional.

Persons asking or receiving more than the above rates, shall incur such offence, forfeit a sum not exceeding 20l, or less than 5s.

PORTICO. See Architecture.

PORTLAND stone is a dull whitish species much used in buildings about London. It is composed of a coarse grit, cemented together by an earthly spar. It will not strike fire with steel, but makes a violent effervescence with nitric acid. See Free-stone.

PORTLANDIA, a genus of the monogynia order, in the pentandria class of plants, and in the natural method ranking with those of which the order is doubtful. The corolla is cleaved; the anthers are longitudinal; the capsule pentagonal, and the matured with a pentalophorous calyx. There are four species. The grandiflora has been particularly descended, who has alone been given a good figure of it. It has frequently flowered in the royal garden at Kew, and in Dr. Pitcairn's at Islington. The external bark is remarkably rough, furrowed, and thick; it has no taste. The inner bark is very thin, and of a dark-brown colour. Its taste is bitter and astringent, and its virtues are the same as those of the Jesuits' bark. Infused in spirits or wine with a little orange-peel, it makes an excellent vermifuge medication.

PORTRAIT. See Painting.

PORTULACA, pseud, a genus of the monogynia order, in the dodecaandria class of plants, and in the natural method ranking under the 13th order, succulente. The corolla is pentatepetalous; the calyx bident; the capsule unicorial, and cut round. There are 12 species, but the following are the most remarkable:

The olarcesa, annual, or common culinary purslane. There are two varieties; one with deep-green leaves, the other with yellow leaves; both of which rise from the same seed. 2. The amaranth, pseud, or shrubby Cape purslane.
Post, an operation in book-keeping. See Book-keeping.

Post; a conveyance for letters or dispatches. England appears to be the first country in Europe, which formed a regular establishment for this purpose: though it was not till a late period that it assumed any thing like a national air even here. Under the reign of Edward VI., however, some species of posts must have been set up, as an act of parliament passed in 1548, fixing the rate of post-horses at one penny per mile; the post-horses having ordered to wear, it is probable, chiefly for travelling, and the carriage of letters or packets only an occasional service. In 1581, we find in Camden's Annals mention made of a chief postmaster for England being appointed. How his office was managed, does not clearly appear; the limited state of the correspondence of the country probably rendered it of trifling consequence. King James I. originally erected a post-office under the control of one Matthew de Quercus, or the P'querque, for the conveyance of letters to and from foreign parts; which office was afterwards claimed by lord Stanhope, but was continued and continued to William Fizel and Thomas Whittingham, by king Charles I., in 1632. Previous to this time, it would appear that private persons were in the habit of conveying letters to and from foreign parts; all such interference with the postmaster's office, was expressly prohibited. King Charles I., in 1635, erected a letter-office for England and Scotland, under the direction of the above Thomas Withings. The rates of postage then established were, two-pence for every single letter for a distance under 80 miles; four-pence from 80 to 140 miles; six-pence above 140 miles. The allowance to the post-masters on the roads for horses employed in these posts, was fixed at two-pence halfpenny per mile for every single horse. All private inland posts were discharged at this time; and in 1637, all private foreign posts were in like manner prohibited. The post thus established, however, extended only to the principal towns, and the times of transmission were not in every case so certain as they ought to have been.

Withings was superseded for abuses in the management of his offices in 1640, and they were sequestered into the hands of Philip Burlamachy, to be exercised under the care and oversight of the king's principal secretary of state. On the breaking out of the civil war, great confusion and interruptions were necessarilyoccasioned in the conduct of the letter-office; but it was about that time that the outline of the present more extended and regular plan seems to have been conceived by Mr. Edmond Prideaux, who afterwards appointed attorney-general to the commonwealth. He was chairman of a committee in 1642, for considering the rate of postage to be set upon inland letters; and some time after was appointed postmaster by an act of parliament of both houses of parliament, in the execution of which office he first established a weekly conveyance of letters into all parts of the nation. In 1643, this revenue was formed for 10,000l. for England, Scotland, and Ireland; and after the charge of maintaining postmasters, to the amount of 7000l. per annum was saved to the public. Prideaux's emoluments being considerable, the common council of London endeavoured to erect another post-office in opposition to his; but they were checked by a resolution of the house of commons declaring that the office of postmaster is, and ought to be, in the sole power and disposal of the parliament. This office was formed by one Manby, in 1654. In 1666, a new and regular general post-office was created, with the supreme authority of the Protector and his parliament, for the same purpose that has been ever since adopted, with the following rates of postage: for 80 miles distance, a single letter two-pence; for a greater distance, not over 200 miles, England, three-pence; to Scotland, four-pence; by an act of parliament passed soon after the Restoration in 1660, the regulations settled in 1666 were re-established, and a general post-office similar to the former, but with some improvements, was erected. In 1663, the revenue of the post-office was found to produce 21,500l. annually. In 1685, it was made over to the king, as a branch of his private income, and was then estimated at 65,000l. per annum. The year after the Revolution, the amount of the post-office revenue was 90,550l. 10s. 6d. At the Union, the produce of the English post-office was stated to be 101,010l. In 1711, the king's post-office, for England and Scotland were abolished; and by the stat. 9 Anne, c. 10, one general post-office, and one postmaster-general, were established for the whole united kingdom; and this postmaster was empowered to erect chief letter-offices at Edinburgh, at Dublin, at New York, and other proper places in America, and the West Indies. The rates of postage were also increased at this time, as follows: In England, for all distances under 80 miles, three-pence; above 80 miles, four-pence. From London to Edinburgh, sixpence. In Scotland, under 50 miles, two-pence; from 50 to 80 miles, three-pence; above 80 miles, four-pence. In Ireland, under 40 miles, two-pence; above 40 miles, four-pence. By the above act, all persons, except those employed by the postmaster, were strictly prohibited from conveying letters without the consent of the postmaster-general, who was empowered to alter the rates of postage, set at 111,461l. 17s. 10d. The net amount, on a medium of the three preceding years, was, in the printed reports of the correspondence of the nation, the equivalent, stated to be for England, 60,000l.; for Scotland, 2000l. In 1754, the gross revenue of the post-office for Great Britain amounted to 210,662l.; in 1764, to 281,354l.; and in 1774 to 345,321l. The privilege of franking letters had been enjoyed by members of parliament from the first erection of the post-office; the original design of this exemption was, that they might correspond freely with their constituents on the business of the nation. By degrees the privilege came to be shamefully abused, and was carried so far, that it was uncommon for the servants of members of parliament to procure a number of franking certificates for the use of their employes; an abuse which was easily practised, for nothing more was required for a letter's passing free than the subscription of a member on the cover. To restrain these frauds, it was enacted, in 1764, that no letter should pass free under the whole direction was of the member's writing, and his subscription annexed. Even this was found too great a latitude; and by a new regulation in 1784, no letter was permitted to go free, unless the date was marked on the cover in the member's own handwriting, and the letter put to the office the same day. That year the rates of postage were raised in the following proportions: an addition of one penny for a single-stage; one penny from London to Edinburgh; one penny for any distance under, and two-pence for any distance above 150 miles. An additional tax of one penny was estimated to arise from these regulations and additional rates. In all the statements of duties upon postage of letters given in this account, the rates mentioned are those upon single letters; double letters and the like, were charged an ounce weight quadruple postage; all above are charged by the weight, in the same proportion.

About the year 1754, a great improvement was made with a strong opposition conveying the mails, upon a plan first suggested in 1782, by Mr. John Palmer. Diligences and stage-coaches, he observed, were established to every town of note in the kingdom; and he proposed that going through the mails in the old mode, by a boy on horseback, and in carts, should contract with the masters of these diligences to carry the mail, along with their passengers, at their own expense. This plan, he conceived, could not much more expeditions conveyance, the rate of travelling in diligences being far quicker than the rate of the post; and it was easy to carry it into execution with little extra expense, as the coach-owners would readily enter into a long indenture to contract at a cheap rate for conveying the mail, on account of the additional recommendation to passengers, their carriages would thereby be rendered more regular, and dispatch. Though government heartily approved of this plan, and the public at large were satisfied of its utility, yet, like all new schemes however beneficial, it was too late. Three years after, it was re-represented by a number of the oldest and ablest officers in the post-office, n.t only as impracticable, but dangerous to commerce and the revenue. Notwithstanding this opposition, however, it was at last established, and gradually extended to many different parts of the kingdom; and, upon a fair comparison, it appeared that the revenue was very considerably improved, though Mr. Palmer's post was not, however, long continued. A number of new appointments which they rendered necessary, greatly increased the former expense of management. The conveyance of the mails on the new plan was contracted for, after the two first years trial, at 20,000l. per annum less than the sum first estimated by Mr. Palmer.

...
The statute re-establishing the post-office in 1630, it is enacted, that none but the postmaster, his deputies, or assigns, shall furnish post-horses for travellers; and a proviso, however, that if he has furnished a horse, he demands, the traveller shall be at liberty to furnish himself elsewhere. The same provision is contained in the act establishing the Scots post-office in 1653, as well as in the subsequent act passed in 1717. By an act of Geo. II, the provision is extended to post-horses only, and every person declared to be at liberty to furnish carriages of every kind for riding post. This regulation has, in fact, done away the prohibition, as hardly any person now thinks of travelling post, except in a carriage.

The rate fixed by the act 1605, in Scotland, for a horse riding post, was three-pence per Scotch mile. By the act 9, Anne, c. 10, three-pence a mile without, and four-pence a mile with a guide, was the sum fixed for each mile of riding post, or of the carriage of letters, and necessity for a speedy communication between different parts of the kingdom, have brought the mode of travelling post so much into use, that upon very great occasions, and in the kingdom, are now in readiness at proper distances; and the convenience of posting is enjoyed in Britain at a degree far superior to what is to be met with in any other country whatever.

Posting at last apparent to the legislature a proper object of taxation. In 1779 the first act was passed, imposing duties on horses hired either by themselves or to run in carriages travelling post; the duties were, one penny per mile on each horse hired by the mile or stage, and one shilling per day if hired by the day. Every person letting out such horses was also obliged to take out a licence at five shillings per annum. These duties were next year repealed, and new duties imposed, of one penny per mile on each horse hired by the mile or stage, and one shilling and six-pence on each if hired by the day. A number of additional regulations were also made at the same time, providing these duties. An addition of one halfpenny per mile, or three-pence per day, for each horse riding post, was imposed in 1785, by stat. 25 Geo. III, c. 51. The duty is secured by a registration kept by the person hiring the horse, and the person delivering it to the person hiring then a ticket, expressing the number of horses hired, and either the distance in miles to be travelled, or that the horses are hired by the day, as the case happens to be. These tickets must be delivered to the bar-keeper at the first turnpike through which the traveller passes; and the turnpike-keeper gives, if demanded, what is termed an exchange ticket, to be produced at the next turnpike. The stamp-office issues to the person licensed to let post horses such a number of these tickets as is required, and these must be regularly accounted for by the person to whom they are issued. As an effectual check upon his account, the turnpike-keeper is obliged to return back to the stamp-office all the tickets he takes up from travellers. Evasion is by these means rendered difficult to be practised without running a great risk of detection. In 1757 the post-office, in order more effectually levying the post-horse duties, a law was passed authorising the commissioners of the stamp-office to let them to farm by public auction, for a sum not less than the production of the post-office in the year ending 1st August 1786.

In the act, commissioned by the commissioners in consequence of this law, previous to the receiving proposals for farming them, the total amount of the duty for Great Britain is stated to have been, at the period above referred. The sum for which that duty was farmed in 1794, amounted in all to 510,030, of which the district of North Britain was 6000.

POST DISSEISIN, a writ for him that having recovered land by tenements by precipe good redit, upon default of redemption is again dissised by the former dississor.

POSTEA, in the return of the proceedings by nisi prius into the court of common pleas after a verdict, and there afterwards recorded. Plead. 211.

POSTERN, in fortification, is a small gate generally made in the angle of the think of a bastion, or in that of the curtin, near the orillon, descending into the ditch; by which the garrison may march in and out unperceived by the enemy, either to relieve the works, or to make private reconnaissances.

POSTULATE, in mathematics, &c., is described to be such an easy, and self-evident supposition, as needs no explication or illustration to render it intelligible; as, that a right line may be drawn from one point to another.

POTAMOGETON, pond-weed, a genus of the tetrania tetragyna class of plants, the corolla whereof consists of four roundish oblate, hollow, patent, and ungualated petals; there is no pericarpium or redum. There are four in number, roundish and accumulat, gibbous on one side, and compressed and angulated on the other. This plant has a refrigerating virtue, and is recommended in the cure of old ulcers. There are 14 species.

POTASS. If a sufficient quantity of wood is burnt to ashes, and these ashes afterwards washed repeatedly with water till it comes off free from any taste, and if this liquid is filtrated and evaporated to dryness, the substance remaining is a potass, which is known in chemistry by the name of potass, but, however, in a state of purity, it is contaminated with several other substances, but sufficiently pure to exhibit many of its properties. In this state it occurs in commerce under the name of pearl ash. When the potass is evaporated to redness, many of its impurities are burnt off; it becomes much whiter than before, and is then known in commerce by the name of pearl ash. Still, however, it is contaminated with many foreign bodies, and is itself combined with carboxic acid gas, which bleeds all its properties. It may be obtained perfectly pure by the following process:

1. Mix it with twice its weight of quick-lime, and ten times its weight of pure water.
2. Boil the mixture for some hours in a clean iron vessel, or allow it to remain for 48 hours in a close glass vessel, shaking it occasionally. Then pass it through a filter. Boil the liquid obtained in a silver vessel very rapidly, till it is so much concentrated as to assume when cold the consistence of honey. Then pour upon it a quantity of alcohol equal in weight to one-third of the pearl-ash employed. Shake the mixture, put it on the fire, let it boil for a minute or two, then pour it into a glass ves-
POTASS.

POTASS.

Potass is a brittle substance of white colour, and a smell resembling that which is perceived during the shaking of quicklime. Its taste is remarkably acid; and it is so exceedingly corrosive, that when applied to any part of the body, it destroys it almost instantaneously. On account of this property, it has been called caustic, and is often used by surgeons under the name of the potential cautery, to destroy useless or hurtful excrecences. Its specific gravity is 1.70.

When heated it melts; at a red heat it swells, and evaporates slowly in a white acid vapour. A strong acid gives it a greenish tinge, but produces no other alteration in it. Potass is not altered by exposure to light.

When exposed to the air, it soon attracts moisture, and is converted into a liquid; at the same time it becomes potass, and for which it has a strong affinity. It is in this state that potass is usually employed by chemists. When four parts of potass in powder, and one of snow are mixed together, the mixture becomes liquid, and at the same time absorbs a quantity of caloric. This mixture was employed by Lowitz to produce artificial cold. When the aqueous solution of potass is evaporated to a proper consistence, it acquires a crystalline shape. The shape of its crystals is very different, according to the way in which they have been produced. When allowed to form spontaneously, they are octahedrons in groups, but contain 0.43 of water. When formed by evaporation on the fire, the mixture becomes a very thin transparent blade of extraordinary magnitude, which, by an assemblage of lines crossing each other in prodigious numbers, present an appearance of a gaudy paper. It is so very close, that the vessel may be inverted without losing one drop of the liquid which it contains.

4. Potass shows no disposition to unite with oxygen, neither is it altered by the action of any of the compounds into which oxygen enters, though it has a strong tendency to unite with several of these compounds.

5. It unites with none of the simple combustible bodies, but Carbon, hydrogen do not act upon it at all; neither does it produce any alteration in them, but it acts upon phosphorus with considerable energy.

6. Potass, with the sulphur of one of potass and one of potass salted together in a glass mortar, the sulphur acquires a green colour, the mixture becomes hot, and exhalates an acridceous odour. It gradually attracts moisture from the air, and is totally soluble in water. When two parts of potass and one of phosphorus are well corked, they melt and combine, and form sulphur of potass.

Therefore, the potash of commerce, slightly, is of a brown colour, not unlike the liver of animals. Hence it was formerly called hepatic sulphur.

Sulphuret of potass, thus prepared, is of a brown colour, not unlike the liver of animals. It is hard, brittle, and has a glassy fracture. It is a brittle substance of white colour, and a smell resembling that which is perceived during the shaking of quicklime. Its taste is remarkably acid; and it is so exceedingly corrosive, that when applied to any part of the body, it destroys it almost instantaneously. On account of this property, it has been called caustic, and is often used by surgeons under the name of the potential cautery, to destroy useless or hurtful excrecences. Its specific gravity is 1.70.

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POT have a strong affinity for oxygen, when put into a solution of potass in water, especially if heat is applied, are gradually oxidized. This is the case with molybdenum, zinc, and iron. Tin also is oxidized in a very small proportion; and this seems also to be the case with manganese.

It is capable of dissolving a considerable number of the metallic oxides; and in some cases it deprives them of a dose of their oxygen. Thus, when poured upon the red oxide of iron it converts it into the black. The cause of this change is unknown. It has been ascertained, that the oxides of the following metals are soluble in potass.

<table>
<thead>
<tr>
<th>Metal</th>
<th>Soluble in Potass</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tin</td>
<td>Yes</td>
</tr>
<tr>
<td>Arsenic</td>
<td>Yes</td>
</tr>
<tr>
<td>Zinc</td>
<td>Yes</td>
</tr>
<tr>
<td>Antimony</td>
<td>Yes</td>
</tr>
<tr>
<td>Tellurium</td>
<td>Yes</td>
</tr>
</tbody>
</table>

But the nature of these solutions has not hitherto been examined with any degree of attention; though the subject is remarkably curious, and promises to throw light both upon the nature of alkalies and metals.

The affinities of potass are as follows:

- Sulphuric acid, Citric
- Nitric acid, Lactic
- Muriatic acid, Benzoic
- Phosphoric acid, Sulphurous
- Floracic acid, Sulphuric
- Oxalic acid, Acetic
- Tartaric acid, Salicetic
- Aspicic acid, Carboxic
- Succinic acid, Frussic

Potass has never yet been decomposed. Several chemists, indeed, have conjectured, that it is a compound of lime and azote; and some persons have even endeavoured to prove this by experiment; but none of their proofs are at all satisfactory. We ought, therefore, perhaps, in strict propriety, to have assigned it a place among our enumeration of simple bodies in the article chemistry; but as it is excluded by most of the foreign chemists, we thought it least likely to promote confusion to follow their arrangement. Besides, we are certain, from a variety of facts, that all the alkalies are compounds. One of them has actually been decomposed; and in the other two have been detected in the act of formation, through the ingredients which compose them have not hitherto been discovered. Moreau and Desormes indeed announced, some time ago, that they considered potass as a compound of hydrogen and lime. Their chief proofs were the appearance of lime, when the salt, composed of hyperoxigenized muriatic acid and potass, is strongly heated with phosphoric acid in a crucible of platinum; and a manifest combination together with the deposition of lime, when charcoal and potass are in like manner exposed to a strong heat in a platinum crucible. But these, and the other experimental proofs, being examined by Darracq, that accurate chemist ascertained that the results obtained by Desormes and Moreau were owing, in most cases, to the impurity of the potass with which they had made their experiments; while in others, they had drawn wrong inferences from mistaken resemblances. Their hypothesis of course cannot be maintained.

Potass is of the highest importance, not only in chemistry, where it is employed for a great variety of purposes, but also in many arts, and manufactures; as washing, bleaching, dying, glass-making, and others, as will appear on an inspection of these articles. It is employed also in surgery and medicine.

POTATO. See SOLANUM.

Potato, in heraldry, is a term for a kind of cross, whose ends all terminate like the head of a crutch.

POWENT, or Potentilla, a genus of the pentagynia order, in the natural method ranking under the 35th order sentientia. The calyx is decemfold; there are five petals; the seeds roundish, naked, and affixed to a small dry receptacle. There are 32 species, the most noted are:

1. The fruticose, or shrubbery potentilla, commonly called shrub-crinquefoil. This is a beautiful deciduous flowering shrub, worthy a place in every curious collection. It grows wild in Yorkshire, and other northern parts of England, &c., but has been long cultivated in gardens as an ornamental shrub. 2. The reptans, or creeping common five-leafed potentilla, or five-leafed grass. 3. The rupetris, or mountain upright cinquefoil, having the stalks green, and white flowers. 4. The erect, or erect seven-lobed yellow cinquefoil, having the stalks terminated by corymbose clusters of yellow flowers. 5. The fragaroides, or strawberry-like trailing potentilla. This species has a great resemblance to the small sterile strawberry plants. 6. The argenteus, silvery upright potentilla, with small yellow flowers.

All these plants flower in June and July; the flowers are disposed each of five roundish petals, and about 20 stamina. They are all very hardy, and may be employed in the different compartments of the pleasure ground. Their propagation is very easy.

POTTERY, garden burnet, a genus of the polyandria order, in the monocera class of plants, and in the natural method ranking under the 54th order, miscellaneous. The male calyx is tetracyphalous; the corolla quadrundulosa; the petals are about 20 stamina. The female calyx is tetracyphalous; the corolla quadrundulosa; there are two pistils; the berry is formed of the indurated tube of the corolla. There are five species, the most remarkable of which is the common garden burnet. This species grows wild in England in chalky soils, but has been long cultivated as a salled-herb for winter and spring use, it being of a warm nature; the young leaves are the useful parts. It is perennial in root, and retains its radical leaves all the year, but the stalks are annual. 2. The hybrida, hybrid agrimony-leaved Montpelier burnet. This species often proves beneficial, by being introduced among the stalks before they flower, it will cause it to multiply at bottom, and become abiding. 3. Poteriurn spinosum, shrubby spinous burnet of Crete.

Burnet is of a cordial nature; in summer, the leaves are used for cool tankards, to give the wine an agreeable flavour. The powder of the root of the first species is commended against spitting of blood, bleeding at the nose, dyspepsia, and the like. It is employed by some with vertient scents. In winter and spring, the young tender leaves are used in salads. Its uses as food for cattle are well known.

POTHOS, a genus of the polyandria order, in the gymnandra class of plants. The
P. O. W. E. V. and A. P. R. E. V. PRAMUNIRE.

This punishment is inflicted upon him who denies the king's supremacy the second time; upon him who affirms the authority of the pope, or refuses to take the oath of supremacy; upon such as are sedition talkers of the inheritance of the crown, and upon them that there is any obligation by any oath, covenant, or engagement whatsoever, to endeavour a change of government either in church or state; or that both or either house of parliament have or has a legislative power without the king.

The judgment in pramunire at the suit of the king, against the defendant being in prison, is, that he shall be out of the king's protection; that his lands and tenements, goods and chattels, shall be forfeited to the king; and that his body shall remain in prison, at the king's pleasure; but if the defendant is condemned upon his default of not appearing, whether at the suit of the king or party, the same judgment shall be given as to the being out of the king's protection and the forfeiture; but instead of the clause that the body shall remain in prison, there shall be an award of a capias. Upon an indictment of a pramunire, a peer of the realm shall not be tried by his peers. 12 Co. 92.

Pragmatic sanction, in the civil law, is defined to be a rescript, or answer of the sovereign, by advice of his council, to some college, order, or body of people, upon consulting them on some case of their community. Such answer given to any particular person, is called simply rescript.

The term pragmatic sanction is chiefly applied to a settlement of Charles VI. emperor of Germany, who, in the year 1322, having no sons, settled his hereditary dominions on his eldest daughter, the archduchess Maria Theresa, which was confirmed by the diet of the empire, and guaranteed by Great Britain, France, the States-General, and most of the powers in Europe.

P. R. S. A. M. I. U. N. See Quartz.

Prasium, in botany, a genus of the gymnospermia order, in the didyma class of plants, and in the natural method ranking under the 42d order verticillatae. There are four monospermous berries. There are two species.

Prebendary, an ecclesiastical who enjoys a prebend. The difference between a prebendary and a canon is, that the former receives his prebend in consideration of his officiating in the church, but the latter merely by being received into the cathedral or college.

P. R. E. C. E. D. N. M. See Medicine.

Pray for, and attend upon, as well as possible, all neighbours, friends, relations, and others above the age of fifteen years within the county. This sheriff at any time may raise to assist him in the execution of a precept of restitution. The power of the county is also called the Small-fox. See Medicine.

Pray, or Small-fox. See Medicine.


Pry, or rules of practice, are certain compendious ways of working the rule of proportion, or golden rule. See Arithmetic.

Præcipit, a writ commanding the defendant to do the thing required, or to show cause why he hath not done it.

P. R. E. C. E. N. M. A. T. Table of precedence of men and women.

The King.

Princes.

King's sons.

King's brothers.

King's uncles.

King's grandsons.

King's brothers or sisters sons.
Archbishop of Canterbury, lord primate of all England.
Lord high chancellor, or lord keeper.
Lord high treasurer.
Lord president of the privy council.
Lord privy seal.
Lord high constable.
Earl marshal.
Lord high admiral.
Lord steward of his majesty's household.
Lord chamberlain of his majesty's household.
Dukes according to their patents.
Marquises according to their patents.
Earls according to their patents.
Viscounts according to their patents.
Viscounts eldest sons.
Dukes younger sons.
Barons eldest sons.
Barons younger sons.
Knights of the garter.
Privy councilors.
Chancellor of the exchequer.
Chancellor of the duchy of Lancaster.
Lord chief justice of the king's bench.
Master of the rolls.
Lord chief justice of the common pleas.
Lord chief baron of the exchequer.
Judges and barons of the degree of the colo of the said court according to seniority.
Baronets made by the king himself in person under the royal standard displayed in an army royal, in open war, for the term of their lives and no longer.
Viscounts younger sons.
Barons eldest sons.
Barons.
Baronets 'not made by the king himself in person.
Kings of the Bath.
Kings of arms.
Eldest sons of the younger sons of peers.
Baronets eldest sons.
Knights of the garter's eldest sons.
Baronets eldest sons.
Knights of the garter's eldest sons.
Baronets eldest sons.
Baronets younger sons.
Esquires of the king's body.
Gentlemen of the privy-chamber.
Esquires of the knights of the bath.
Esquires by creation.
Esquires by office.
Younger sons of knights of the garter.
Younger sons of baronets of both kinds.
Younger sons of knights of the bath.
Younger sons of knights bannerets.
Gentlemen entitled to bear arms.
Clergymen, barristers at law, officers in the navy and army, who are all gentlemen by profession.
Citizens.
Burgesses.

A table of precedence of women.
The queen.
Princess of Wales.
Princesses daughters of the king.
Princesses and duchesses, wives of the king's sons.
Wives of the king's brothers.
Wives of the prince's uncle.
Wives of the eldest sons of dukes of the blood royal.
Daughters of dukes of the blood royal.
Wives of the king's brothers or sisters sons.
Wives of duchesses.
Marchionesses.
Wives of the eldest sons of dukes.
Daughters of dukes.
Countesses.
Wives of the eldest sons of marquises.
Daughters of marquises.
Wives of the youngest sons of dukes.
Viscountesses.
Wives of the eldest sons of earls.
Daughters of earls.
Wives of the younger sons of marquises.
Baronesses.
Wives of the eldest sons of viscounts.
Daughters of viscounts.
Wives of the younger sons of earls.
Wives of the youngest sons of baronets.
Viscounts.
Wives of the eldest sons of barons.
Duchesses.
Wives of the younger sons of viscounts.
Wives of the youngest sons of barons.
Wives of the eldest sons of Earls.
Duchesses.
Wives of the eldest sons of dukes.
Daughters of dukes.
Countesses.
Wives of the eldest sons of marquises.
Baronesses.
Wives of the eldest sons of viscounts.
Daughters of viscounts.
Wives of the younger sons of earls.
Wives of the eldest sons of baronets.
Viscounts.
Wives of the eldest sons of barons.
Duchesses.
Wives of the younger sons of viscounts.
Wives of the youngest sons of barons.
Baronettes.
Wives of knights of the garter.
Wives of baronets of each kind.
Wives of the knights of the bath.
Wives of the eldest sons of the younger sons of peers.
Wives of the eldest sons of baronets.
Daughters of viscounts.
Wives of the eldest sons of knights of the garter.
Daughters of knights of the garter.
Wives of the eldest sons of baronets.
Daughters of viscounts.
Wives of the eldest sons of knights of the bath.
Daughters of knights of the bath.
Wives of the eldest sons of knights bachelor.
Daughters of knights bachelor.
Wives of the younger sons of baronets.
Wives of the esquires of the king's body.
Wives of the esquires to the knights of the bath.
Wives of esquires by creation.
Wives of esquires by office.
Wives of the younger sons of knights of the garter.
Wives of the younger sons of baronets.
Wives of the youngest sons of knights of the bath.
Wives of the younger sons of knights bachelor.
Wives of gentlemen entitled to bear arms.
Wives of esquires entitled to bear arms, who are gentlemen by birth.
Daughters of gentlemen entitled to bear arms, who are gentlemen by birth.
Wives of clergymen, barristers at law, officers in the navy and army.
Wives of citizens.
Wives of burgesses.

PRECESSION. See EQUINOXES.

PRECIPITATION, a process in chemistry, which is a separation whereby the particles of a body dissolved and suspended in any liquor, are detached from it and fall down to the bottom of the vessel. See CHEMISTRY.

PRECORDIA. See ANATOMY.

PREDIAL TITLES, those which are paid of things arising and growing by the ground only, as corn, hay, fruit of trees, and the like.

PREDICATE, in logic, that part of a proposition which affirms or denies something of the subject; thus, in these propositions: 'she is white,' 'ink is not white,' whiteness is the predicate which is affirmed of snow, and denied of ink. See PROPOSITION.

It is a celebrated law in predicates, that nothing is esteemed to be absolutely affirmed of another, unless it is affirmed in such a manner as wants nothing either in the subject, predicate, or copula to make it true. This also is a noted property of a predicate, that it contains in some measure its own subject; thus, metal contains gold, silver, copper, &c. of which it is predicated. Every predicate is indeed an attribute; but every attribute is not a predicate; thus, soul, learning, are attributed to man, but not predicated of him.

PREGNANCY, is a plea in stay of execution, when a woman is convicted of a capital crime, alleging that she is with child; in which case, the judge must direct a jury of twelve discreet women to enquire of the fact; and if they bring in their verdict quick with child (for barely with child is not sufficiently, execution shall be said generally, till either she is delivered, or proves by the course of nature, not to have been with child. 4 Black. 395.

PREHNITE. Though this stone had been mentioned by Sager, Romé de Lisle, and other mineralogists, Werner was the first who properly distinguished it from other minerals, and made it a distinct species. The specimen which he examined was brought from the Cape of Good Hope by Colonel Preston; hence the name prehnite, by which he distinguished it. It was found near Dumbarton by Mr. Gretclie; and since that time it has been observed in other parts of Scotland.

It is both amorphous and crystallized. The crystals are in groups, and confused; they seem to be four-sided prisms with elliptical summits. Sometimes they are irregular six-sided plates, and sometimes flat rhomboidal parallelopipeds.

Its texture is foliated; fracture uneven; internal lustre pearly; brittle. Specific gravity 2.6 to 2.66. Colour apple green, or greenish grey. Before the blow-pipe it froths more violently than zeolite, and melts into a brown enamel. A specimen of prehnite, analysed by Klaproth, was composed of 43.83 silica.

30.33 alumina.
18.53 lime.
5.66 oxide of iron.
1.16 air and water.

99.31.

Whereas Mr. Hasenfratz found in another specimen

PRECEPT, in law, a command in writing sent by a chief justice, justice of the peace, &c. for bringing a person, record, or other matter, before him.

Precept is also used for the command or incitement by which one man stirs up another to commit felony, theft, &c.
The mineral known by the name of kouphite is a variety of the prehnite. PREMISES, is that part of the beginning of a deed, the clause of which is expressed in the grantor and granatee, and the land or thing granted. 5 Rep. 55. See DEED.

PREMENA, a genus of the diosynanthe angiospermous class and order. The calyx is two-lobed; corolla four-celled; seeds solitary. There are two species, small trees of the East Indies.

PREMUNIRE. See PREMUNIRE.

PRAENATUM, in botany, a genus of the polygamy class and order of the king altrug class of plants, and in the natural method ranking under the 40th order, composite. The receptacle is naked; the calyx calculated; the pappus is simple, and almost sessile; the flowers are placed in a single series. There are 19 species, some of them natives of England.

PREPENSE, in law, denotes forethought: thus, when a man is slain upon a sudden quarrel, if there was malice prepense formerly between them, it makes it murder.

PREPUSE. See Anatomy.

PREROGATIVE, is a word of large extent, including all the rights and privileges which by law the king has as chief of the commonwealth, and as instituted with the consultation of the laws. 4 Bac. Abr. 149.

All jurisdiction exercised in the kingdoms that are in obedience to our king, is derived from the crown; and the laws, whether of a temporal, ecclesiastical, or military nature, are called his laws; and it is his prerogative to take care of the due execution of them. Hence all judges must declare their authority in the crown, by some commission warranting by law; and must exercise it in a lawful manner, and without any the least deviation from the known and stated forms.

The king, as the fountain of justice, has an undoubted prerogative in erecting officers, and all officers are said to derive their authority mediatly, or immediately from him; but though all such officers derive their authority from the crown, and whereas the king is termed the universal officer or disposer of justice, yet it has been held, that he has not the office in him to execute it himself, but is only to grant or nominate, nor can the crown grant any new powers or privileges to any such officers, but they must execute their offices according to the rules established and prescribed them by law. Co. Lit. 114.

Prerogative court, the court wherein all wills are proved, and all administrations taken which belong to the archbishop by his prerogative; that is in case where the deceased had goods of any considerable value out of the diocese wherein he died; and that value is 40. L. 114, except it is otherwise by composition between the said archbishop and some other bishop, as in the diocese of London it is 10l. and if any contention grow betwixt two or more, touching any such will or administration, the cause is properly de- bated and decided in this court. 4 Inst. 335.

PRESBYTERIANS, a sect of protestants, so called from the fact that the priests or ministers of the church appointed in the new testament was by presbyters; that is, by ministers and ruling elders, associated for its government and discipline.

The presbyterians affirm that there is no order in the church as established by Christ and his apostles, superior to that of presbyters; that all ministers being ambassadors of Christ, are equal by their commission; and that elder or presbyters, and bishop are the same in name and office, for which they alledge, Acts xx. 28, &c. The only difference between them and the church of England, relates to discipline and church government. Their highest assembly is a synod, which may be provincial, national, or eccen- trical; and they allow of appeals from inferior to superior assemblies, according to Acts x. 6, 22, 23. The next assembly is composed of a number of ministers and elders, associated for governing the churches within certain bounds. This authority they found upon Acts xi. 30, Acts xiv. 6, &c. The lowest of their assemblies or presbyteries, are consisting of a sufficient number of a con- gregation, who have power to cite before them any member, and to admonish, instruct, rebuke, and suspend him from the eucharist. There have they also a deacon, whose office is to take care of the poor.

The ordination of their ministers is by prayer, fasting, and imposition of the hands of the presbytery. This is now the discipline of the church of Scotland.

But the appellation presbyterian, is in Eng- land appropriated to a large denomination of dissenters, who have no attachment to the Scotch mode of church government any more than to episcopacy among us; and, therefore, to this body. Christians the term presby- terian is improperly applied. English presby- terians adopt the same mode of church government with the independents. See INDEPENDENTS.

PRESCRIPTION, in law, is a right or title acquired by use and time, introduced for assuring the property of effects, in favour of persons who have for a certain time had them in their possession. Prescription has been called a prescription by the laws upon negligence; but the law of prescription does not punish the indolence of proprietors, but only interprets their silence for their consent, presuming that a man who neglects to assert his right for a series of years, gives it up. In the common law, prescription is usually under- stood of a possession from time immemorial, or beyond the memory of man; but in the civil law, and even in our statute law, there are prescriptions of a much shorter date. The things a man may make title to by prescription are, a fair, market, toll, way, water, rent, common, park, warren, franchise, court-leet, waifs, estrays, &c. There is likewise a prescription against actions and statutes, thus, by the 31 Eliz. c. 1, it is ordained that all actions, &c, that are brought upon statutes, the penalty whereof belongs to the king, shall be brought within two years after the date thereof; if not they are void. But our statutes also, a judge or clerk convicted of false entering of pleas, &c, may be sued within two years; but the crime of main- tenance or embezzlement, whereby perjury is committed by a jury, must be prosecuted within six days, or otherwise the parties pre- sent...

PRESENTATION, in law, the act of a patron offering his clerk to be instituted in a benefice of his gift, the same being void. All persons that have ability to make a purchase or grant, may also present to vacant benefices in their gift; though where a clergyman is a patron of a church, he cannot present himself, but may pray to be admitted by the bishop, and the admission shall be effectual. An infant of any age may also present in his own name; but a presentation by a feme covert must be in the name of both husband and wife. As coparceners make but one patron, they are either to present jointly, or the eldest may present first, and the rest in their turn. Joint-tenants must also join in a presentation; and when a corporation presents, it must be under their common seal. Aliens born and papists cannot present to benefices, which are also void by the universities; but a popish recusant may grant his patronage to another, who may present where there is no fraud. A patron may re- voke his presentation before institution, but a patron of an infant must go to the dean and chapter for presenting to the next avoidance of a church, whether granted by will or deed, will pass, but a presentation whilst the church is full, is judged void.

PRESENTMENT of offices, is that which the grand jury find of their own know- ledge, and present to the court, without any bill of indictment laid before them at the suit of the king, as a presentment of a nuisance, a label, and the like, upon which the officer of the court must afterwards frame an indictment before the party presented can be put to answer it. There are also presentments by justices of the peace, constables, surveyors of the highways, church wardens, &c.

PRESIDENT, an officer created or elect- ed to preside over a company, in contradistinction to the other members, who are called resident.

The lord president of the council is the fourth great officer of the crown, as ancient as king John, when he was still called conversus capitals. His office is to attend on the king, procure business at the council table, and report thereon. The king, the council, and the council chamber, is considered as the king's court, and the court of law is called the court of king's signet.

The lord president of the court of session in Scotland, is the first of the fifteen lords who presides in that august assembly, which is the supreme court of justice in that kingdom.

PRESS, in the mechanic arts, a machine made of iron or wood, serving to squeeze or compress any body very close. The ordinary presses consists of six members, or pieces, viz. two flat smooth planks, between which the things to be pressed are laid; two screws or worms, fastened to the lower plank, and passing through two holes in the upper; and two nuts, in form of an 8, serving to drive the upper plank, which is moveable, against the lower, which is stable, and without motion.

PRESSt used by tailors, resembles the joiner's press, except that the pieces of wood between the two planks, of which some of them is moveable; the other, which is in form of a tressel, being sustained by two legs or pillars, jointed into it at each end. This press serve
for sawing and cleaving the pieces of wood required in marquetry or inlaid work.

Press, forging. See PRINTING-PRESS.

Press rolling, is a machine used for the taking off prints from copper plates. It is much less complete than that of the letterprinters. See its description and use under the article ROLLING PRESS PRINTING.

Press, in coining, is one of the machines used in striking of money, differing from the balance in that it has only one iron bar to give it motion, and press the moulds or coins: it is not charged with lead at its extremes, nor drawn by cordage. See COINING.

Binder's cutting-Press, is a machine used equally well by binders, stationers, and paper-makers; consisting of two large pieces of wood, in form of cheeks, connected by two strong wooden screws, which, being turned by an iron bar, draw together, or set asunder, the cheeks, as much as is necessary for the putting in the books or paper to be cut. The cheeks are placed lengthwise on a wooden stand, in the form of a chest, into which the cuttings fall. Aside of the cheeks are two pieces of wood, of the same length with the screws, serving to direct the cheeks, and prevent their opening unequally. Upon the cheeks the plough moves, to which the cutting-knife is fastened by a screw; which has its key, to dismount it on occasion to be sharpened.

The plough consists of several parts; among the rest a wooden screw or worm, which, catching within the nuts of the two feet of the worm, draws or carrues, bringing the knife to the book or paper which is fastened in the press between two boards. This screw, which is pretty long, has two directories, which resemble those of the screws of the press, the planes being so square and even on the cheeks, so that the knife may make an equal paring, that foot of the plough where the knife is fixed, slides in a kind of groove, fastened along one of the cheeks. Lastly, the knife is a piece of steel, six or seven inches long, flat, thin, and sharp, terminating at one end in a point, like that of a knife, and at the other in a square form, which serves to fasten it to the plough. See BOOKMAKING.

As the long knives used by us in the cutting of books or paper are not to jump in the cutting thick books, the Dutch are said to use circular knives, with an edge all round, which not only cut more steadily, but last longer without grinding.

Press, in the wooden manufacture, is a large wooden machine, serving to press cloth, capes, rateens, &c., thereby to render them smooth and flat; also to press the stations, and paper-making. This machine consists of several members: the principal whereof are the cheeks, the nut, and the worm or screw, accompanied with its bar, which serves to turn it round, and make it descend perpendicularly on the middle of a thick wooden plank, under which is the press G. The calendar is also a kind of press, serving to press or calender linens, silks, &c.

Presses used for expressing of liquors are of various kinds; some, in most respects, resemble the press F, but having the under plank perforated with a great number of holes, to let the juice expressed run through into a tub or receiver underneath.

Press, fig. 1, is a simple packing press, described by M. Buschendriek, in Les Annales des Arts. ABD is a strong frame of wood, through the upper bar D a strong iron rack E, similar to a saw, slides a small click F, pushed by a spring, prevents it rising after the lever F has pressed it down; the lower end of this rack has the bed of the press K fixed to it, under which the goods G to be pressed are put. The lever F has a mortise through it, to admit the rack E; and a click G, which takes into its teeth the lever, moves round a bolt H, as a centre; which can be put through any of the holes in the beam, according to the quantity of the goods to be pressed; which are put as follows. When the lever F is lifted up, its click F slides over the sloping side of the teeth, and when it is pulled down, the click takes hold of the teeth and draws the rack down with it another tooth until the lever is raised to take another tooth as before. The only objection to this simple press is a want of power for pressing many articles, and that the teeth of the rack could not be made strong enough for a man to press down a whole tooth without resting. To remedy the first inconvenience, it has occurred to us that a bolt h might be put through two of the beams, and the end of a common handspike H put under it. This handspike might be connected with F by an endless chain put over both: this chain might have a hook at the end, so as to shorten or lengthen it by hooking it into another link, as occasion required. For the teeth of iron rack E, with teeth in it, might be fastened to the lever F, and a long click I, connected with the frame, might fall into them, so as to prevent the lever rising. By this means each of the teeth of the rack is divided into four or five parts; and when the click takes hold of a new tooth, the long click I may be lifted up, and the lever raised. As before, the click might be hooked up when the press I is used as above described; the chain or handspike may be taken away, and replaced in a very short time.

Fig. 2. is a screw-press, used for expressing some kinds of oil; the frame ABD is formed of one piece of cast-iron, the upper piece has a brass nut fixed in it, through which the screw E works; the screw has holes through its lower end, to put in a long iron lever F, by which the screw is turned. The substance from which the oil is to be pressed is tied up in horse-hair bags, and laid under the bed of the press G, with a warm iron plate between each bag; the screw is then turned by men, as long as they can move it; a rope is then made fast to the other end of the wheel, and the power of a windlass or capstan is used to assist the lever; the oil weeps out of the bags, and runs down through a spout into the reservoir H, placed to raise it.

Press, for printing, see PRINTING-PRESS.

Fig. 3. is a representation of the hydrostatic press used by Mr. Linnaeus, in Sweden, 1766. The frame of this is like a common press; the bed A is fastened to the piston B of a stout brass barrel D, the lower end of which communicates by a pipe E, with a forcing pump, within which is a jar F; this is cut hollow, and has the connecting rod G jointed within it. The lever H, which works the pump, is jointed to the lower end of this rod, so that the circular motion of the lever is altered by the connecting rod moving in or out of the hollow in the piston rod; and the parallelism of the piston is preserved by a collar H.

Fig. 4. explains the construction of the pump within the cistern F: I is the barrel of brass, this has the piece J screwed into it lower, and this piece J is screwed into the end of the pipe E, and contains within it a valve opening downwards. To the part L of the barrel, the piece K containing a valve opening upwards is screwed; this is open to the water, oil, &c., contained in the cistern F, when the lever G is raised, the barrel fills with water through the valve K, and when it is pressed down, the water is forced through the pipes E into the large barrel D, and by pushing out its piston B, presses the goods laid upon the bed A of the press. When the goods are sufficiently pressed, the lever G is pushed down, and the lower end of the piston opens the valves JK, and the detent K pushes towards the piston, opens the valve K, which allows the water to pass back into the reservoir, and at the same time the press is worked. The valves are composed of a small brass cone, fig. 4, which exactly fits its seat, and is kept in its place by a wire fastened to it; this wire is cut flat on one side to allow the water to pass through when the valve is open, and a small spiral spring closes it.

Presses used by joiners, to keep close the pieces they have glued, especially panels, etc., of marble, is very simple, consisting of two pipes, viz. two pieces of wood, four or five inches square, and two or three feet long; wherein the holes at the two ends serve for nuts to the screws.

PRESSING, in the manufactures, is the last part of the process, viz. the working of the pieces, wherein the medium, viz. water, is introduced, to render it smooth and glossy. There are two methods of pressing, viz. cold or hot. As to the former, or cold-pressing, after the stuff has been scoured, filled, and shrunk, it is folded square in equal folds, and a skin of vellum, or pasteboard, put between each plat. Over the whole is laid a square wooden plank, and so put into the press, which is screwed down tight by means of a lever. After it has lain a sufficient time in the press, they take it out, removing the pasteboards, and lay it up to keep. Some only lay the stuff on a firm table, after placing and pastebinding, cover the whole with a wooden plank, and load it with a proper weight.

The method of pressing hot is this: when the stuff has received the above preparations, it is sprinkled a little with water, sometimes gum-water, then plaited equally, and between every fourth, and between every sixth or seventh plate, as well as over the whole, an iron or brass plate well heated in a kind of furnace. This done, it is laid upon the press, and securely screwed.
PRIMAVERA, in the civil law, is where the informer colludes with the defend
ants, and so makes only a sham prosecution.

PRIMICOXING, a prolix language, makes a point on the plan or chart, near about where the ship then is, or is to be at such a time, in order to find the course they are to steer.

PRIME VIE, among physicians, denote the whole alimentary duct; including the esophagus, stomach, and intestines, with their appendages.

PRIMATES, the first order of mammalia in the Linnean system; they are distinguished by fore-tetah cutting, upper four parallel (except in some species of bats, which have two outer pairs), and that there are groups on each side, in each jaw; teeth two, pectoral; feet two, are hands; nails, usually flattened, oval; fruit fruits, except a few that use animal food. There are four genera, viz., Homo, Lessina, and Variotia.

PRIMING, or prime of age, is the gunpower put into the pan or touch-hole of a piece, to give it fire thereby; and this is the last thing done in charging.

PRIMORIGIN, a piece of ordnance, that they have a pointed iron-rod, to pierce the cartridge through the touch-hole, called primer or priming-iron.

PRIMOGENTURE, the right of firstborn. This right seems to be an unjust prerogative, and contrary to the natural right; for since it is birth alone gives children a title to the paternal succession, the chance of primogeniture should not throw any inequality among them.

It was not till the race of Hugh Capet, that the prerogative of succession to the crown was appropriated to the first-born. By the ancient custom of gavel-kind, still preserved in some parts of our island, and which the United States of America, primogeniture is of no account, the paternal estate being equally shared among the sons. See Gavel-kind.

PRIMULA, the primrose, a genus of the monogynous order, in the penultimate class of plants, and in the natural method ranking under the 21st order, precise. The involu-

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PRIMULA, the primrose, a genus of the monogynous order, in the penultimate class of plants, and in the natural method ranking under the 21st order, precise. The involu-

or six weeks. 2. Primula officinalis. The

PRIMULAE, or Primrose, a genus of the insect, among physicians, denote the whole alimentary duct; including the esophagus, stomach, and intestines, with their appendages. PRIMATES, the first order of mammalia in the Linnean system; they are distinguished by fore-tetah cutting, upper four parallel (except in some species of bats, which have two outer pairs), and that there are groups on each side, in each jaw; teeth two, pectoral; feet two, are hands; nails, usually flattened, oval; fruit fruits, except a few that use animal food. There are four genera, viz., Homo, Lessina, and Variotia.
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The first line being thus finished, the impression is completed by the next; in order to which he moves the brass rule from behind the former, and places it before it, and thus composes another line against it, after the same manner as before; then going on with this, till his stick is emptied of all the matrices, which are disposed in the case, upon the tables, and laid off into little cells or boxes. Those of the upper case are in number ninety-eight; these are all of the same size, and in them are the capitals, small capitals, accented letters, figures, &c., the capital letters being placed in alphabetical order. In the cells of the lower case, which are fifty-four, are placed the small letters with the points, spaces, &c. The boxes here of different sizes, the largest being for the letters most used; and these boxes are not in alphabetical order, but the cells which contain the letters most used, are nearest the compositor's hand, so that the compositor may more easily reach the upper boxes. The instrument in which the letters are set is called a composing-stick, see Plate Miscel., fig. 193; which consists of a box, called a chase, and a handle, &c. The chase is put on the right side of which arises a ledge $bb$, which runs the whole length of the plate, and serves to sustain the letters, the sides of which are to rest against it; along this ledge there is a hole, by which the screw $a$ is introduced for the purpose of adjusting the height of the letter, in the composing stick, against the ledge, for the letter to bear against. Things thus prepared, the compositor proceeds to compose, he puts a rule, or thin slip of brass plate, cut to the length of the same, against the height of the letter, in the composing stick, against the ledge, for the letter to bear against. Things thus prepared, the compositor proceeds to compose, he puts a rule, or thin slip of brass plate, cut to the length of the same, against the height of the letter, in the composing stick, against the ledge, for the letter to bear against. Things thus prepared, the compositor proceeds to compose, he puts a rule, or thin slip of brass plate, cut to the length of the same, against the height of the letter, in the composing stick, against the ledge, for the letter to bear against. Things thus prepared, the compositor proceeds to compose, he puts a rule, or thin slip of brass plate, cut to the length of the same, against the height of the letter, in the composing stick, against the ledge, for the letter to bear against. Things thus prepared, the compositor proceeds to compose, he puts a rule, or thin slip of brass plate, cut to the length of the same, against the height of the letter, in the composing stick, against the ledge, for the letter to bear against. Things thus prepared, the compositor proceeds to compose, he puts a rule, or thin slip of brass plate, cut to the length of the same, against the height of the letter, in the composing stick, against the ledge, for the letter to bear against. Things thus prepared, the compositor proceeds to compose, he puts a rule, or thin slip of brass plate, cut to the length of the same, against the height of the letter, in the composing stick, against the ledge, for the letter to bear against. Things thus prepared, the compositor proceeds to compose, he puts a rule, or thin slip of brass plate, cut to the length of the same, against the height of the letter, in the composing stick, against the ledge, for the letter to bear against. Things thus prepared, the compositor proceeds to compose, he puts a rule, or thin slip of brass plate, cut to the length of the same, against the height of the letter, in the composing stick, against the ledge, for the letter to bear against.

Some authors tell us, that Caxton, in the art of printing, spread itself throughout a good part of Europe; Haerlem and Strasbourg had it very early; from Haerlem it passed to Rome in 1477, and into England in 1469, by means of Thomas Brad trucke, who sent W. Turner, master of the robes, and W. Caxton, merchant, to Haerlem to learn the art. These privately prevailing with Caxton, and one Tierninus, an under-workman, who was appointed to compose, a press was set up at Oxford, and an edition of Roffius on the Creed was printed the same year in octavo. From Oxford, Caxton brought it to London about the year 1479, and the same year it was carried to Paris. Hitherto there had been nothing printed but in Latin, and the vulgar tongues; and this first in Roman characters, then in Gothic, and at last in Italy; but in 1469, the Latin, Greek, and Hebrew characters were composed, and they have the honour of the first Hebrew editions, which were printed about the same time with the Greek. Towards the end of the sixteenth century they appeared in various editions of books in Syria, Arabic, Persian, Armenian, Capric, or Egyptian characters, some to gratify the curiosity of the learned, and others for the use of the Christians of the Levant. Of the Greek, the art of printing has been carried into the three other parts of the world.

PRINTING, method of; the printing-letters, or type, as they are sometimes called, are

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During the first century a.D. the Roman clothier, Finguariuia, a Florentine goldsmith, who poured some melted bismuth on an engraved plate, found the exact impression of the engraving left in the cold bismuth, marked by the black taken out by the hot plate being cooled. This method was subsequently employed in making copperplates. The metal was poured in the form of a thin sheet, and when cool the hardened metal was broken into small pieces which were then laid on the paper to be printed. The use of copperplates was first introduced in the printing of calicoes, and later on in paper and book printing.

The process of printing on copperplates is as follows: The metal is cast in the form of a plate, and when cool is broken into small pieces, which are then laid on the paper to be printed. The paper is then passed through a press, and the raised letters on the metal plate transfer their impression to the paper below. The process is repeated until all the desired copies have been produced. The metal plate is then removed and a new one cast, the process being repeated as often as may be necessary.

The use of copperplates in printing was first introduced in the printing of calicoes, and later on in paper and book printing. The process of printing on copperplates is as follows: The metal is cast in the form of a plate, and when cool is broken into small pieces, which are then laid on the paper to be printed. The paper is then passed through a press, and the raised letters on the metal plate transfer their impression to the paper below. The process is repeated until all the desired copies have been produced. The metal plate is then removed and a new one cast, the process being repeated as often as may be necessary.
collars; which patching very strongly, yet equally, press the moistened paper into the stokes of the engraving, where it absorbs the ink.

PRISM, in geometry, an oblong solid, contained under more than four planes, whose bases are equal, parallel, and alike situated. See GEOMETRY.

PRIVY, in botany. See LIGUSTRUM.

PRIVILEGE, in law, a peculiar benefit granted to certain persons or places, contrary to the usual course of law.

Privy counsellors are made by the king's nomination without either patent or grant; and on taking the necessary oaths, they become immediately privy counsellors during the life of the king that chooses them, but subject to removal at the king's discretion. No inconvenience now arises from the extension of the number of the privy council, as those only attend who are especially summoned for that particular purpose.

PRIVY SEAL, is a seal that the king uses to such grants, or other things, as pass the great seal.

PRIZE, or Prize, in maritime affairs, a vessel taken at sea from enemies of a state, or from pirates; and that either by a
ship of war, a privateer, &c., having a commission for that purpose.

Vessels are looked on as prizes, if they fight under any other command than that of the state from which they have their commission; if they have no charter-party, instead of, or bill of lading, aboard; it loaded with effects belonging to the king's enemies, or with provisions or goods. Those of the king's subjects recovered from the enemy, after remaining twenty-four hours in their hands, are deemed lawful prize.

Vessels that refuse to strike, may be conquered, and if they make resistance and are not, become lawful prize if taken.

In ships of war, the prizes are to be divided among the officers, seamen, &c., as his majesty shall appoint by proclamation, but among privateers, the division is according to the agreement between the owners.

By stat. 13 Geo. II. c. 4, judges and officers, failing of their duty, in respect to the condemnation of prizes, forfeit five hundred pounds, with full process of suit: one moiety to the king, and the other to the informer.

PROA. Flying, in navigation, is a name given to a vessel used in the South Seas, because it sails along the wind, and its sails require twenty hours an angle. In the construction of the proa, the head and stern are exactly alike, but the sides are very different; the side intended to be always the lee-side being flat; and the windward side made rounding, in the manner of other vessels; and to prevent her oversetting, which from her small breadth, and the straight run of her leeward side, would, without this precaution, infallibly happen, there is a frame laid out of her from windward, to the end of which is fastened a log, fashioned in the shape of a small boat and made hollow. The weight of the frame is intended to balance the proa, and the small boat is by its buoyancy (as it is always in the water) to prevent her oversetting to windward; and this frame is usually called an outrigger. The body of the vessel is made of two pieces joined endwise, and sewed together with bark, for there is no iron used about her; she is about two inches thick at the bottom, which at the gunwale is one inch and a half thick. The sail is made of matting, and the mast, yard, boom, and outriggers, are all made of bamboo.

PROBABILITY of an event, in the doctrine of chances, is greater or less according to the number of chances by which it may happen or fail. (See Expectation.) The probability of life is liable to rules of computation. In the Encyclopedic Methodique, we find a table of the probabilities of the number of life, constructed from that which is to be found in the seventh volume of the Supplement à l'Histoire de M. de Buffon, of which the following is an abridgment:

Of young chickens born at the same time, those will probably die,

- in one year - 7098
- Remaining 2 or 12996
- in eight years - 11927
- Remaining 1 or 11897
- in thirty-eight years - 15956
- Remaining 7 or 2718
- in fifty years - 17904
- Remaining 1 or 5989
- in sixty-one years - 19965
- Remaining 2 or 3992

PROBATE. See Will.

PROBE, a surgeon's instrument for examining the circumstances of wounds, &c., See Surgery.

PROBLEM, in logic, a proposition that neither appears absolutely true nor false; and consequently may be asserted either in the affirmative or negative.

PROBLEM, in geometry, is a proposition wherein some operation or construction is required; as to divide a line or angle, erect or fall perpendiculars, &c., See Geometry.

PROBLEM, in algebra, a question or proposition which requires some unknown truth to be investigated, and the truth of the discovery demonstrated.

PROBLEM, Kepler's, in astronomy, is the determining a planet's residence from the time; so called from Kepler, who first proposed it. It was this: to find the position of a right line, which, passing through one of the foci of an ellipse, shall cut off an area described by its motion, which shall be in any given proportion to the whole area of the ellipse.

The proposer knew no way of solving the problem but by an indirect method; but sir Isaac Newton, Dr. Keil, &c., have since solved it directly and geometricaly several ways.

PROBLEMATICAL resolation, in algebra, a method of solving difficult questions by certain rules, called canons.

PROBOSCIS, in natural history, is the trunk or snout of an elephant, and some other beasts and insects.

PROCEEDING, in law, a writ whereby a plea or cause, formerly called from an inferior court to the court of chancery, King's Bench, &c., in the name of privilege, habeas corpus, or certiorari, is released, and returned to the other court to be proceeded in, upon its appearing that the defendant has no cause of privilege, or that the matter in the party's allegation is not well proved.

PROCELLARIA, in ornithology; a genus of birds, belonging to the order of albatrosses. The beak is somewhat compressed, and without teeth; the main lines black, by white; the back and coverts of the wings ash-coloured; the quill-feathers dusky; and the legs yellowish. In lieu of a black toe, it has only a 'sort of spur, or sharp straight nail. These birds feed on the blubber or bladders of whales, &c., which being soon convertible into oil, supplies them constantly with means of defence, as well as provision for their young, which they cast up into their mouths. They are likewise said to feed on sunset, which they use to qualify the venemous diet they live on. This species inhabits the isle of S. Kilda; makes its appearance there in November, and continues the whole year, except September. It is large, white, and very hiritle egg, and the young are hatched the middle of June. No bird is of such use to the islanders as this: the fulmar supplies them with oil for their lamps, down for their beds, a delicacy for their tables, a balm for their wounds, and a medicine for their distempers. The fulmar is also a certain prognosticator of the change of the wind: if it comes to land, no west wind is expected for some time; and the contrary when it returns and keeps the sea.

The whole genus of petrels have a peculiar faculty of spouting from their bills to a considerable distance, a large quantity of pure white foam, into the sea, which, falling down, forms a scum on the surface, into the face of any one that attempts to take them; so that they are, for the sake of this panacea, seized by surprise; as this oil is subservient to the above-mentioned medical purposes. The fulmar is used in London and Edinburgh with success in rheumatic cases. Frederick Martens, who had the opportunity of seeing vast numbers of these birds in different situations, that they are very bold, and resort after the whale-fishers in great flocks; and that, when a whale is taken, they will, in spite of all endeavours, light on it and pick out large lumps of fat, even to the bone; it is alive that the whales are often discovered at sea, by the multitudes of them flying; and that when one of the former is wounded, prodigious multitudes immediately follow its bloody track. He adds, that it is a most glutinous bird, eating till it is forced to gorge itself.

2. The puffinus, or shear-water, is fifteen inches in length; the head is slightly hooked; both wings and tail, in the middle of the back, are black; the bill is an inch and three quarters long; nostrils tubular, but not very prominent; the head, and whole upper sides of the body, wings, tail, and thighs, are of a sooty blackness; the under side from chin to tail, and inner coverts of the wings, white; the legs weak, and compressed sideways; dusky behind, whitish before. These birds are found in the Gulf of Man; and, as Mr. Bay supposes, in the Scilly isles. They resort to the former in February, take a short possession of the rabbit-burrows there, and then disappear till April. They lay one egg, white, and blunt at one end; and the female at the beginning of August, which numbers are killed by the person who farms the island; they are salted and barrelled; and when they are broken are eaten with potatoes. During the day they keep at sea, fishing; and towards evening return to their young, whom they feed by discharging the contents of their stomachs into their mouths, oil, which when turned into oil, from the backward situation of their legs, they sit quite erect. They quit the island the latter end of August, or beginning of September; and we have reason to imagine that, like the
the public genus 71 and thus that 3d, 7, 2</j>

And, d, berry l.d -

flame tire candle, flame trial times in to toed, the mations with which by the king's clergy, the king's lords, and lords of the law-books, are, too, the magistrates. They our convocation, see magistrates, the sum of all the terms of the series, is equal to half the said product. So the sum of the 7 terms is 3, 5, 7, 9, 11, 13, and 15.

PROCLAMATION, a public notice given of any thing of which the king thinks proper to advertise his subjects. Proclamations are a branch of the king's prerogative, and no person can make them without the king's authority, except mayors of towns, &c. by custom or privilege. Proclamations which require the people to do, or not to do, certain things, have the force of laws; but then they are supposed to be consistent with the laws already in being, otherwise they are superseded.

PROCLAMATION. See PHYSIOLOGY.

PROCOT, a genus of the polyandria monogynia class and order. The ca. is three-leaved; cor. none; berry five-cornered, many-seeded. There is one species, a shrub of Santa Cruz.

PROCKLA, a genus of the polyantha monogynia class and order. The ca. is three-leaved; cor. none; berry five-cornered, many-seeded. There is one species, a shrub of Santa Cruz.

PROCEED, the manner of proceeding in every cause, being the writs and precepts that proceed or go forth upon the original in every action, being the original or judicial. Process is only meant to bring the defendant into court, in order to contest the suit, and abide the determination of the law. See Impery's Practice.

PROCIRCA, a genus of the polyantha monogynia class and order. The ca. is three-leaved; cor. none; berry five-cornered, many-seeded. There is one species, a shrub of Santa Cruz.

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And most of these expressions will become much simpler if the first term is 0, except of s.

Geometrical Progression, is a series of quantities in which there is the same continual ratio or proportion, either increasing or decreasing; or if it is a series of quantities that are continually proportional; or which increase by one common multiplier, or decrease by one common divisor, or which common multiplier or divisor is called the common ratio. As,

increasing, 1, 2, 4, 8, 16, &c.

decreasing, 8, 4, 2, 1, &c.

where the former progression increases continually by the common multiplier 2, and the latter decreases by the common divisor 3.

Or ascending, a, ra, r^2a, r^3a, &c.

or descending, a, a/r, a/r^2, a/r^3, &c.

where the first term is a, and common ratio r.

1. Hence, the same principal properties obtain in a geometrical progression, as have been remarked of the arithmetical one, only multiplication in the geometricals for addition in the arithmeticals, and division in the former for subtraction in the latter. So that, to construct a geometrical progression, from any given first term, and with a given common ratio; multiply the 1st term continually by the common ratio for the rest of the terms, when the series is an ascending one; or divide continually by the common ratio, when it is a descending progression.

2. In every geometrical progression, the product of any two terms is equal to the product of each pair of the intermediate terms that are equidistant from the extremes, and also equal to the square of the middle term when there is a middle term, or an uneven number of the terms.

Thus, 1, 2, 4, 8, 16, 16 16 16 16

prod. 16 16 16 16 16 16 16 16

Also, r^2a, r^2a, r^2a, r^2a, r^2a, r^2a, r^2a, r^2a

prod. r^2a r^2a r^2a r^2a r^2a r^2a r^2a r^2a

3. The last term of a geometrical progression, is equal to the first term multiplied, or divided, by the ratio raised to the power whose exponent is less by 1 than the number of terms in the series, or a = ar^n-1, when the series is ascending one, or a = ar^n when it is a descending progression.

4. As the sum of all the antecedents, or all the terms except the least, is to the sum of all the consequents, or all the terms except the greatest, so is 1 to r, the ratio. For,

if

r + r^2 + r^3 + r^4 + r^5 + r^6 + r^7

are all except the last, then

r + r^2 + r^3 + r^4 + r^5 + r^6 - 1

are all except the first; where it is evident that the former is to the latter as 1 to r, or the former multiplied by r gives the latter. So, a denoting the last term, s the first term, and r the ratio, also r the sum of all the terms; then

s = r - s

and from this equation all the relations among the four quantities a, s, n, r, are easily derived; such as,

r = sq - s

v=id

multiply the greatest term by the ratio, subtract the least term from the product, then the result divided by 1 less than the ratio, will give the sum of the series. And if the least term is 0, the theorem is also true, and if descending progression is indefinitely continued, then the sum is barely

r - 1

As in the infinite progression s = 1, and r = 2, it is or r - 1 = 2.

1. The first or last term of a geometrical progression, is the sum of all the terms from the ratio minus 1, to the nth power of the ratio minus 1; that is, s = r^n - 1

r - 1

Other relations among the five quantities a, s, n, r, where

s denotes the least term,

n the greatest term,
r the common ratio,

and the number of terms.

the sum of the progression, are as before; viz.

s = a - 1

r - 1

n = an - 1

r - 1

n = ar - (n-1)r

r - 1

n = (r^n - 1)/r - 1

r - 1

n = (r^n - 1)/r - 1

r - 1

n = (r^n - 1)/r - 1

r - 1

n = (r^n - 1)/r - 1

r - 1

And the other values of a, s, and r, are to be found from these equations, viz.

(r - s)/r = s - (s - r)/r = a

r - 1

r - 1

r - 1

r - 1

r - 1

5. When a projectile is shot into the air, it will necessarily continue the state they are in except as far as they are hindered, and forced to change it by some cause. Hence, a projectile, put in motion, must continue eternally to move on in the same right line, and with the same uniform or constant velocity, were it to meet with no resistance from the medium, nor had any force of gravity to encounter.

In the first case, the theory of projectiles would be very simple indeed; for there would be nothing more to do, than to compute the space passed over in a given time by a given constant velocity or either of these, from the other two being given.

But by the constant action of gravity, the projectile is continually deflected more and more from its right-forward course, and that with an accelerated velocity: which, being combined with its projecticle impulse, causes the body to move in a curved line, with a variable motion, which is the law of the parabola, as will be proved below; and the determination of the range, time of flight, angle of projection, and various other properties, constitutes what is usually meant by the doctrine of projectiles, in the common acceptation of the word.

What is said above, however, is to be understood of projectiles moving in a non-resisting medium; for when the resistance of the air is also considered, which is enormously great, and which very much impedes the first projectile velocity, the path deviates greatly from the parabola, and the determination of the circumstances of its motion becomes one of the most complex and difficult problems in nature.

In the first place, therefore, it will be proper to consider the common doctrine of projectiles, or that on the parabolic theory, or as depending only on the nature of gravity and the projectile motion, as abstracted from the resistance of the medium.

Little more than 200 years ago, philosophers took the line described by a body projected horizontally, such as a bullet out of a cannon, while the force of the powder greatly exceeded the weight of the bullet, to be its true line, after which they allowed it became a curve. Nicholas Tartaglia was the first who perceived the mistake of the path of the bullet was a curved line through the air, and the extent of its curve. But it was Galileo who first determined that particular curve it is that projectile described, showing it to be a parabola; and that projectile projected horizontally from an elevation, is a parabola, the vertex of which is the point where the bullet quits the cannon. And the same is proved generally, in the 3d article following, when the projection is made in any direction whatever, viz. that the curve is always a parabola, supposing the body moves in a non-resisting medium.

The Laws of the Motion of Projectiles.

1. If a heavy body is projected perpendicularly, it will continue to ascend or descend perpendicularly; because both the projecting and the gravitating force are found in the same line of direction.

2. If a body is projected in free space, either to the horizon, or in any oblique direction; it will, by this motion, make conjunction with the action of gravity, describe the curve line of a parabola. (Fig. 1.)

The holp body be projected from A in the direction AD, with any uniform velocity; then in any equal portions of time it would, by that impulse alone, describe the equal spaces AB, B."
PROJECTION.

BC, CD, &c. in the line AD, if it was not drawn on paper, is perpendicular to the direction of gravity. Draw BE, CF, DG, &c. in the direction of gravity, or perpendicular to the horizon, and take BE, CF, DG, &c. equal to the spaces AB, AC, AD, &c. as the body moves. Then, since by these motions, the body is carried over the space AB in the same time as the space BE, and the space AC in the same time as the space CF, and the space AD in the same time as the space DG, &c.; therefore, by the composition of motions, at the end of those times the body will be found and respectively in the points E, F, G, &c. and consequently the real path of the projectile will be the curve line ABEFG, &c. But the spaces AB, AC, AD, &c. being described by uniform motion, are as the times of description; and the spaces BE, CF, DG, &c. described in the same times by the accelerating force of gravity, are as the squares of the times; consequently the perpendicular descents are as the squares of the spaces in AD, that is, BE, CF, DG, &c. arc respectively proportional to \( AB^2, AC^2, AD^2, \) &c. which is the same as the property of the parabola. Therefore the path of the projectile is the parabola, that is, the curve line ABEFG, &c. to which AD is a tangent at the point A.

Hence, 1. The horizontal velocity of a projectile is always the same constant quantity, in every point of the curve; because the horizontal translational motion is in a constant ratio to the motion in AD, which is the uniform projectile motion; viz., the constant horizontal velocity being to the projectile velocity, as radius to the cosine of the angle DAB, or angle of elevation or depression of the piece above or below the horizonal line AH.

2. The velocity of the projectile is the direction of the curve, or of its tangent, at any point A, is as the cosine of its angle BAI of direction above the horizon. For the motion in the direction of the horizontal direction AD is constant, and AI being to AD as radius to the secant of the angle A; therefore the motion at A in AB, is as is the secant of the angle A.

3. The velocity in the direction DG of gravity, or perpendicular to the horizon, at any point of the curve, is to the uniform projectile velocity at A, as 2[\( g \)]D to AD. For the times of describing AD and DG being equal, and the body moving in the space described by the two motions through DG such as would carry the body uniformly over twice DG in an equal time, and the spaces described with uniform motions being as the times of these motions, it follows that the velocity AD is to the space 2DG as the projectile velocity at A is to the perpendicular velocity at G.

III. The velocity in the direction of the curve, at any point of it, is as is, equal to that which is generated by gravity in freely descending through a space which is equal to one-fourth of the parameter of the diameter to the parabola at that point. (Fig. 2.)

Let PA or AB be the height due to the velocity of the projectile at any point A, in the direction of the tangent AC, or the velocity acquired by falling through that height; and complete the parallelogram ACDB. Then is CD = AB or AP, the height due to the velocity in the curve at A; and CD is also the height due to the perpendicular velocity at D, which will therefore be equal to the former: but, by the last theorem, it follows that the body would drop a perpendicular velocity at D1, as AC to 2CD; and as these velocities are equal, therefore AC or BD = 4CD, and hence AP is equal to 1BD, or 2 of the parameter of the diameter AB, by the nature of the parabola.

Hence, 1. If through the point P, the line PL is drawn perpendicular to AP: then the velocity at that point will be equal to the velocity acquired by falling through the perpendicular distance of the point from the said line PL; that is, a body falling freely from the point P will acquire the same velocity at the point as the body AP in falling from the point P. Therefore, PA acquires the velocity in the curve at A.

PA, the reason of which is, that the line PL is what is called the directrix of the parabola; the property of which is, that the perpendicular to it, from every point of the curve, is equal to one-fourth of the parameter of the diameter at that point, viz.,

\[ PA = \frac{1}{4} \text{ parameter of the diameter at } A. \]

2. If, a body, after falling through the height PA, which is equal to AB, and when it arrives at A, if its course is changed, by reflection from a firm plane AI, or otherwise, into any direction, AC, without losing the velocity; and as AC is taken equal to 2AP or 2AB, and the parallelogram is completed; the body will describe the parabola passing through the point D.

3. Because AC = 2AB, or 2CD, or 4AP; therefore AC\(^2\) = 2AP\(^2\) = 2CD\(^2\) or 4AP\(^2\); and because all the perpendiculars BE, CF, DG, &c. equal to \( BA^2, CA^2, DA^2 \), &c. therefore AP, AE = AE\(^2\) = 4AP, and \( gH^2 = 4gA^2 \), &c.; and because the rectangle of the extremes is equal to the rectangle of the means, of four proportionals, therefore it is always,

\[ AP : AE = AE : EF, \]

and \( AP : AC = AC : CD, \)

and \( AP : AG = AG : GH, \)

and \( AP : AV = AV : VV. \)

IV. Having given the direction of a projectile, and the impetus or altitude due to the first velocity; to determine the greatest height to which it will rise, and the random or horizontal range. (Fig. 3.)

Let AP be the height due to the projectile velocity at A, or the height by which a body must fall to acquire the same velocity as the projectile has in the curve at A; also AG the direction, and AH the horizon. Upon AG let fall the perpendicular AG to the perpendicular vector AQ, or the greatest height of the curve; but shall AR be equal to the greatest altitude CV, and 4RC equal to the horizontal range AH. If, having drawn PQ perpendicular to AQ, take AQ = 4AQ, and draw GH perpendicular to AH; then AR is the range.

For, by the last cor., \( AP : AQ = AQ : AG, \)

and by sim. triangles, \( AP : AQ = AG : GH, \)

or \( AP : AG = AG : GH, \)

therefore \( AG = 4AQ \), and, by similar triangles, \( AH = 4AR \).

Also, if V is the vertex of the parabola, then AB or \( \frac{1}{2} AG = 2AQ \), or \( AQ = QB \); consequently \( AR = BV \), which is \( CV \), by the nature of the parabola.

Hence, 1. Because the angle Q is a right angle, which is the angle in a semicircle; therefore if upon AP as a diameter a semicircle is described, it will pass through the point Q. (Fig. 4.)

2. If the horizontal range and the projectile velocity are given, the direction of the piece as to hit the object H will be thus easily found: Take AD = \( \frac{1}{2} AH \), and draw DG perpendicular to AD at H, making the arc described on the diameter AP in Q and then AD will be the direction of the piece. And hence there are two directions AD and AH, which, with the same projectile velocity, give the very same horizontal range \( AH \); and these two directions make equal angles \( ABD \) and \( QAP \) with AH and AP, because the arc \( PQ \) is equal to the AR.

3. Or if the range AH and direction AB are given, to find the altitude and velocity or impetus: Take AD = \( \frac{1}{2} AH \), and erect an altitude EQ meeting AB in Q; then AQ shall be equal to the greatest altitude CV. Also erect AP perpendicular to AH, and OP to AQ shall be the height due to the velocity.

4. When the body is projected with the same velocity, but in different directions: the horizontal range AH will be as the sines of double the angle of elevation; or, which is the same thing, as the rectangle of the size and cosine of elevation. For AD or AQ, which is \( \frac{1}{2} AH \), is the sine of the arc AQ, which measures double the angle \( AQB \) of elevation.

And when the direction is the same, but the velocities different, the horizontal ranges are as the square of the velocities, or as \( \frac{1}{4} \) of the sine AD, which is as the square of the velocity; for the sine AD or RO, or \( \frac{1}{2} AH \), is as the radius, or as the diameter AP.

Therefore, when both are different, the ranges are in the compound ratio of the squares of the velocities, and the sines of double the angles of elevation.

5. The greatest range is when the angle of elevation is half a right angle, or \( 45^\circ \). For the double of \( 45^\circ \) is \( 90^\circ \), which has the greatest sine. And consequently, C is the focus of the parabola, and AH its parameter.

And the ranges are equal at angles equally above and below \( 45^\circ \).

6. When the elevation is \( 15^\circ \), the double of which, or \( 30^\circ \), having its sine equal to half the radius, consequently its range will be equal to \( \frac{1}{2} \) AP, or half the greatest range at the elevation of \( 45^\circ \); that is, the range at \( 15^\circ \) is equal to the impetus or height due to the projectile velocity.

7. The greatest altitude CV, being equal to AR, is as the versed sine of double the angle of elevation, and also as AP or the square of the velocity. Or as the square of the side of elevation, and the square of the velocity; for the square of the sine is as the versed sine of the double angle.

8. The time of flight of the projectile, which is equal to the time of a body falling freely through \( 45^\circ \) or \( 4CV \), 4 times the altitude, is that time in which the body arrives to the altitude, or as the projectile velocity and sine of the elevation.

9. And hence may be deduced the following set of theorems, for finding the circumstances relating to projectiles on horizontal planes, having any two of them given. Thus, let \( g \), \( s \), \( 1 \), \( 2 \), \( 3 \), \( 4 \), \( 5 \) sine, cosine, and tang. of elevation, \( s \), \( a \), \( g \), \( 1 \), \( 2 \), \( 3 \), \( 4 \), \( 5 \) sine and vers of double the elevation, \( R \) the horizontal rage, \( T \) the time of flight, \( V \) the projectile velocity, \( H \) the greatest height of the projectile, \( g = 16\frac{1}{2} \) feet, and \( a \) the impetus or the altitude due to the velocity \( V \).

Then,

\[
R = 2as = 4acr = \frac{sv}{g} = \frac{ev}{g} = \frac{gt^2}{g} = \frac{4v^2}{g}.
\]

\[
V = \sqrt{v^2 + \frac{2gs}{g}} = \sqrt{\frac{2gs}{g}} = \sqrt{2as} = \sqrt{2as}.
\]

\[
T = \frac{v}{a} = \frac{2as}{g} = \frac{2as}{g}.
\]

\[
H = \frac{v^2}{2g} = 2R = 2R = 2R.
\]
And from any of these, the angle of direction may be found.

V. To determine the range on an oblique plane; having given the impetus or the velocity in any direction.

Let AB be the oblique plane, at a given angle above or below the horizontal plane AG; AG the direction of the piece; and AP the altitude or impetus. Let the velocity of the piece be VA.

By the last prop. find the horizontal range AH to the given velocity and direction draw HE perpendicular to AH, meeting the oblique plane AG in P; draw EP parallel to the direction AG, and HP parallel to HE; so shall the projectile pass through H, and the range on the oblique plane will be AH. This is evident from the properties of the parabola; see Conic Sections, where it is proved, that if AH, AI, are any two lines terminated at the curve, and IF, HE, are drawn to the arc, then is EF parallel to the tangent AG. (Togs. 6 and 7.)

Hence, if AO is drawn perpendicular to the plane AG, and AP is bisected by the perpendicular STO; then with the centre O describing a circle through A and P, the same will also pass through s; because the angle GAI, 45°, and the angle AG and AI, are equal to the angle APY, which will therefore stand upon the same arc AG.

2. If there are given the range and velocity, or the velocity, the direction will then be easily found; Take AI = 2AI; draw AG perpendicular to AH, meeting the circle described with the radius AO in two points a and g; then AG or AP will be the direction of the piece. And hence it appears that there are two directions, which, with the same impetus, give the very same range AI, on the oblique plane; and these two directions make equal angles with AI and AP, the plane and the perpendicular, because the arc PG = the arc AG. They also make equal angles with AG and AP, drawn from A through S, because the arc AS = the arc SP.

3. Or, if there are given the range AI, and the direction AP, to find the velocity or impetus, take AG = 2AI; and erect AG perpendicular to AH, meeting the line of direction in g; then draw AP, making the angle APG = the angle APO; so shall AP be the impetus, or altitude due to the projectile velocity.

4. The range on an oblique plane, with a given elevation, is directly as the rectangle of the tangent of the angle of elevation above the horizon, and the sine of the direction above the oblique plane, and reciprocally as the square of the cotangent of the angle of the plane above or below the horizon.

\[ \text{Range} = \sin \angle z \cdot \frac{AZ}{AI} \]\n
5. The greatest height \( z \) or \( ky \) of the projectile, above the plane, is equal to \( \frac{1}{2} \times AP \). And therefore it is as the impetus and square of the sine of direction above the plane directly, and square of the cosine of the plane's inclination reciprocally.

\[ \text{Height} = \sin \angle z \cdot \left( \frac{1}{2} \times \frac{AP}{AI} \right) \]

where \( k \) is \( \frac{1}{2} \times \frac{AP}{AI} \).

6. The time of flight in the curve \( \text{AGv} \) is \( \sqrt{\frac{g}{c}} \), where \( g = 16 \times 2 \) feet. And therefore it is as the velocity and sine of direction above the plane directly, and cosine of the plane's inclination reciprocally. For the time of describing the curve, is equal to the time of falling freely through GI, or \( \frac{dG}{c} \), or \( \frac{c}{c} \times AP \).

Therefore, the time being as the square root of the distance, \( \sqrt{\frac{2h}{g}} \cdot \sqrt{\frac{c}{AP}} = \sqrt{\frac{2h}{g}} \cdot \sqrt{\frac{c}{c}} = \sqrt{\frac{2h}{g}} \) time of flight.

7. From the foregoing corollaries may be collected the following set of theorems, relating to projectiles made on any given inclined planes, either above or below the horizontal plane; in which the letters denote as before, namely, \( e \) = cos. of direction above the horizon, \( C \) = cos. of inclination of the plane, \( s \) = sin. of direction above the plane, \( R \) = range on the oblique plane, \( T \) = time of flight, \( V \) = the projectile velocity, \( a \) = the impetus, or alt. due to the velocity, \( V_s = 16 \times 2 \) feet. Then

\[ R = e \times 4d = eV^2 = T^2 = eH. \]

\[ V = \sqrt{ag} = \sqrt{\frac{c}{c}} \times \sqrt{g} = \sqrt{ag} \]

If the height \( z \) or \( ky \) of the projectile, above the plane, be required, or the angle \( \alpha \) of direction, the same may be found by the method of the curve, and after separating in the manner of a curve from its tangent, if the mouth of the piece is considered as the point of contact.

This is put beyond a doubt from the experiments made by Mr. Robins; who found that the direction to the piece, the perpendicular line was not less uncertain, falling sometimes 200 yards short of what it did at other times, although there was no visible cause of difference in making the shot. See Rule.

PROJECTION, in mechanics, the act of giving a projectile its action. For a long time before Copernican philosophers seemed to be satisfied with the parabolic theory of projectiles, deeming the effect of the air's resistance on the path as of no consequence. In process of time, however, as the true philosophy began to dawn, they began to suspect that the resistance of the medium might have some effect upon the projectile curve, and they set themselves to consider this subject with some attention.

Huygens, supposing that the resistance of the air was proportional to the velocity of the moving body, concluded that the line described by it would be a kind of logarithmic curve. But Newton, having clearly proved, that the resistance to the body is not proportional to the velocity itself, but to the square of it, showed, in his Principia, that the line a projectile describes, approaches nearer to an hyperbola than a parabola.

Mr. Robins has shewn that, in some cases, the resistance to a cannon-ball amounts to more than three times the weight of the ball; and Dr. Hutton, having prosecuted this subject far beyond any former example, has sometimes found this resistance amount to nearly 100 times the weight of the ball; and estimated eight of right ordnance with a velocity of 2000 feet per second, which is a rate of almost 23 miles in a minute.

Mr. Robins has not only detected the errors of the parabolic theory of gunnery, which takes no account of the resistance of the air, but shews how to compute the real range of resistible bodies.

There is an odd circumstance which often takes place in the motion of bodies projected with considerable force, which has at equal angles above and below this direction for the maximum.

The greatest height \( z \) or \( ky \) of the projectile, above the plane, is equal to \( \frac{1}{2} \times AP \). And therefore it is as the impetus and square of the sine of direction above the plane directly, and square of the cosine of the plane's inclination reciprocally.

\[ \text{Height} = \sin \angle z \cdot \left( \frac{1}{2} \times \frac{AP}{AI} \right) \]

\[ \text{Height} = \sin \angle z \cdot \frac{1}{2} \times \frac{AP}{AI} \]

Therefore, the time being as the square root of the distance, \( \sqrt{\frac{2h}{g}} \cdot \sqrt{\frac{c}{AP}} = \sqrt{\frac{2h}{g}} \times \sqrt{\frac{c}{c}} = \sqrt{\frac{2h}{g}} \) time of flight.

And from any of these, the angle of direction may be found.

Of the Path of Projectiles, as depending on the Resistance of the Air.

For a long time after Copernican plane, it was usual to conceive the appearance or representation of an object on the perspective plane. So, the projection of a point, is a point where the eye sees the body; and the projection of a plane, is a plane where the eye sees the body. Hence it is easy to conceive what is seen by the projection of a line, a plane, or a solid.

PROJECTION, in perspective, denotes the appearance or representation of an object on the perspective plane. So, the projection of a point, is a point where the eye sees the body; and the projection of a plane, is a plane where the eye sees the body. Hence it is easy to conceive what is seen by the projection of a line, a plane, or a solid.

The chief use of the projection of the sphere, is in the construction of phœnomena, maps, and charts; which are said to be of this or that projection, according to the several situations of the eye, and the perspective plane, with regard to the meridians, parallels, and other points or places to be represented.

The most usual projection of maps, is the Mercator's, in which the meridian, which exhibits a right sphere; the first meridian being the horizon. The next is that on the plane of the equator, which has the pole in the centre, and the meridians the radii of a circle, &c. and this represents a parallel sphere. See Map.

The projection of the sphere is usually divided into orthographic and stereographic; to which may be added gnomonic.

PROJECTION orthographic, is that in which the surface of the sphere is drawn upon a plane, the point of the sphere being placed at an infinite distance vertically to one of the hemispheres. And,
projection stereographic of the sphere, is that in which all great circles of the sphere are drawn upon the plane of the circle, eye being in the pole of that circle.

projection geometrical of the sphere, is that in which the circle is drawn upon a plane without side of it, communed through it, the eye being at the center of the sphere.

Law of the perspective projection.—1. The rays coming from the eye, being at an infinite distance, and making the projection, are parallel to each other, and perpendicular to the plane of projection.

2. A right line perpendicular to the plane of projection, is projected into a point where that line meets the said plane. (Fig. 8.)

3. A right line AB, or CD, not perpendicular, but either parallel to or oblique to the plane of projection, is projected into a right line, as EF or GH, and is always comprehended between the extreme perpendiculars AE and BF, or CG and DH.

4. The projection of the right line AB is the greatest, when AB is parallel to the plane of the projection.

5. Hence it is evident, that a line parallel to the plane of the projection, is projected into a right line equal to itself, but that a line that is oblique to the plane of projection, is projected into one that is less than itself.

6. A plane surface, as ACED, perpendicular to the plane of the projection, is projected into the right line AB, in which it cuts that plane. Hence it is evident, that the circle ACBD perpendicular to the plane of projection, passing through its center, is projected into that diameter AB in which it cuts the plane.

7. Any arc as C is projected into O", equal to OW, the right sine of that arch; and the complemental arc J is projected into JF, the reversed sine of that arch.

8. A circle parallel to the plane of the projection, is projected into a circle equal to itself, having its center on the circle of the center of the projection, and its radius equal to the cosine of the distance of its center from the plane. And a circle oblique to the plane of the projection, is projected into an ellipsis, whose greater axis is equal to the diameter of the circle, and its less axis equal to the double cosine of the obliquity of the circle to a radius equal to half the greater axis.

9. If in this projection a right circle, or one perpendicular to the plane of projection, and passing through the eye, is projected into a line of half the circle.

2. The projections of all other circles, not passing through the projecting point, whether parallel or oblique, are projected into circles. Figs. 10, 11, and 12.

Thus, let ACED represent a sphere, cut by a plane RS, passing through the center I, perpendicular to the diameter EH, drawn from E to the place of the eye; and let the section of the sphere by the plane RS be the circle CDLF, whose poles are H and E. Suppose now AGB is a circle on the sphere to be projected, whose pole most remote from the eye is P; and the visual rays from the eye HGB meeting in E, form the curve BE and CD, the centers of which triangle AGB is a section through the circle RS, whose diameter AB is then the figure HCP, which is the projection of the circle AGB, let it be itself perpendicular to the plane of projection; and all oblique great circles cut the primitive circle in two points diametrically opposite.

3. The projected diameter of any circle subtends an angle at the eye equal to the distance of that circle from its nearest pole, taken on the sphere; and that angle is bisected by a right line joining the eye and that pole. Thus, let the plane RS (Fig. 13) cut the sphere HPBC through its center I; and let the great circle, whose diameter AC is projected into ar, and Kol any small circle parallel to ABC, whose diameter KL is also projected in de. The distances of those circles from the pole P being given, the arcs AHP, KHP, and the angles as, ae, are the angles at the eye, subtended by their poles, as AC, and KL. Hence, when the angle ae is measured by the arc AHP, and the angle AE by the arc KHP, and those angles are bisected by EP.

5. Any point of a circle is projected at such a distance from the center of projection, as is equal to the tangent of half the arc intercepted between that point and the pole opposite to the eye, the semidiameter of the sphere being the radius.

Thus, let CSB (Fig. 14) be a great circle of the sphere, whose center is G; GH the plane of projection; RS the line of projection, in which the pole A is projected in a, in the line IC, the diameter of the sphere AGC. Also let DH and PA be tangents to the circles ACS and ABL. Then will the projected angle of AGP be equal to the spherical angle IAC.

6. The distance between the centers of the primitive circle and an oblique circle, is equal to the tangent of half the inclination of those circles, and the centers are equal to the tangent of their inclination, the semidiameter of the primitive being radius.

For let AC (Fig. 17) be the diameter of a circle, whose poles are P and Q. Let the projection of this circle be the primitive circle, whose pole is I, then is

10. When the plane of projection becomes the primitive circle, whose pole is I, then is

11. If through any point in the primitive circle, an oblique circle is drawn, passing through that point, will be in a right line drawn through the center of the first oblique circle, and perpendicular to a line passing through that center, the given point, and the center of the primitive circle. Thus, let GACE (Fig. 17) be the primitive circle, and ADEI a great circle described through D, its center being B. Let the right line drawn through B, perpendicular to a right line CI passing through D and B and the center of the primitive circle. Then the centers of all oblique circles, as EGD, passing through D, will fall in the line HK.

7. Equal arcs of any two great circles of the sphere will be intercepted between two other great circles of the sphere, through the remotest poles of those great circles. For let PBCP (Fig. 18) be a sphere, on which AGB and CFD are two great circles, whose remotest poles are E and P and through those poles the great circles PBCF and the small PGE be drawn, cutting the great circles AGB and CFD in the points G and D. Then are the intercepted arcs BG and DF equal to one another.

8. If lines are drawn from the projected pole of any great circle, cutting the peripheries of the projected circle and a pole of projection, the intercepted arcs of those peripheries are equal; that is the arc BG = CF.

9. The radius of any lesser circle, whose plane is perpendicular to that of the primitive circle, is equal to the tangent of that lesser circle's distance from the pole. For let P (Fig. 19) be the pole and AB the diameter of a lesser circle, in plane being perpendicular to that of the primitive circle, whose center is C; then AB is the center of the projected lesser circle, as distant from the pole of the arc PA, and AC = the secant of PA.

PROJECTURE. See Architecture. PROLAPSUS. See Surgery.

PROLATE, in geometry, an epitaph applied to a spheroid produced by the revolution of a semi-ellipse about its larger diameter.

PROMISE, is where, upon a valuable consideration, persons bind themselves by words to do or perform such a thing agreed on; it is in the nature of a verbal covenant, and wants only the solemnity of writing and the approbation of the law. Yet for the breach of it, the remedy is by suit; for instead of an action of covenant, there lies only an action upon the case, the damages whereunto are to be estimated and determined by the jury.

PROMISSORY NOTE. See Bills of Exchange.

PRONOUN, in grammar, a declinable part of speech, which in g put instead of a noun, points out some person or thing.

PROOF, the shewing or making plain the truth of any matter alleged; either in giving evidence to a jury at a trial, or else on interrogatories or by copies of records, or exemplifications of them. See Evidence.

PROOF of artillery and small arms, is a trial whether they stand the quantity of powder allotted for that purpose. The rate of the board of ordnance is, that all guns under 24-pouders are loaded with powder as much as their shot weights; that is, a brass 24-pouder with 21 lb. 12 oz. and a 32-pouder with 26 lb. 1 oz. The iron 24-pouder with 18 lb. the 32-pouder with 21 lb. 8 oz. and the 42-pouder with 25 lb. and there is

When guns of a new metal, or of lighter construction, are proved; then besides the common proof, they are fired 200 or 300 times, as quick as they can be loaded with the common charge given to the piece. Our light six-pouders were fired 300 times in three hours and twenty-seven minutes, loaded with 1 lb. 4 oz., without receiving any damage.

The proof of powder, is in order to try its goodnes and strength. See Gunpowder.
the ground, supported only by a piece of wood in the middle, of about five or six inches thick, to raise the muzzle a little, and the piece is fixed against a solid butt of earth.

**Proof of mortars and howitzers,** is made to ascertain their being well cast, and of strength to resist the effort of their charge. For this purpose the mortar or howitzer is placed upon the ground, with some part of the trunions or breech sunk below the surface, and resting on wooden billets at an elevation of about seventy degrees. The mirror is generally the only instrument to discover the defects in mortars and howitzers. In order to use it, the sun must shine; the breech must be placed towards the sun, and the glass over against the mouth of the piece which illuminates the bore and chamber sufficiently to discover the flaws in it.

**Proof of foreign brass artillery.**

1. The Prussians. Their battering-train and garrison artillery are proved with a quantity of powder equal to half the weight of the shot, and fired seventy-five rounds as fast as in a minute; that is, two or three rounds in a minute. Their light field-train, from a 12-pounder upwards, are proved with a quantity of powder = 13d of the weight of the shot, and fired 150 rounds, at three or four rounds in a minute. From a 12-pounder downwards, are proved with a quantity = 15d of the shot's weight, and fired 300 rounds, at five or six rounds each minute, properly spunged and loaded. Their mortar, with the chamber full of powder, the breech has 3, 4, 6, powder, and the shells loaded. Three rounds are fired as quick as possible. 2d. The Dutch prove all their artillery by firing each piece five times: the two first rounds with a quantity of powder = 3-3d's of the weight of the shot; and the three last rounds with a quantity of powder = half the weight of the shot.

3d. The French the same as the Dutch.

**Proof, in brandy and other spirituous liquors,** is in a glass from which appears on the top of the liquor when poured into a glass. This froth, as it diminishes, forms itself into a circle called by the French the chapelet, and by the English the bead or bubble.

**Propolis.** See Resins.

**PROPORTION.** In arithmetic, &c. See Algebra, p. 54.

Proportion is often confounded with ratio; but they are quite different things. For, ratio is properly the relation of two magnitudes or quantities of one and the same kind: as the ratio of 4 to 8, or of 15 to 30, or of 1 to 2 and so implies or respects only two terms or things. But proportion respects four terms or things, or two ratios which have each two terms; though the middle term may be common to both ratios, and then the proportion is expressed by three terms only, as 4, 8, 94, where 4 is to 8 as 9 to 94.

Proportion is also sometimes confounded with progression. In fact, the two often coincide; the difference between them only consisting in this, that proportion is particular species of progression being indeed a continued proportion, or such as has all the terms in the same ratio, viz. the 1st to the 2d, the 2d to the 3d, the 3d to the 4th, &c.; so that progression is a series or continuation of proportion. See Progression.

Proportion is either continual or discrete, or interrupted.

The proportion is continual when every two adjacent terms have the same ratio, or when the consequent of each ratio is the antecedent of the next following ratio, and so all the terms form a progression. 2, 4, 8, 16, &c; where 2 is to 4 as 4 to 8, and as 8 to 16, &c.

Discrete or interrupted proportion, is when the consequent of the first ratio is different from the antecedent of the 2d, &c; as 2, 4, 8, and 3, 6.

Proportion is also either direct or inverse.

Direct proportion is when more requires more, or less requires less; as it will require more men to perform more work, or fewer men for less work, in the same time.

Inverse or reciprocal proportion, is when more requires less, or less requires more. As it will require more men to perform the same work in 15 days, how many men can do the same in 10 days?

Then, reciprocally as 15 to 10 so is 9 to 6 the ant, or terms; the latter 9 is 6. 9 to 6 is 2 to 1, swz.

Proportion, again, is distinguished into arithmetical, geometrical, and harmonical.

**Arithmetical proportion** is the equality of two arithmetical differences in the numbers 12, 9, 6; where the difference between 12 and 9, is the same as the difference between 9 and 6, viz. 3.

And here the sum of the extreme terms is equal to the sum of the means, or to double the single mean when there is but one. As 12 + 6 = 9 + 9 = 18.

Geometrical proportion is the equality between two geometrical ratios, or between the quotients of the terms. As in the three 9, 6, 4, where 9 is to 6 as 6 is to 4, thus denoted 9:6 = 6:4; for 9 upon the other side, being each equal 2 or 1/2.

And in this proportion, the rectangle or product of the extreme terms, is equal to that of the two means, or the square of the single mean when there is but one. For 9 X 4 = 6 X 6 = 36.

Harmonical proportion, is when the first term is to the third, as the difference between the 1st and 2d is to the difference between the 2d and 3d: or in four terms, the 1st is to the 4th, as the difference between the 1st and 2d is to the difference between the 2d and 3d; or the reciprocals of an arithmetical proportion are in harmonical proportion. As 6, 4, 3, because 4 upon the one side, 1 being each equal 2 or 1/2; are in arithmetical proportion, making 4 + 1 = 5 = 1 + 1/2. Also the four 24, 16, 12, 9, are in harmonical proportion, because 24 + 12 = 9 + 16 = 25.

**PROPORTIONAL COMPARISONS,** are comparisons with two pair of opposite legs, like a St. Andrew's cross, by which any space is enlarged or diminished in any proportion.

Proportionals, also called also logarithmic scales, are the logarithms, or artificial numbers, placed on lines, for the ease and advantage of multiplying and dividing, &c. by means of compasses, or of sliding rules. These are in effect so many lines or numbers, as they are called by Gunter, but made single, double, triple, or quadruple; beyond this beautiful and simple composition of the three kinds of proportions, arithmetical, geometrical, and harmonical, viz. 

\[ a : b : c = d : e : f, \]

being the first, second, and third terms in any such proportion, then

in the arithmeticals, \[ \frac{a}{d} = \frac{b}{e} = \frac{c}{f}, \]

in the geometricals, \[ \frac{a}{b} = \frac{c}{f}, \]

and in the harmonicals, \[ \frac{a}{d} = \frac{f}{d} = \frac{b}{e} = \frac{c}{f}. \]

Continued proportions form what is called a progression. See Progression.
If a set of continued proportionals are either augmented or diminished by the same part of themselves, the same or different will also be proportionals.

Thus, if \(a, b, c \ldots \) be proportionals, where the common ratio is \(1 + \frac{1}{r}\).

And if any single quantity is either augmented or diminished by some part of itself, and the result is also increased or diminished by the same part of itself, and this third quantity treated in the same manner, and so on; then shall all these quantities be continued proportionals. So, beginning with the quantity \(a\), and taking always the 4th part, then shall

\[a, a \pm \frac{a}{r}, a \pm \frac{a}{r^2}, \ldots \]

proportionals, or \(a, a \pm \frac{a}{r}, (a \pm \frac{a}{r^2}), (a \pm \frac{a}{r^2})^2, \ldots \) &c.

proportional the common ratio being \(1 + \frac{1}{r}\).

If one set of proportionals is multiplied or divided by any other set of proportionals, each term by each, the products or quotients will also be proportionals.

Thus, if \(a, b, c, d, \ldots \) be proportionals, then

\[a \times d, b \times c, \ldots \]

will be proportionals, or \(a \times d, b \times c, b \times c, \ldots \) &c.

If there are several continued proportionals, then whatever ratio the 1st has to the 2d, the 1st to the 3d shall have the duplicate of the ratio, the 1st to the 4th the triplicate of it, and so on.

So in \(a, n, a, n, a, n, a, \ldots \) the ratio being \(a\); then if \(a, n, a, n, a, n, a, \ldots \), the duplicate ratio, and if \(a, n, a, n, a, n, a, \ldots \), the triplicate ratio, and so on.

In three continued proportionals, the difference between the 1st and 2d term, is a mean proportional between the 1st term and the second difference of all the terms.

Thus, in the three proportion, \(a, n, a, n, a, n, \ldots \)

Terms
diff. 1st. diff. 2d diff. 3d diff. 4th diff. 5th diff. 6th diff. 7th diff.

\[a \times a = a^2, a \times a = a^2, a \times a = a^2, a \times a = a^2, \ldots \]

Or in the numbers \(9, 6, 18, \ldots \)

18

12

8

3

2

4

8

Then 2, 4, 8 are proportionals.

When four quantities are in proportion, they are also in proportion, composition, division, &c; thus, \(a, b, c, d, e, \ldots \), being in proportion, viz.

1. \(a, b, c, d, e, \ldots \)
2. Inversion \(a, b, c, d, e, \ldots \)
3. Alternation \(a, b, c, d, e, \ldots \)
4. Composition \(a + a, b + b, c + c, d + d, e + e, \ldots \)
5. Conversion \(a + a, b + b, c + c, d + d, e + e, \ldots \)
6. Division \(a + a, b + b, c + c, d + d, e + e, \ldots \)

III. Properties of continued proportionals.

1. If three or four numbers in continued proportion, are either multiplied or divided by any number, the products or quotients will also be continued proportionals.

Thus, \(6, 3, 2, 1, \ldots \), being harmonic, propor., and \(\frac{1}{2}, \frac{1}{3}, \frac{1}{4}, \ldots \) are also harmonic, propor.

2. In the three harmonic proportionals, \(a, b, c\), when any two of these are given, the third can be found from the definition of them, viz. that

\[a : b = b : c ; \text{ or } a + b + c = a \times b \times c, \text{ for hence}
\]

\[e = \frac{2a b}{a + b} \text{ the harmonic mean and } e = \frac{a + c}{2} \text{ the third harmonic to } a \text{ and } b.
\]

3. And of the four harmonicals, \(a, b, c, d, \ldots \) any three being given, the fourth can be found from the definition of them, viz. that \(a : b = b : c = c : d \ldots \); for hence the three \(a, b, d, \ldots \) will be thus found,

\[e = \frac{2a b c}{a + b + c} \ldots
\]

4. If there are four numbers disposed in order, as \(2, 3, 4, 6, \ldots \) of which one extreme and the two middle terms are in arithmetical proportion, and the other extreme and the same middle terms are in harmonic proportion; then are the four terms in geometrical proportion: so

the three \(2, 3, 4, 6\) are arithmeticals, and the three \(3, 4, 6\) are harmonicals, then the four \(2, 3, 4, 6\) are geometricals.

5. If between any two numbers, as \(2, 6\), there are interposed an arithmetical mean 4, and also a harmonic mean 3, the four will then be geometricals, viz. \(2, 3, 4, 6\).

6. Between the three kinds of proportion, there is this remarkable difference, viz. that from any given number there can be raised a continued arithmetical series increasing ad infinitum, but not decreasing; while the harmonical can be decreased ad infinitum, but not increased; and the geometrical admits of both.

Proportions of the human body. See DRAWING.

PROPORTIONS OF THE ANCIENT STYLES. See STATUES, and SCULPTURE.

PROPOSITION, in logic, part of an argument wherein some quality, either negative or positive, is attributed to a subject; or according to Chauvinus, it is a complete consistent sentence, indicating or expressing something either true or false, without ambiguity; as, God is just.

PROPOSITION, in mathematics, is either some truth advanced and shown to be such by demonstration, or some operation proposed and its solution shown. If the proposition is deduced from several theorems or definitions compared together, it is called a theorem; if from a praxis, or series of operations, it is called a problem.

PROSERPINACEA, a genus of the monyonya order, in the tarbela class of plants; and in the natural method ranking under the 15th order, stella. There is one quadrifol petal surrounding the germ; there is no proper calyx; the receptacle is palescum. There are sixty-four species, chiefly natives of the Cape of Good Hope; of which the most remarkable are, 1. The conicole, with linear, spear-shaped, entire leaves, grows to the height of ten or twelve feet, with a straight regular stem. The branches naturally form a large regular head. The leaves are long and narrow, of a shining silver-colour, and, as they remain the whole year, make a fine appearance in the greenhouse.

2. The argenteus, commonly called silver-tree, has a strong upright stem covered with purplish bark, dividing into several branches which grow erect, with broad, shining, silver, leaves, which make a fine appearance when intermixed with other exotics. Through the whole year it exhibits its glossy white or silvery leaves. It has at first a very uncommon and beautiful appearance; and sometimes in the course of a year or two, reaches the height of twenty feet, which it never exceeds. In a rich soil it grows twice as quick, and is by far the largest of the prophet kind. They are generally planted near some temple, and from very slow growth; Mr. Sturman thinks it was probably brought to the Cape of Good Hope from Amaraqua; for he had travelled over the whole north-east side of Hottentot's Holland, without finding it either in its natural state or planted. 3. The nitsa, or wagework, greatly resembles the second sort; the leaves are very silvery and white, with erect purple branches. All these plants being tender exotics, require to be continually kept in the greenhouse during winter. The first may be propagated by cuttings, which should be cut off in April, just before the plants begin to shoot; the second and third sorts may be propagated by seeds.

PROHONOTARY, a term which properly signifies first notary, and which was antiently the title of the principal notaries of the emperors of Constantinople.

Prothorony is used for an officer, in the court of king's bench and common
pleas; the former of which courts has one, and the latter, the actions and prolixity of the king's bench, records all civil actions in
that court, as the clerk of the crown-office does all criminal causes. The prolixities of
the common pleas enter in and in all de-
celerations, pleadings, assizes, judgments and
actions; they also make up an official writs, except writs of habeas-corpus, and
strangaria, for which there is a parti-
cular office, called the habeas corpora office; the
litigious enter recognizances acknow-
edged, and all common recoveries; make
exemplifications of records, &c.
PROTOXIDE, in chemistry, a term used to
denote the minimum of oxidizement. See OXIDE.
PROTRACIOM, the same with plotting.
See SURVEYING.
PROTRACTOR, the name of an instru-
ment used for protracing or laying down on
paper the angles of a field, or other figure.
See SURVEYING.
PROVISO, in law, a condition inserted in
a deed, upon the observance whereof the va-
tility of the deed depends.
PROVOST, a sheriff, whereas there are
divers kinds, civil military, &c.
PROVOST of a city or town, is the chief
municipal magistrate in several trading cities,
particularly Edinburgh, Glasgow, &c. being
much the same with mayor in other places.
He presides in city-courts, and, together
with the bailies, who are his deputies, de-
termines in all differences that arise among
citizens.
PROVOST marshal of a city, is an officer
appointed to seize and secure deserters, and
all other criminals. He is to hinder soldiers
from pillaging, to indict offenders, and see
the sentence passed on them executed. He
also regulates the weights and measures, and
the price of provisions, &c. in the army.
For the discharge of his office, he has a lieu-
tenant, a clerk, and a troop of marshals
on horseback, as also an executioner. There
is also a provost marshal in the navy, who
has the same power over prisoners, &c.
PROW, in navigation, denotes the head
fore part of a ship, particularly in a galley,
being that which is opposite the poop or
stem.
PRUNELLA, self-hue, a genus of the
graminaceus order, in the dilluminia class
of plants; and in the natural method ranking
under the 13th order, holaraceae. The
filaments are bifurcated, with an anther only
on one point; the stigma is bifid. There
are three species, herbs of Europe.
PRUNELLA sal, in pharmacy, a prepara-
tion of purified saltpetre.
PRUNES, in commerce, are plums dried
in the sunshine, or in an oven.
PRUNING wall-trees. Of this a "mas-
ter work of gardening," it has been said, 
"that even a prue too little, and garden-
ers too much;" these extremes are to be
avoided, as attended with peculiar evils,
equally mischievous: wall-trees are presentely spoiled by either practice. If they are too thickly planted, the shoots and fruits cannot be
properly ripened: and if they are too thin (the
greater evil of the two), the consequence of
the cutting that has made them so, is the
production of wood rather than fruit: forcing
cut shoots, where otherwise blossom-bud
would have been formed. The designation
of trees to a wall (from the superabundant
heat) necessities, not to but able to pro-
cure an operator to attend them; let him
then resolve to learn the art himself, and
the ability will be very gratifying to him.
As many words must be used on this article
of pruning, for the sake of order, the busi-
ness of managing wall-trees may be, 1. Con-
cerning the form. 2. The health. 3. The
fruitfulness of them.
1. As to the form, or general appearances
of the wall-trees. If a tree is young and
nearly planted, the first thing is to head it
down, by cutting off (if it be a hectarov, pe-
ach, or apricot) all the shoots, and the
stem itself, down to a few eyes, that the lower
part of the wall may be firm-lied with new
and strong wood. Make the cut sloping,
and behind taking care (by putting the
foot on the root, and the left hand on the
stem) not to disturb the tree by pull of
the knife. Plaster the part with a bit of cow-
dung, clay, or sth. earth. It is evident from
this that maiden stocks are the best to plant.
The heading down is to be made so as to
leave two or three eyes, or four or if a high
wall, on each side of the stem, from which
shoots will come properly placed for training.
The number of eyes may be also according to
the strength of the tree, and its root system.
if there are not two well-placed eyes on each
side of the stem, two shoots, thus situated,
may be left, cutting them short to two or three
eyes each. Eyes or shoots behind or before,
consider as of no use, and let them early be
disposed of by rubbing or cutting. This work
is to be performed in spring, when the tree is
putting forth shoots; i.e. about the begin-
ing of April.
If towards the end of May there should be
wanting shoots on either side the tree, having
perhaps only one put forth where two were
expected, this one shoot should be cut, or
pinched down, to two or three eyes; and be
left, if it be put in summer will be found to
have left shoots from them, and thus a proper head be
obtained. This work of shortening shoots of
the year may be done any time before Mid-
summer; but in this case, all ill-placed or su-
perfluous growths must be rubbed off as soon
as seen, that those to be reserved may be the
stronger, receiving more nourishment.
As the lateral shoots grow, let them be
timely nailed to the wall, close, straight, and
equidistant, but none, once if they are
quite well-placed, they will need no binding;
but sometimes shoots must be laid in which
are not perfectly so. Lay in as many good
moderate-sized shoots as may be throughout
the summer, for choice at winter pruning, yet
do not crowd the tree. As the shoots pro-
ceed in length, nail the to the wall, that no
d材料 are damaged of them may be seen; but
avoid unnecessarily occasions cutting, and in
the formation of a tree, keep each side
as nearly as can be equal in wood; and the
shoots inclining downwards, which is a mode
of training necessary, to air the lower part of
the wall (none of which should be lost), and
to check the too free motion of the sap, which
wall-trees are liable to from their warm situa-
tion; and all the branches should have an horizontal tendency, though
the upper cannot have it so much as the
lower ones. Those that are perpendicular,
or nearly so, mount the wall too fast, and run
away with the food which is placed in the
horizontals; which being impoverished by the
vigorous middle branches, gradually become
too weak to extend themselves, and nourish
the fruit. The pruner, therefore, must be
united, and nurse them from the middle, over
the middle of the tree, unoccupied; or, at least
suffer none but weak or very moderate shoots
to find a place there.
The idea of a well-formed tree is somewhat
represented by the ribs of a spread Ian, or
the fingers of the hand extended. Regularity
is allowed to be so necessary to the beauty
of a wall-tree, that some have even drawn lines
for a guide to train by; but nature (ever free
and easy) will not submit to so much artificial
work, and such a position of the branches
is not necessary. A tree may be
regular without being linear, and the proper
useful shoots are not to be sacrificed to a fun-
ciful precision. Though crossing of branches
is against a rule, yet it does happen (as in
want of wood or fruit) where even this awk-
wardness may be permitted. The object is
fruit; and to obtain this end, form must some-
times give place.
All forfeit and back shoots, and other
useless wood, should be displaced in time, for
they exhaust the strength of the tree to no
purpose, and occasion a rude appearance.
It is a very expeditious method to place su-
perfluous young shoots, by pushing or break-
ing them off; but when they get woody it is
apt to tear the bark, and in this case the knife
must be used: the better way is to disbud by
rubbing; yet a young luxuriant tree should
be suffered to grow a little while to spend the
sap. There is one evil, however, attending
on disbudding, and rubbing off young for-
rights, that some fruit spurs are thus lost;
or apricots are apt to bear little short
shoots of from half an inch to an inch (or more), and there are others which do the
same; so it is a rule with some pruners to
wait to distinguish spurs from shoots, and
then to use the knife, yet used it as little as
may be in summer.
In regulating a tree at any time, begin at
the bottom and middle, and work the way or-
derly outward and upward. Never shorten in
summer (which would produce fresh shoots),
except a forward shoot where wood may be
wanting; but where the tree is really too
thick, cut clean out what may be spared.
None of the shoots produced after mid ad-
vance should be nailed in, except where wood
is wanting to fill a naked place. They never
bear fruit.
2. The health of wall-trees is greatly pro-
duced for by observing the directions already
given concerning their form; for if observed,
each shoot will have the proper benefit of sun
and air, to concite its juices and prepare it
for fruiting.
It injures a tender shoot when it presses
hard against a nail. If the hammer strikes a
shoot, and bruises the bark, it often spoils if
not kills it, by the part carking. The
shreds may be too tight, so that the shoot
cannot properly swell; and if shoots are too broad and too numerous, they are apt to occasion sickness and early death, or harbour for insects and fungi: let the number be lessened at all opportunities. A slip of the knife may wound a neighbouring branch, and make it gum, canker, or die. It is well to be thrifty and some patience, to avoid this accident; and in order to it, keep the point of the knife sharp, and mind the position of it when cutting. Cut close and sloping behind the eye; neither so near as to injure it, nor so wide as to leave a stub.

The bending of a branch much is a violence to be avoided; so that every shoot should be kept from the first in the direction it is to grow in.

Luxuriant wood must be particularly attended to, to get rid of it in time, before it has robbed the weaker branches too much. That is luxuriant wood which, according to the general habit of the tree, is much larger than the rest; for a shoot that is devious and unfruitful in one tree may not be so in another. If strong wood, that is not very luxuriant, happens to be at the bottom of the tree, so that it can be trained quite horizontally, it may often be turned to purpose by a little smartly pushed up position checks the sap. A luxuriant shoot may be kept in summer where it is not designed to retain it, merely to cut it down at winter-pruning to two or three eyes, for getting wood thicker, if suffered the next year; or this shortening may take place in June, to have new shoots the present year. Luxuriant shoots may be sometimes retained for a time, merely as waste pipes.

All diseased, damaged, very weak, or worn out branches (as they occur), should be cut out, to make way for better; but if a tree is generally diseased, some caution must be used not to cut out too much at once, if there is any hope of restoring it. A very old tree, or a young one that does not thrive, may be cut a great deal; but prune it so as to have a general sprinkling of the best of the branches, and keep short lengths of an eye or two of the weaker ones, in a sort of alternate order.

Young trees are very apt to be too thick with themselves the first year or two of fruiting. The remedy is obvious, and should resolutely be applied.

A weak tree is helped much by training it more erectly than usual, as less check is thus given to the sap, and so the shoots are more likely to swell: such a tree should be kept thin of branches, and always pruned early in autumn, keeping the top tree from such wood as is stronger than that which is in general below, and so all the shoots shorter than usual.

Old decaying trees should be lessened a little every year, and constantly watched, to observe where young and strong shoots are putting out below, in order to cut down to them; and though the time for doing this is commonly believed to good winter pruning, yet it may be best done in summer, as the shoots would thrive the better; observing to put some grafting-clay or cow-dung to the part, to prevent gumming, which summer pruning is apt to do. No watchful eye is as good as bringing the oldest and most ill-conditioned tree to a healthy and bearing state it all is but right at the root, it having a good soil about it.

Keep all wall-trees clean, and particularly weak ones, from moss, cobwebs, or other filth; and attend to insects, snails, caterpillars, and another flies. Any bark that is decayed by cracks, &c. must be cleared away to the quick, either by rubbing, or the knife, and the idea of the quick and insects are particularly to gather there: wipe the part clean with spungie and soap.

Consider the soil about an unthrifty tree, and if it is thought bad, improve it by moving away as much of the old as conveniently can be done, and laid care fully quite bare, and examined, in order to cut off decayed or cankered parts, and to apply immediately to them some fine and good fresh earth, with a little thorough-roten dung in it, and a sprinkling of soil or wood ashes. Hog-dung applied fresh is said to have a peculiar efficacy in recovering weak trees; and cow-dung may reasonably be expected to do good if the soil is a warm or hungry one; and if the tree is not the healthiest, as it is a cold dressing. If the soil is a strong one, a compost of fowl's or sheep's dung, lime, with any fresh light earth, (one part of each of the former, and three of the latter, mixed with too much water) or an artificial manure, to which a little sharp sand may be added. All these applications should be made late in autumn, or early in spring.

The constitution of a tree is sometimes naturally barren; or the soil that the roots have got into may be so deleterious that no pains or perseverance will avail any thing; but continuing fruitless and sickly, admonishes the owner to take it up and try another plant, rectifying the soil thoroughly if the evil is thought to arise there. The smotherfly sometimes repeatedly attacks the same tree, which is a sign of inherent weakness, for the juices of a sickly tree are sweeter than those of a sound one, and so more liable to such attacks. Sometimes a tree of this kind, when removed to a good soil, and pruned greatly down, does very well. A soil too rich of dung often occasions trees to be blighted, and the remedy is to impoverish it with a sharp sand.

In order to health and strength, a tree must not be kept too full during summer, as it prevents the proper ripening of the wood, and makes the shoots long-jointed. If more than one shoot proceeds from the same eye, receive only the strongest and best-situated. A crowded tree cannot be healthy, and it becomes both lodging and food for insects. The blossom-buds of a tree being always formed the year before, they will be few and weak in a thicket of leaves, as debauched of the necessary sun and air; but in order to avoid an overfulness, do not make any great amputations in summer.

In clearing a tree of superabundant wood, take care not to cut off the young shoots of a branch. All shoots after midsummer should be displaced as they arise, except where wanted to fill up a vacancy. In a too vigorous tree, the midsummer shoots may be left on a while on those branches that are to be cleared out at winter pruning, as cutting such trees in summer is to be avoided as much as possible; so that a little rudeness in a luxuri-ant tree may be permitted as a necessary evil, provided it becomes not too shady or gauntly. Watering wall-trees with an emulsion smartly on a summer's evening is conducive to their health, and trees them from insects.

3. The fruitfulness of wall-trees (the ultimate object of planting and pruning them) is determined by their proper form and health being good, the foundation is laid, but several things are yet to be done to obtain the end proposed; and this chiefly regards the principal cutting, or what is called winter or spring pruning.

If trees have been planted far enough asunder, it is a happy circumstance, as the proper horizontal form, and the open middle, may be preserved. The longer the horizontals are, the more necessary it is to be carefully cut none but weak branches in the centre uprightly.

If trees are confined as to length of wall, they of course take a more erect form, but still strong wood should not mount just in the middle.

A tree is to be thinned of damaged, unpro-"宵"ed, and ill-placed shoots, and of woody branches that are decaying or reach far without fruitini shoots on them, and always some of the old wood should be cut out there is young to follow or supply its place. The super- abundance is to be taken away, so as generally to leave the good ones at four, five, or six inches asunder, according to the size of the wood and fruit.

Luxuriant wood is, if those shoots that are not of a rising sort, but have been taken out from the rest, as they would impoverish the good, and destroy the fruit, and are never fruitful; but if a tree is generally luxuriant it must be borne with; and the less it is cut, comparatively speaking, the better. Such a tree after a few years, may come to bear well; and when it begins to shoot moderately, some of the largest wood may be taken out each year, or shortened down to two or three eyes, and so brought into order. The more horizontally free-shooting trees are trained, the better, as the bending of the shoots checks the sap.

As the pruner is to begin below, and towards the stem, so the object in thinning must be to leave or to lower those shoots that are place lowest on the branches, so that the tree may be furnished towards the centre. See that those left are sound, and not too weak or over-strong, for the moderate shoots generally bear best. Weak shoots are always more fruitful than strong ones; and if they are furnished with fair blossoms, should be kept where a tree is full of wood, and even preferred to moderate ones on a very flourishing tree.

The next object is, to furnish a tree. In order to this, the thinning of old wood, young being ready (or easily to be procured) to follow, has already been mentioned; but the principal step is the shortening of the shoots, which occasions them to throw out below the cut, for future use. If they were not to be shortened, the tree would presently extend a great way, bearing chiefly at the extremities; and all over the middle it would be very thin of fruit, and thus a great part of the wall lost.

The mode of bearing in peaches, nectarines, and apricots, is of the last year's wood, which makes it necessary to shorten, in order to a certain supply of shoots for bearing
the next year, and thus to have succession-wood in every part of the tree.

The rule for shortening is this: Consider the strength of the tree; and the more vigorous the shoots are, cut off the less. If luxuriant shoots have leaves much shortened, it would throw out nothing but wood; and if a weak tree was not pretty much cut, it would not have strength to bear. From vigorous shoots one-fourth may be cut off; from middling ones one-third; and from weak ones one-half.

In shortening, make the cut at a leading shoot-bud, which is known by having a blossom-bud on the side of it, or, which is better, one on each side. Blossom-buds are rounder and fuller than leaf-buds, and are discernible even at the fall of the leaf, and plainly seen early in the spring. It is desirable to make the cut in twin blossoms, yet as this cannot always be done, the rule of proportion of length must generally determine. It often happens that the shoots and buds are chiefly, and sometimes all, at the end of the shoot; but still it should be shortened if it is at all long. Never cut where there is only a blossom-bud; and prefer those shoots that are shortening into twin blossom-buds under the branch in the middle. The shoots that lie well and are fruitful or healthy, and but a few inches long, may be left whole. Always contrive to have a good leader at the end of every principal branch.

Young trees (as of the first year of branching) should have the lowest shoots left longer in proportion, and the upper shorter, in order to form the tree better to the filling of the very young shoots may have three or four eyes more than the upper.

In furnishing a tree, consider where it wants wood, and cut the nearest unbearing branch (if necessary, a bearing one) down to one, two, or three eyes, according to the number of shoots desired, for in each close shortening, a shoot will come from each eye. With a view to wood for filling up a nailed place, a shoot formed after midsummer may be thus shortened; though the general rule is, to cut the short shoots as useless, the dependance for blossoms being on the early-formed shoots.

The time for the principal, or winter pruning, is by some gardeners held indifferent, if the weather is mild at the time; but a moderate winter's day is often quickly followed by a severe frost, which may hurt the eye and blossom next the cut. The best time is February, if it is mild, or as soon after as possible; for when the blossom-buds get swelled, they are apt to be knocked off by a little touch or jar of the hammer.

Apricots should not be so much shortened as peaches, nor do they so well endure the knife. Shoots of the apricot, if under a foot, may be left entire, if there is room. The spurs of apricots should be pared, if not too long, or numerous, for they bear well, and continue for years. Some sorts of peaches are also apt to put out fruit-sprouts, and must be cut down accordingly. When they will grow and bear leaves any where, they will not fruit well in England without a favourable season, or hot summer.

Young new-planted vines should be pruned quite short for two or three years, that they may get strong. If the plant has a weak root, not above one shoot ought to grow the first year; and the rest cut down in autumn, or to two or three eyes.

The best time for the principal, or winter pruning of vines, is as soon as the fruit is off, or the leaves falling. November does very well, and if this season passes, February should be adopted rather than quite in the winter. Late in the spring they are apt to bloom by cutting, which greatly weakens them.

The mode of bearing in vines is only on shoots of the present year, proceeding from year-old wood. The rule, therefore, at winter pruning, is to reserve those shoots of the year that are best situated as to room, for training of those shoots that are to come from them, to be almost one from every eye. Make choice of those that are placed most towards the middle, or stem, of the vine, that all the wall may be covered with bearing wood; and every year cut some of the old shoots far, to make room for younger to follow.

The shortening of the shoots should be according to their strength, and the space there is for training those shoots that will be produced, which always grow very long. If there is room, three, four, or five eyes may be left; but not more to any shoot, except it is desirable to extend some shoot to a distance to fill up a particular space; and then eight or nine eyes may be left, which being repeated again another year, and so on, a vine will soon reach far.

Sometimes vines are trained on low walls by a long-extended horizontal branch, a few inches from the ground, as a mother-bearer. Those shoots that come from this horizontal are to be trained perpendicularly, and cut down to one or two eyes each year, so that they may not encroach too fast on the space above them. If the vine is confined to a narrow but lofty space, it is to be trained to an extended perpendicularly mother-bearer, having short shoots pruned down to a single eye, or at most two. The management of vines requires severe cutting, that they may not be too full in the summer, for they put out a great deal of wood, and extend their shoots to a great length; and therefore the young pruner must resolve to cut out enough.

An alternate mode of pruning vines is practised by one, one shoot short, and another long, i.e., one with two eyes, and another with four or five. Severe cutting does not hurt vines, and make them unfruitful, as it does other trees; and therefore, where short shoots, they must be pruned down to a single bud, as the case requires.

The summer management of vines must be carefully attended to. As soon as the young shoots can be nailed to the wall, let them not be neglected; but remember they are very tender, and will not bear much bending; train in young shoots, rubbing or breaking off the others. The early fruit is soon seen in the bosom of the shoot; and those thus furnished are of course to be laid in, as many as can be found room for, in preference to those shoots that are barren; which nevertheless should also be trained, if they are strong and well placed, and there is space for them. The shoots from old wood, except any tolerable shoots that proceed from a part where wood is wanting to fill up some vacant space. If two shoots prove from one eye, dispose the weakest, or the outermost if they be alike, and the fruit should not dictated otherwise. Vines grow rapidly; and must be nailed to the wall, from time to time, as they proceed, that there may be no rude prunings, which would not only have a slovenly appearance, but in several respects be injurious.

The stopping of the shoots is to take place, both as to time and measure, according to the strength and situation of them, or whether fruitful or barren. Those weak shoots that have fruit, and are rather ill placed, or confined for room, may be stopped at the second, or even first, joint above the fruit; and those shoots that are strong and have room to grow, should not be stopped till they are in flower (in July), and at the third or fourth joint above the fruit. In shortening the shoots of the vine, do it about half an inch above an eye, and the side-shoots as close and sound one. The barren shoots are to be cut off in full length, and not stopped at all if there is room for them, or, at least, but a little shortened towards autumn, as in August, because they would put on much useless and strong side-shoots if cut before.

The side-shoots, i.e., those little ones put out by the eyes that are formed for next year, are commonly directed to be immediately displaced by raising off, as soon as they appear; and if the vine is large, and the shoots slender, it is very proper; but if otherwise, their being left to grow awhile (so as not to get too rude and crowding) is rather an advantage, in detaching the sap from pushing the shoots out immediately long; and when these are taken off, the lower eyes may each may be left with the same vine. But the side shoots that proceed from the top of each branch, should be left on, and when it gets long, then shortened down to an eye or two.

In order to fruitfulness, vines will need dressing with some sort of manure; for though the vines grow in vineyard countries on rocky hills, and in very ale, they have done so on some chalky, hot, gravelly hills in England, yet some warm manure they must generally have applied, or they will produce little good fruit.

Some people are very fond of exposing the fruit of the vine to the full sun, by stripping off their leaves; but this should not be practised till the bunches have attained their proper size, removing only to be ripened, and even then but little should be done in this way. The loss of leaves is an injury to every plant, as it prevents the elaborating of the saccharine juices necessary to perfect the fruit.

Fig-trees are best pruned early in spring, after an autumn cut (if late) they are apt to die down. The proper bearing in the fig is, that fruit chiefly comes the present year on the little shoots from wood of the previous year, and that towards the ends of the branches which these circumstances dictate the rules for pruning. Two-years-old wood will bear some, but older wood never.
PRUNING.

The shoots, during summer, are to be laid in at full length, plentifully, as room will permit. The weak, ill-placed, or superabundant ones, cut clean out; yet rather break, or rub them off; in an early state of growth, for sprouting branches all in summer is apt to make them bleed as it is called, i.e. the sap run; when cut in autumn, the fig will sometimes bleed for a day, but if late-cut in spring, the oozing will continue perhaps a week. At the principal pruning, the strongest and the closest-jointed shoots are to be preferred, and let about seven or eight inches unerased, without shortening. Let the spare shoots be cut out close and smooth, and as much of the old wood as may be; for the tree will increase too fast, and get too much bearing wood in the middle, if this is not freely done; and the essential point in the management of the fig-tree is (as indeed of all wall-trees) to have young wood all over it, and not to bear too much in the middle, and towards the bottom. Wood is seldom wanted in a fig-tree; but where it is, the shortening of a shoot, properly situated (by taking off the leading bud, or cutting lower, as the case requires), is necessary to produce it. Do this in the first instance.

When hard frosts are expected, saw some shoots and some litter over the roots of fig-trees. Mats should be nailed over their branches (first pulling off the figs), as the sudden nature of their wood makes them tender, these coverings are to remain till the frosts are judged to be over, and then let them be covered up at night, and not by day, for a week or two, to harden them by degrees.

But fig-trees will mostly survive hard winters when in standards, without covering; and though shoots trained to a wall are tenderer, yet l'pea-haulm hang close among the branches (at the approach of sharp frosts) will preserve them. This sort of protection, as affording plenty of air, is by many good gardeners preferred to the more common practice of matting. But if mats were contrived to roll up and down, or kept a little distance from the tree, so as to give more air, a less injury will result; the usefulness of the tree will be better ensured, for too close (and, as it commonly happens in consequence, too long) covering is injurious to both. Fig-trees that have been close covered or l'pea-haulms hurt by cold, and yet the spring air, as soon as possible, is desirable.

Pears being planted against a wall in autumn, should not be cut down till spring, when the heads is to be reduced according to the goodness of the root, and so as to lay a proper foundation for covering the wall.

The mode of bearing in pear-trees is on short spurs, which appear first towards the ends, and then form themselves all along the branches, which do not produce blossoms for three or four years from planting, and sometimes (according to the sort, or perhaps soil) for several years more. When they are come to fruiting, some pears bear pretty much as they are, others hardened, some on two, others on three. The same branches continue to bear on spurs from year to year, and most when five or six years old; but as in course of time the branches may become diseased and broken, and not produce so fine fruit as younger wood, it is always proper to procure a succession of young bearers, as the opportunity of good shoots offer, cutting out old wood.

The time for general or winter pruning of pear-trees ought to be November, as the blossoms are then very discernible, and at spring pruning they get so turgid and tender, that almost the least touch knocks them off, or even the jarring of the tree, and sproutson planted against walls, and what has been said of pruning and managing pears is applicable to them; the branches, however, may be laid in somewhat closer, as they will not require so much room; yet they must have to leave from twenty-five to fifty feet in length of a low wall, or on a high one something less.

Mulberries require good room, as their mode of bearing is mostly at the end of the trained shoots, which are therefore not to be shortened. Twenty or twenty-five feet should be allowed them, and a new-planting tree is to be headed down as directed for pears, &c. A succession of new wood must be obtained every year, and of course some old taken out, for the fruit is produced chiefly on year and two-year old wood; and as it comes on spurs, and also small shoots of the same year, the leaving short stems (of moderate wood) in pruning, seems justified, though by some condemned.

Cherry-trees, if against a wall, should be trained at length, four or five inches atunder. The fruit comes from spurs all along the shoots, on one and two years old wood, which will continue to bear. In pruning, have an eye, however, to some fair shoots for successors to those that are getting diseased, or worn out. Some cut all superfluous shoots clean away, and others leave a sprinkling of short stubs, which may be allowed; but let them not advance far forward.

Plums of the finer sorts are often planted against walls, and deserve a good one. For the pruning of plum-trees, the directions given for cherries apply to them, only that the branches should be laid somewhat wider, i.e., at five or six inches, according to the sort, as free or less free in their growth.

Currants and gooseberries bear fruit upon young wood, and on little spurs of the old, and young shrubs should be pruned down to little stubs or spurs, about half an inch long, which will throw out fruit-shoots and spurs. The mother-branches of currants and gooseberries will last many years; but when young wood can be brought in for principals, a removal every three or four years is necessary to produce fine fruit.

The work of pruning espalier-trees is much the same as for wall-trees.

As trees planted for espalier training should be young, let great care be taken to set them off right at first, by regular shoots, full furnished immediately from the stem, which is effected by proper heading down. Apples, pears, plums, cherries, &c. in general, need not be so much freed of all branches at planting, as peaches, nectarines, and apricots. There are, however, gardeners who prune down to the stem all sorts of wall and espalier trees, as peaches are.

The principle of pruning standard trees is the same, whether it be for the fruit or for the shoot, the object is, to form a compact handsome round and open head, rather small than large, equal on all sides, with tolerably erect wood, capable (as far as the pruner can go) of supporting the fruit without bending. Perfect symmetry indeed is not necessary: but confusion of branches, weak and crossing, crowded and dangling, is to be prevented by pruning; for a proper use of the knife is capable of doing much towards beauty and utility, as is the case with standard trees. A little pruning of standards every year, and a general one every three or four years, to cut out what is decayed, and some of the old wood where a succession of young may be obtained to succeed, is the way to keep them in vigour, and have the best fruit; for that which grows on old wood gets small and austere. To take off large branches, a thin broad chisel is proper; but if a saw is used, smooth the part with a knife.

Clear trees from moss, by scraping them with a long narrow-bladed blunt knife, on a bit of hard wood; and cut or rub off bits of decayed bark, in which insects are apt to breed, and which the pruning fruit will scorch and bruise, to the long end-hairs of which are well adapted to clean the forky parts. A bit of hair cloth is also used for the purpose; and a finish is properly made to do the business well, with a brush and soap and water.

Of pruning shrubs. Of pruning shrubs cultivated for their ornament, and some for their fruit; of the latter kind are raspberries and barberries.

Raspberries bear fruit on little side shoots of the present year, proceeding from stems of the last, and sometimes produce a little on those of the same year. To prune or dress the shrub, therefore, first cut out all the old bearers, whose wood dies; then cut out, close to the stool, all the new shoots, except three or four of the strongest, which may be carefully twisted from the bottom upwards, or tied together at the top, or if upright and strong, left to support themselves singly.

The barberry is a beautiful and somewhat large shrub, which should be suffered to grow with a full head, like a dwarf standard tree. It bears along the sides, on the stake, and old wood, but chiefly towards the ends, and its branches should therefore not be shortened, except with a view to throw out wood. Keep the fruit free from suckers, and the stem from the fruits in its lower parts, and prune out weak, luxuriant, straggling, and crossing branches, forming it to a somewhat round head, which keep moderately open. Let the stem be freed from lower branches to the height of three, four, or five feet, according as the shrub may be desired to approach to a tree.

Flowering shrubs are of great variety, and the method of pruning them is to be determined according to the several modes of bearing, of which consider chiefly these; that is, whether they produce their flowers upon the last year's shoots or the present, on the ends or the sides of their branches. If a shrub bears on the last year's shoots, it is evident that it must be cut away no more than is necessary to keep it within bounds, open and handsome as to its form; in this case it is the business to cut clean out, or very low, what is to be spared. If a shrub bears on the present year's shoots, the old wood is cut down freely, so however as to leave eyes enough for new shoots to proceed from, to
make a sufficient head and show. If the shrub hangs all together or chiefly at its ends, no in-teresting mistake is made; but if some of the flowers are long, this may be either cut out, or quite low, leaving the shorter ones to bear. If the shrub hangs along its sides, the shortening is of no conse-quence, and the desired form may be freely pro-voked for at pleasure.

The season for pruning shrubs is generally the spring; but autumn is better, if not too near winter, as at this time some of the leaf buds might occasion some of the sorts (as jasmines and honeysuckles) to die down. The time of flowering must in some measure direct the time of pruning. Shrubs that flower in winter (as the laurels) should be cut in spring. Those that flower in spring may be pruned immediately after their blow, or in summer. Those that flower in summer should be pruned in autumn, and those that flower in autumn should be pruned either soon after flowering, or in spring.

Be sure to take off in time, i.e., as soon as discovered, all suckers and over-strong shoots from shrubs; for by their luxuriance they greatly overgrow the finer-stemmed branches, which are the fruitful ones of such large sappy wood looks very unsightly.

The height of shrubs in certain situations is material, and to provide for this, the art of pruning is in a great measure competent. To keep them low, cutting down is of course necessary; but it will be well also to make the soil poor if too rich. To encourage them to mount, keep trimming off close the lower branches, and improve the ground by digging and dressing occasionally.

So bear upon shoots of the present year, and upon those formed after midsummer in the past year, but chiefly upon the former. Therefore they may, or rather should, be cut down low, leaving only three or four eyes to a shoot; except some of those short shoots formed the last year too late to blow then, leave whole. If rose-trees are not close pruned, they will be unable to support their flowers properly. Use a sharp knife, and take care of the eye or bud. Roses for forcing should be pruned in July and August.

Honeysuckles flower on shoots of the pre- sent year, and therefore whether trained to walls, or kept in bushes, should be also pruned close; but not so short in the latter case, for those against walls should be cut down to an eye or two, and those in bushes to three or four eyes.

Sweetbriers flower on shoots of the present year, and therefore should be cut after the manner of honeysuckles. These shrubs (and most others) are seldom pruned down enough; so that in a few years they get very rambling and unsightly; but if kept compact, we have beauty as well as sweetness, to compensate our care. In all cases, a less number of fine flowers obtained by short and open pruning, is certainly preferable to many indistinct ones.

Lilacs bear their flowers at the ends of shoots of the last year, so of course at spring. If the shrub is long and crowded, cut either clean out, or very low, what may be superfluous. If they need much reduction, let them be cut down as soon as (or somewhat before) they have got off flower.

To enter further into the detail of shrubs would be inconsistent with our limits. The reader will find some directions occasionally under the names, and commonly act safely under the general directions above.

PRUNUS, a genus of the monogynia or, in the icosaedra class of plants; and in the natural method ranking under the 36th order, plumbago inferior; there are five petals; the fruit is a plum, having a kernel with prominent su-tures. There are thirty-three species, of which six are cultivated in Britain: they are originally natives of America and Siberia.

1. The domestica, or common plum-tree, grows 20 or 30 feet high, with oval spear-shaped leaves, and with the pedunculi for the most part single, terminated by flowers, succeeded by plums of many different colours, 2 to 5 inches, and species. 2. Th. sittia, wild-plum, or bussule-tree grows 12 or 15 feet high; the branches somewhat flattened, the leaves oval, hairy underneath; and the pedunculi by pairs, terminated by white flowers small, round, plain, like fruit, of different colours in the varieties.

3. The spinosa, black-thorn, or sloe-tree, grows 10 or 12 feet high, very branchy and bushy quite from the bottom, armed with strong, sharp spines, small, spear-shaped, smooth leaves, pedunculi growing singly, ter-minated by flowers, succeeded by small, round, black cherries in autumn. It grows wild every where in hedges and woods; and is very proper for planting field-hedges, peeling of very quick and close growth.

4. The cerasus, or common cherry-tree, grows 20 feet or more in height, with oval clusters of lanceolate smooth leaves, umbellate flowers, succeeded by clusters of red roundish fruit, of different sizes and properties in the varieties.

Hambury says, "were these tree scarce, and with much difficulty propagated, every man, though possessed of a single tree only, would look upon it as a treasure; for besides the charming appearance these trees have when blossomed, as it were, all over with bloom in the spring, can any tree in the vegetable tribe be conceived more beautiful, striking, and agreeable, than the cherry and healthy cherry-tree, at that period when the fruit is ripe?"

The cherry-trees afford an almost endless variety; all differing in some respect in their manner of shooting, leaves, flowers, and fruit: two in particular demand admission into the pleasure-garden, the double-blossomed and the red-flowering. The peaching show that the common cherry-tree makes when in bloom is known to all; but that of the double-blos-somed is much more enchanting. It blossoms like the other, but the flowers are produced in large and noble clusters; for each separate flower is as double as a rose, is very large, and placed on long and slender footstalks, so as to occasion the branches to have an air of ease and freedom. They are of a pure white; and the trees will be so profusely covered with them, as to charm the imagination. Standards of these trees, when viewed at a distance, have been compared to balls of snow, and these appraoch to the greater pleasure we receive. These trees may be kept as dwarfs, or trained up to stan-

...
PRUSSIATS.


The white prussiat discovered by Mr. Prost is composed of prussic acid and peroxide of iron. The solution, when exposed to the atmosphere, becomes gradually blue, and is converted into basic prussiate of iron.

The white prussiat is composed of prussic acid and peroxide of iron. It is a deep-blue powder, insoluble in water, and scarcely soluble in acids. It is composed, according to the most accurate experiments hitherto made, of equal parts of oxide of iron and prussic acid, and is affected by the exposure of the air. It decomposes by being destroyed, and the oxide of iron remains behind. The prussian blue of commerce, besides other impurities, contains mixed with it a great quantity of alumina.

Yellow prussiat is composed of prussic acid combined with an excess of peroxide of iron; it is therefore a mixture of prussic acid and prussiate of peroxide of iron. It is, therefore, a mixture of yellow prussiate of iron. The yellow prussiat is soluble in acids. It may be obtained by dissolving the alkalies or alkaline earths with prussic acid. Part of the salt is carried off by these bodies, and the yellowish prussiate remains in the state of a powder.

Green prussiat, first discovered by Mr. Berthollet, is composed of oxyprussic acid, and peroxide of iron. It is therefore in fact an oxyprussiat.

The yellow prussiat or barytes of iron. For the first accurate description of this salt, we are indebted to the ingenious Mr. William Henry. It may be formed by adding prussic acid to hot barytes water till it ceases to be discoloured, when filtered and gently evaporated, yields crystals of prussiate of barytes and iron.

These crystals have the figure of rhombohedral prisms; they have a yellow colour, like that of iron, but having a peculiar luster, and a mixture of transparent, and have a specific gravity of 4.612. When dissolved in water, it is divided into two parts; one is soluble in acids, and the other, which is the less soluble, is converted into basic prussiate of barytes and iron.

If the prussian test contains a superabundance of alkali, two inferences follow. This superabundant quantity will precipitate those earthy salts which are liable to contain an excess of aci, and which serve to convert the excess of alkali into basic salt; hence alunina and barytes will be precipitated. It is to the use of impure tests of this kind that we owe the opinion, that barytes and alumina are precipitated by the prussian test. A supposition which is in some measure founded on the metallic nature of these earths. This mistake was first corrected by Meyer of Steinit.

Another inconvenience arising from the superabundance of alkali in the prussian test is, that it gradually decomposes the yellow prussiat which the test contains, and converts it into yellow prussiat. In what manner it does this will be understood, after what has been said, without any explanation.

On the other hand, when the Prussian alkali contains a quantity of yellow prussiate of iron, as great inconveniences follow. This yellow prussiat has an affinity for prussic acid, which, though inferior to that of the potash, is still considerable; and on the other hand, the potass has a stronger affinity for every other acid than for the prussic. Therefore, the test is exposed to the air, the carbonic acid which the atmosphere always contains, is dissolved by the air, and causes the yellow prussiat and the prussic acid to decompose the prussiat of potass in the test, and the yellow prussiat is precipitated in the form of prussian blue; and every other acid produces the same effect. A test of this kind would indicate the presence of iron in every mixture which contains an acid (for a precipitation of prussian blue would appear), and could not therefore be employed with any confidence.

To describe the various methods proposed by chemists for preparing this salt would be unnecessary, as the greater number do not answer the purpose intended. The method practised by Philpott, first described to chemists by Westrum, and afterwards described in our language by Kirwan, is considered as one of the best. It is as follows:

Prepare pure potass, by gradually projecting into a large crucible, heated to whiteness, a mixture of equal parts of common salt and crystals of tartar; when the whole is injected, let it be kept at a white heat for half an hour, to burn off the coal. Detach the alkali thus obtained, reduce it to powder, and mix it with a mixture for precipitating potassium carbonate, and subject it to a white heat for half an hour. Dissolve it in twice its weight of water, and filtrate the solution while warm. Pour this solution into a glass receiver, placed in a sand-lurnace heated to 170° or 180°, and then gradually add the best prussian blue in powder, injecting new portions according as the former come to a grey, and supplying water as fast as it evaporates; continue with the alkali, until the whole is converted into prussian blue.
in four times their weight of cold water, to exclude the amount of optical air contained. Also, away a few drops of this solution with barytes water, to see whether it contains any sulphuric acid, and add some barytes water to the remainder if necessary: filter off the solution from the sulphate of barytes, which will have precipitated, and set it by to crystallize for a few days; that the barytes, if any should remain, may be precipitated. If the crystals now obtained are of a pale yellow color, they dissolve in boiling water; but if they still discover bluish or green streaks, the solutions and crystallizations must be repeated.

One cautiu is kept in a well-stopped bottle, which, to preserve them from the air, should be filled with alcohol, as they are insoluble in it.

Before they are used, the quantity of iron the solution contained should be ascertained, by heating 100 grains to redness for half an hour in an open crucible: the prussic acid will be consumed, and the iron will remain in the state of a reddish-brown magnetic oxide, which should be weighed and noted. The weight of this oxide is half the weight of the Prussian blue afforded by the Prussian alkali: its weight must therefore be subtracted from that of metallic precipitate obtained with this test. Hence the weight of the crystals, in a given quantity of the solution, should be noted, that the quantity employed in precipitation may be known.

Care must be taken to calculate the crystallization of the oxide of iron becomes brown, for while it is black, it weighs considerably more than it should.

Another good method of preparing this salt has been lately given by Mr. Henry; but it is rather too expensive for general use. It consists in first forming a triple prussiate of barytes, and adding it in crystals to a solution of carbonat of potass till the solution no longer restores the colour of reddened litmus paper. After digesting the mixture for half an hour, filter the liquid, and evaporate it gently. The triple prussiate of potass crystallizes.

PRUSSIC ACID, is one of the most important instruments which the chemist possesses. It was discovered about a century ago by Diesbach at Berlin; and a method of preparing it was published by Woodward in the Philosophical Transactions for 1724, which he said he had got from one of his friends in Germany. This method was as follows: Detonate together four ounces of nitre and as much tartar, in order to procure an extern-parameon alkali; then add four ounces of dried bulluck's blood; mix the ingredients well together, and put them into a crucible covered with a lid, in which there is a small hole; calcine with a moderate fire till the blood no more contains the power of blackening any white body exposed to it: increase the fire towards the end, so that the whole matter contained in the crucible shall be moderately but sensibly red. In this state throw it into two plats of water, and boil it for half an hour. Decant off this water, and continue to pour on more till it comes off in spirits. Add all these liquids together, and boil them down to a more concentrated mass. Add two ounces of sulphat of iron and eight ounces of alum in two pints of boiling water; mix this with the former liquor while both are hot. An effervescence takes place, and apowder is precipitated, of a green color, covered with blue. Separate this precipitate by filtration, and pour muriatic acid upon it till it becomes of a beautiful blue; then wash it with water and dry it.

Different explanations were given of the nature of this precipitate by different chemists. All of them acknowledged that it contained iron; but to account for the colour was the difficult point. Brown, and Geffroy, and the green color is owing to the fact that a great many other animal substances besides blood communicated to alkalis the property of forming Prussian blue; but the theories by which they attempted to account for it, were altogether insufficient. At last a very important step was made in the investigation of this compound by Macquar, who published a dissertation on it in the year 1732.

This celebrated chemist ascertained the following facts: 1. When an alkali is added to a solution of iron in any acid, the iron is precipitated in a yellow colour, and soluble in acids; but if mixed from an alkali prepared by calculation with blood (which has been called a Prussian alkali), it is of a green colour. 2. Acids dissolve only a part of this precipitate, and leave behind an insoluble matter, which with water forms intense blue colour. The green precipitate, therefore, is composed of two different substances, one of which is Prussian blue. 3. The other is the brown or yellow oxide of iron; and the green color is owing to the mixture of the blue and yellow substances. 4. When heat is applied to this Prussian blue, its blue color is destroyed, and it becomes exactly as common to common oxide of iron. It is composed of iron and compound of iron and other substance, which has the property of driving off. 5. If it is boiled with a pure alkali, it loses its blue color also, and at the same time the alkali acquires the property of precipitating a blue colour solutions of iron in acids, or it has become precisely the same with the Prussian alkali. 6. Prussian blue, therefore, is composed of iron and something which can be seen from it, something which has a greater affinity for alkali than for iron. 7. By boiling a quantity of alkali with Prussian blue, it may be completely saturated with this something, which may be called colouring matter. 8. No acid can separate this colouring matter from iron after it is once united with it. 9. When iron dissolved in an acid is mixed with an alkali saturated with the colouring matter, a double decomposition takes place, the acid unites with the alkali, and the colouring matter with the iron, and forms: Prussian blue. 10. The reason that, in the common method of preparing Prussian blue, a quantity of alkali necessary to precipitate the iron, there is not a sufficient quantity of colouring matter (for the alkali is never saturated with it) to saturate all the iron displaced by the alkali, which is contained in the solution with Prussian blue. Muriatic acid dissolves this oxide, carries it off, and leaves the blue in a state of purity.

Such were the conclusions which Macquer drew from his experiments, experiments which not only discovered the composition of Prussian blue, but threw a ray of light on the nature of affinities, which has contributed much towards the advancement of that important branch of chemistry.

The nature of the colouring matter, however, was at first unknown. At length, in 1772, Morevau announced his suspicion that the colouring matter was probably an acid.

Such was the knowledge of chemists respecting the nature of this colouring matter, wherever all at the time, and explained its properties and composition. He observed that the Prussian alkali, after being exposed for some time to the air, lost the property of forming Prussian blue; the colouring matter must therefore have left it. He put a small quantity of it into a large glass globe, corked it up, and kept it some time; but no change was produced either in the air or the Prussian alkali. Something must therefore displace the colouring matter when the alkali is exposed to the open air, which is not present in a glass vessel. Was it carbuncle acid gas? To ascertain this, he put a quantity of Prussian alkali into a glass globe filled with that gas, and in 24 hours the alkali was incapable of producing Prussian blue, it is therefore carbuncle acid gas which displace the colouring matter. He repeated this experiment with success, that he hung in the globe a bit of paper which had been previously dipped into a solution of sulphat of iron, and on which he had let fall two drops of an alkaline fixivium in order to precipitate the iron. This paper was taken out in two hours, and became covered with a fine blue on adding a little muriatic acid. Carbuncle acid, then, has the property of separating the colouring matter from alkali without decomposing it.

He found also that other acids produce the same effect. Hence he concluded, that the colouring matter might be obtained in a separate state. Accordingly he made a great many attempts to procure it in that state, and at last discovered the following method, which succeeds perfectly:

Mix together ten parts of Prussian blue in powder, five parts of the red oxide of mercury, and thirty parts of water, and boil the whole in a glass vessel. The blue colour disappears, and the mixture becomes yellowish-green. Pour it upon a filter; and after all the liquid part has passed, pour ten parts of hot water through the filter to wash the residuum completely. The oxide of mercury decomposes Prussian blue, separates its colouring matter, and forms with it a salt soluble in water. The liquid, therefore, which has passed through the filter contains the colouring matter combined with mercury. The other component parts of the Prussian blue, being insoluble, do not pass through the filter. Pour this mercurial liquid upon 24 parts of clean iron filings, quite free from rust. Add at the same time one part of concentrated sulphuric acid, and shake the mixture. The iron filings are dissolved, and the mercury formerly held in solution is precipitated in metallic state. The cause of this sudden change is obvious: the iron deoxidizes the mercury, and is at the same instant dissolved by the sulphuric acid, which has a stronger affinity for it than the colouring matter. This paper was taken therefore, only sulphat of iron and the colouring matter.

Now the colouring matter being volatile, 3
PRUSSIC ACID.

which the sulphat of iron is not, it was easy to obtain it apart by distillation. Accordingly he distilled the mixture in a gentle heat; the colouring matter came over by the time that one-fourth of the liquor had passed into the receiver. It was mixed, however, with a small quantity of sulphuric acid; from which he separated it by distilling a second time, and the quantity of carbonat of lime. The sulphuric acid combines with the lime, and remains behind, which the colouring matter cannot do, because carboxic acid has a stronger affinity for lime than it has.

Thus he obtained the colouring matter in a state of purity. It remained now to discover its component parts. He formed a very pure Prussian blue, which he distilled, and increased the fire till the vessel became red; and a small quantity of water which he had put into the receiver contained a portion of the blue colouring matter and of ammonia; and the air of the receiver consisted of azote, carboxic acid gas, and the earthy part of the matter. He formed from this and other experiments, that the colouring matter is a compound of ammonia and oil. But when he attempted to verify this theory by combining together ammonia and oil, he could not succeed in forming colouring matter. This obliged him to change his opinion; and at last he concluded that the colouring matter is a compound of ammonia and oil. He mixed together equal quantities of powdered charcoal and potass, put the mixture into a crucible, and kept it red-hot for a quarter of an hour: he then added a quantity of sal ammoniac in small pieces, which he pushed to the bottom of the melted mixture, kept it in the fire for two minutes till it had ceased to give out vapours of ammonia, and then threw it into a quantity of water. The solution possessed all the properties of oil. The work. Thus Mr. Scheele succeeded in forming the colouring matter.

This colouring matter was called prussic acid by Morveau, in the first volume of the chemical part of the Encyclopedie; an appellation which is now generally received.

These admirable experiments of Scheele were repeated and carried still further, by Berthollet in 1787, who applied well to the explanation of the composition of the colouring matter the light which had resulted from his previous experiments on the component parts of ammonia. This illusorius chemist, scarcely inferior to Scheele in ingenuity and address, ascertained, in the first place, that the prussalic acid is a triple salt, composed of prussic acid, the alkali, and oxide of iron; that it may be obtained in octahedral crystals; and that when mixed with sulphuric acid, and exposed to the light, it lets fall a precipitate of Prussian blue. His next object was, to ascertain the component parts of prussic acid. To this purpose he poured into prussic acid obtained by Scheele's process; it loses its oxygen, and is converted into common muriatic acid. At the same time the prussalic acid becomes more odorous and more volatile, less capable of combining with alkalies, and precipitates iron from its solutions, not blue, but green. Thus prussic acid, by combining with oxygen, acquires new properties, and is converted into a new substance, which may be called oxypuritic acid. If more oxypruritic acid gas is made to pass into prussic acid, and it is exposed to the light, the prussic acid separates from the water with which it was combined, and precipitates to the bottom in the form of an athermic oil of a black color; it contains into a vapour insoluble in water, and incapable of combining with oil. When the green precipitate, composed of oxypuritic acid and iron, is mixed with a pure fixed alkali, the oxypuritic acid is converted, and converted into carbonat of ammonia.

From these experiments, Berthollet concluded, that prussic acid does not contain ammonia ready-formed, but that it is a triple compound of carbon, hydrogen, and azote, in proportions which he was not able to ascertained. This conclusion has been still further verified by Mr. Cloutier, who found that when ammoniacal gas is made to pass through a red-hot porcelain tube containing charcoal, a quantity of prussic acid is formed. This experiment does not succeed unless a pretty strong heat is applied to the tube.

Fourcroy and several other chemists believe, that the prussic acid contains also a portion of oxygen in its composition, resting chiefly upon the following experiments of Vauquelin.

Exper. I. Put into a retort 100 parts of the muriat of ammonia, 50 parts of lime, and 25 parts of charcoal in fine powder; adapt to the retort a receiver containing a slight solution of the sulphat of iron, and immerse into it the Beck of the retort; then apply a brisk heat, and continue the action of the fire until nothing more is emitted. Stir well the liquors contained in the receivers, and expose them to the air for several days, in order that the combination between the oxide of iron and the prussic acid may proceed, and that the prussat of iron may absorb as much oxygen as is necessary for its passing to the state of blue prussat, and for its being proof against acids: then pour into these liquors equal quantities of sulphuric acid well diluted with water, and you will have Prussian blue, the quantities of which will be as one to six; that is to say, the Prussian blue of the experiment in which Vauquelin employed oxide of lead, was six times more abundant than that of the experiment in which he employed only lime to disengage the ammonia.

Having thus traced the gradual progress of philosophers in ascertaining the nature of the prussic acid, it only remains to give an account of its properties, which were first examined by the indefatigable Scheele.

Prussic acid obtained by Scheele's process is a colourless, liquid like water. It has a strong odour, resembling that of the flowers of the peach, or of bitter almonds. Its taste is sweetish, acid, and hot, and apt to excite cough. It does not alter the colour of vegetable bodies.

It is exceedingly volatile, and evidently capable of assuming the gaseous form; though it has never been obtained apart, nor examined in that state. At a high temperature (when united to a fluid) it is decomposed and converted into ammonia, carbonic acid, and carburet hydrogen.

It unites difficulty with alkalies and earths, and is separated from them much more easily than from metallic oxides. More exposure to the light of the sun, or to a heat of 110°, is sufficient for that purpose; and these changes are decomposed also by all the acids.

It has no action on metals; but it unites with their oxides, and forms with them salts, which are almost all insoluble, if we except prussats of mercury, and manganese. These compounds are not decomposed by acids. Yet the prussic acid is not capable of taking the metallic oxides from the other acids.

Prussic acid has a great tendency to enter into triple compounds, combining at once with alkali, and a metallic oxide, and these compounds are much more permanent and difficult to decompose than its single combinations.

The affinities of this acid, as far as they have been ascertained are as follows:

Barytes, Streonat, Potass, Soda, Lime, Magnesia, Ammonia.

It does not seem capable of combining with alumina.

This acid is of great importance to the chemist, in consequence of the property which it has of forming insoluble compounds with metallic oxides, and also with metallic oxides alone. This puts it in our power to ascertain the presence of a metallic body held in solution. When the prussic acid is dropped in a precipitate appears if a metal is present. The colour of this precipitate indicates the metal, and the quantity of it enables us to ascertain the quantity of metal contained in the solution. It is used especially to indicate the presence of iron, which it does by the blue colour at the solution assumes; and to free solutions from iron, which it does by precipitating the iron in the form of Prussian blue.

It is evident, however, that the pure prussic acid cannot be employed for these purposes, because it is incapable of taking metallic oxides from other acids. It is always employed combined with an alkali or earthy basis. In that state it decomposes all metallic salts by a compound affinity. The base most commonly employed is potass or lime; and indeed it is most usually employed in the state of a triple salt, composed of prussic acid, potass, and oxide of iron, which is preferred because it is not apt to be decomposed by the action of the atmosphere.

Of all the metallic solutions tried by Scheele, pure prussic acid occasioned only a precipitate in these cases.

1. Nitrat of silver precipitated white.
2. Nitrat of mercury . . . . . black.
3. Carbonat of iron . . . . . . green becoming blue.

It has no action on the oxides of

Gold precipitated by the alkaline carbonates, is rendered white by this acid. It disengages carbonic acid from the oxide of silver precipitated by the same alkalies; but the oxide remains white.

Orange, red, oxide of mercury, and forms with it a salt which may be obtained in crystals. Oxide of copper precipitated by carbonates of potash, effervescences in it, and acquires a slight orange-yellow colour.

Oxide of iron precipitated from the sulphate of iron by carbonat of potash, effervescences in it, and becomes blue.

Oxide of cobalt precipitated by the same alkalies, gives in it some marks of effervescence, and becomes yellow-brown.

The compounds which prussic acid makes with zirconia and yttria, seem also to be insoluble; for these earths are precipitated from their solutions by prussat of potash; a circumstance in which they differ from all the other earths and alkalies, and which indicates a coincidence between them and the metallic zircon.

PHYLANUM, in Grecian antiquity, a large building in Athens, where the council of the ptyxenes, or presidents of the senate, assembled, and where those who had rendered any signal service to the commonwealth were maintained at the public expense.

PSIDIUM, the guava, a genus of the monogyne order, in the icacosia class of plants, and in the natural method ranking under the 10th order, besperidia. The calyx is quinquifid, superior; there are five petals; the berry is unicellular and monospermy. There are eight species.

The most remarkable are:

1. The pyriferum, or white guava. 2. The pomiferum, or red guava. Both these are however thought by some to be only varieties of the same plant. The red guava rises to the height of 20 feet, and is covered with a smooth bark; the branches are angular, co- veved with oval leaves, having strong minut rib, and many veins running towards the sides, of a light-green colour, standing oppoee upon very short forktails. From the wings of the leaves the flowers are produced in a very large number, but the leaf is about an inch and a half long. They are composed of five large roundish concave petals, within which are a great number of stamens shorter than the petals, and tipped with pale-yellow tops. After the flower is past, the germen becomes a large oval fruit shaped like a pomegranate.

A decotion of the roots of guava is employed with success in dysenteries: a bath of a decotion of the leaves is said to cure the itch; and other cutaneous eruptions. Guayava, or guava, is distinguished from the colour of the pulp, into the two species above-mentioned, the white and the red; and, from the figure of the fruit, into the round and the oblong, and into the smooth or perfumed guava. The latter has a thicker rind, and a more delicate taste, than the other. The fruit is about the bigness of a large tennis-ball; the rind or skin generally of a russet stained with red. The pulp within the thick rind is of an agreeable flavour, and interspersed with a number of small white seeds. The rind, when stewed, is eaten with milk, and preferred to any other stewed fruit. From the same part is made marmalade; and from the whole fruit is prepared a fine jelly. The fruit is very astrin- gent, and nearly of the same quality with the pomegranate, and should be avoided by all who are subject to speciousness. The seeds are so hard, as not to be affected by the fer- mentation in the stomachs of animals; so that when voided with the excrements, they take root, germinates, and produce thriving trees. Whole monosperm can be prepared, and cured with guavas, which have been propagat- ed in this manner. The buds of guava, boiled with barley and liquorice, produce an excellent pith for diarrhœas, and even for the bloody flux in women.

The wood of the tree, employed as fuel, makes a lively, ardent, and lasting fire.

PSITACUS, or parrot, a genus belonging to the order of pioce. The species is hooked from the base; and the upper mandible is moveable: the nostrils are round, placed in the base of the bill, which in some species is furnished with a kind of cere; the tongue is broad, and blunt at one end; the bill is large, and the crown flat; the legs are short, the toes placed two before and two behind. It might seem a wonder why nature has destined to this, which is not naturally a bird of the air, but feeds on fruits and vegetable substances, the crooked bill allotted to the hawk and other carnivorous birds; but the reason seems to be, that the parrot being a heavy bird, and its legs not strong enough for it to fly for long distances; the trees by the help of this sharp and hooked bill, with which it lays hold of any thing and secures itself before it stirs a foot; and besides this, it helps itself forward very much, by pulling itself up with this help.

Parrots are found almost everywhere within the tropics; and in their natural state they live on fruits and seeds, though, when tame, they will eat flesh and even fish; and in the East and West Indies they are very common; and in such warm climates are very brisk and lively: here, however, they lose much of their vigour. They sechon the same food as the birds of paradise; two kinds of trees: they lay two eggs. At particular times they fly in very large troops, but still they keep two and two together. The genus consists of infinite variety, not so much from those, as in respect of the number and size of their feathers may be supposed. They seem to run vastly into one another, so as to appear ta be related, though received from different parts of the world: thi, however, may possibly be occasioned by their being carried from one place to another for the sake of sale.

Buffon ranges the parrot in two great classes: the first of which comprehends those of the Old Continent, and the second those of the New. The first he subdivides into five families; the cockatoos, the parrots properly so called, the lories, the long-tailed parquets, and the short-tailed ones; and the latter into the bright macaws, the amazons, the crows, the popijays, the long-tailed parquets, and the short-tailed ones.

Mr. Latham has increased the genus from 47 to 103; and since the time he wrote his Index, at least 20 more have been discovered. They are very generally divided into three kinds: 1. The larger, which are as big as a moderate fowl, called macaus and cockatoos; these have very long tails. 2. The middle-sized ones, commonly called parquets, which have short tails, and are a little larger than a pigeon. And 3. The small ones, which are called parquets, and have long tails, and are of a smaller size than the above. The following are the most remarkable:

1. The psittacus macao, or red and blue macao, is red, except the wing-quills, which above are blue, before rufous; the scapular feathers are varied of white and green; the cheeks are naked and wrinkled. It is about two feet seven inches and a half long, and about as big as a capon. Edwards says, when perfect, it will measure a full yard from bill to tail. It inhabits Brazil, Guiana, and other parts of South America. It was for- merly very common in St. Domingo, but is now rarely found there. It generally lives in moist woods, especially such as are planted with palms. It is, however, perhaps what is called the macaw-tree. It does not in ge- neral learn to speak, and its voice is parti- cularly rough and disagreeable. The flesh is hard, black, and unwholesome, but makes a much used by the inhabi- tants of Cayenne and other places. This species, in common with other parrots, is subject to his finds attuned, and though it lives in such large numbers and is very frequent, it will generally fall a victim to that disease at last. The Americans call it gonzalo.

2. The psittacura ararauna, or blue and yellow parrot, is the most beautiful and merriest, and is much used by the inhabi- tants of Brazil, Guiana, Brasil, and Surinam.

3. The psittacus severus, or Brazilian green macaw, is black, with a greenish splendour; the bill and eyes are reddish, and the legs are yellow. It is about one foot and five inches long, and is common in Guiana, Brazil, and Surinam.

4. The psittacus aurora, or yellow ama- zon, is about 12 inches long, of a green co- lor, with blue wing-quills, and a white front; its orbits are snowy. It inhabits Mexico or Brasil; but in all probability the latter, from the one which Salerne saw, and which pro- nounced Portuguese words. The psittacus cyanitis, or yellow lory, is about ten in- ches long, and is an inhabitant of Guiana. The bill is of a black colour; the cere, the throat, and space about the eyes, are white; above the eye there is a patch of yellow, and the rest of the head and neck is crimson. The breast is yellow, wing-covers green, and the quills are blue, edged with yellow. Under the wings, belly, thighs, vent, and under the other part of the body, the colour is white, which last is tipped with red; the legs are dusky, and the claws black.

PSOPHIA, a genus belonging to the or- der gallinæ. The bill is moderate; the up- per bill is convex; the formulae are ob- long, sunk, and pervious; the tongue is car- diagonal, flat, and fringed at the end; and the legs are naked a little above the knees. The toes are three before and one behind; the bill of which is small, with a round pro- trusion beneath it, which is at a little dis-
tance from the ground. Mr. Latham only enumerates two species:

1. Psophia tristis, or gold-breasted trumpeter.

2. Psophia undulata, or undulated trumpeter.

By the Spaniards of Maynas it is called trompetero, and by the French at Cayenne again, under which last name it is described in parts of South America, Brasil, Guiana, Surinam, &c. It is most plentiful in the Amazon’s country. It is about 20 inches long, being about the size of a large fowl, and lays eggs rather larger than the hen’s. It inhabits the Carribee and Cuba, where it is called a pheasant, and its flesh is reckoned as good as that of a pheasant. The most characteristic and remarkable property of these birds consists in the wonderful noise they make either of themselves, or when urged by the keepers of the menagerie. Some have supposed it to proceed from the anus, and some from the belly. It is now certain, however, that this noise proceeds from the lungs. Another very remarkable circumstance is, that they follow people through the streets, and out of town, and sometimes even perfect strangers. It is difficult to say why; for if you go into a house, they will wait your return, and again join you, though often after an interval of three hours. “I have sometimes (says M. de la Borde) betaken myself to my house; but they always followed me. Not long since, when I stopped, they stopped also. I know one (continues he) which invariably follows all the strangers who enter his master’s house, accompanies them into the garden, takes the same turn as they do, and attends them back again.”

2. Psophia undulata, or undulated trumpeter, is about the size of a goose. The upper part of the body is of a pale reddish brown, beautifully undulated with black. The head is adorned with a dependent crest. On each side of the neck, beneath the ears, begins a list of black, widening as it descends, and meeting on the lower part with the feathers artfully arranged, and hanging loosely down. The under parts are generally white; the legs are of a dusky blue colour, like the bill. It is native of Africa. Mr. Latham’s specimen is probably a Mrs.

**PSORALEA.** See Medicine.

**PSORALEA, a genus of the deciduous order, in the diaphaldea class of plants, and in the natural method ranking under the 32d order, papilionaceae. The calyx is quinquepartite; the capsule falicately, filicaceous, varicose. The seeds are few and solitary.**

There are six species. The most remarkable are:

1. Draco. 2. Ecatastaphyllum. 3. Lunatus. And. 4. Santalum. This last is called red sanders; and the wood is brought from the East Indies in large billets, of a compact texture, a dull red, almost blackish colour on the outside, and a deep brighter red within. This wood has no manifest smell, and little or no tinge. The principal use of red sanders is as a colouring drug; with which intention it is employed in some formula, particularly in the tinctoria lavandulae composita. It communicates a deep red to recondite spirit, but gives its roots, it never fails of producing a deep red, and a deep brighter red within when used for the purpose of painting. This wood has no manifest smell, and little or no taste.

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PTEROSPERMUM, a genus of the polyanthra order, in the monadelphous class of plants, and in the natural ranking under the 57th order, collomullera. The calyx is isomeropetale; the corolla consists of five oblong spreading petals. The filaments are about fifteen, which unite towards the base into a tube. The style is cylindrical; the capsule is oval, woolly, and quinqueta; each of which are bi-valved, containing many oblong, compressed, and winged seeds. There are two species, natives of the East Indies; the wood of which is very hard, and is used for the holly-tree.

PTEROTRACHIA, a genus of the vernus mollusca. Body detached, gelatinous, with a movable fin at the abdomen or tail; eyes two, placed within the head. There are four species, that inhabit chiefly the Archipelago.

PTINUS, a genus of insects belonging to the order coleoptera. The generic character is, antennæ filiform, with the three last joints long and slender, without distinct margin, receiving occasionall the head. The genus pinnus, like that of dermestes, consists of small insects, which, in general, have similar habits in their larva and complete state among dry animal substances; and some species in dry wood, committing great havoc among the older articles of furniture, in which they pierce with innumerable holes, thus causing their gradual destruction.

To this genus belongs the celebrated insect, distinguished by the title of the death-watch, or, piñudo. Among the popular superstitions which the almost general illumination of modern times has not been able to obliterate, the dread of the death-watch may well be considered as one of the most predominant, and still continues to disturb the habitations of rural tranquillity with groundless fears and absurd apprehensions. It is not indeed to be imagined that those who are engaged in the more important cares of providing for the necessities of life, should have either leisure or inclination to investigate with philosophic exactness the causes of a particular sound; yet it must be allowed to be a very singular circumstance that an animal so common should not be more universally known, and the peculiar noise which it occasionally makes be more universally understood. It is chiefly in the advanced state of spring that this alarming little animal commences its sound, which is no other than the call or signal by which the male and female are led to each other, and which may be considered as analogous to the call not answering the voice of the insect, but to its beating on any hard substance with the shield or fore-part of its head. The prevailing number of distinct sounds is from seven to nine or eleven; which very circumstance may perhaps still add in some degree to the ominous character which it bears among the vulgar. These sounds or beats are given in quick succession, and are resounded at uncertain intervals; and in old houses where the insects are numerous, may be heard at almost every hour of the day, especially if the weather be warm. The sound exactly resembles that which may be made by beating moderately hard with a nail on a table. The insect is a brown or greyish insect, resembling that of decayed wood, viz. an obscure greyish brown, that it may for a considerable time elude the search of the enquirer. It is about a quarter of an inch in length, and is moderately thick in the body; and the wings are marked with numerous irregular variations of a lighter or greyer cast than the ground-colour.

We must be careful not to confound this animal, which is the real death-watch of the vulgar, emphatically so called, with a much smaller insect of a very different genus, which makes a sound like the ticking of a watch, and in which the whole body and wings are marked with numbers of irregular spots of a lighter or greyer cast than the ground-colour. It belongs to a totally different order, and is the tenens pulsatilium of Linnaus. We cannot conclude this slight account of the death-watch without quoting a sentence from that celebrated work the Pseudolobzia Epidemica of the learned sir Thomas Brown, who on this subject expresses himself in words like these: 'He that could eradicate this error from the human people, would save from many a cold sweat the miserable heads of nurses and grandmothers.'

A very destructive little species of pinnus is often found in collections of dried plants, &c. remarkable for the ravages it committs both in its larva and perfect state. The larva resembles that of a beetle in miniature, being about the eighth of an inch long, and of a thickish head, bent, and of a white colour. The perfect insect is very small, measuring only about the tenth of an inch, and is slender, of a pale yellowish chestnut-colour, appearing, when magnified, bent and slender, for a long time, with the wing-cover finly striped by rows of small impressed points or dots. The ravages of the larva are most remarkable during the summer. The prime of life of Linneus is another very destructive species. It is longer somewhat more than the tenth of an inch, and its colour pale chestnut-brown, sometimes marked with the wing-covers by a pair of greyish bands; the antennæ are short, thick, and slender; the body remarkably convex; the head and thorax, when magnified, appears to have a projecting point on each side. Its larva resembles that of the preceding species, and is found in similar situations.

PTOLEMAIC, or Ptolemaic system of astronomy, is that invented by Claudius Ptolemeus, a celebrated astronomer and mathematician of Ptolemais in Egypt, who lived in the beginning of the second century of the Christian era.

This hypothesis supposes the earth immovably fixed in the centre, not of the world only, but of the universe; and that the sun, the moon, the planets, and stars, all move about it from east to west, once in 24 hours, in the order following, viz. the moon next to the earth, thence Mercury, Venus, the sun, Mars, Jupiter, Saturn, the fixed stars, the first and second crystalline heavens, and above all, the fiction of their primum mobile.

PUBES. See Anatomy.

PUL CHIROPTER. See Aphis.

PULEX, or Pulex, a genus of insects of the order aptera. The generic character is, legs six, fornic for leaping; eyes two; antennæ filiform; mouth furnished with an infected, stenoeous mount, concealing a piercer; abdomen compressed.

It is one of the most singular in the order aptera. The pulix irritans, or common flea, so well known in its complete state in every region of the globe, is remarkable for undergoing the several changes exhibited by the insect race of other tribes; being produced from an egg, in the form of a minute worm or larva, which changes to a chrysalis, in order to give birth to the perfect animal. The female flea deposits, or rather drops, her eggs at distant intervals, in any favourable situation: they are very small, of an oval shape, of a white colour, and a polished surface. From these, in the space of six days, are hatched the larvae, which completely emerge in its strengthened worm-like shape, beset with distant hairs, and furnished at the head with a pair of short antenna or tentacula, and at the tail with a pair of slightly curved forked or hollow tapers. Their colour is white, or grey, and their motions quick and tortuous. These larvae are very frequently found in the nests of various birds, and, in particular, of pigeons, to which they return to the worm-like brood, and saturate themselves with blood. In the space of ten or twelve days, they arrive at their full growth, when they usually measure near a quarter of an inch in length. After lying for the space of twelve days in chrysalis, the complete insect emerges, in its perfect form. It now begins to exert its lively motions; and employs the sharp proboscis with which nature has furnished it, in order to obtain nourishment from the first man, or bird, or quadruped, to which it can gain access. The time required for the evolution of this animal varies considerably according to the season of the year, and in the winter months is of much longer duration than the period above-mentioned; the egg scarcely hatching under twelve days, and the larva lying nearly twice the usual time in chrysalis.

Among the chief singularities observable in the structure of the flea, may be noticed the extraordinary situation of the first pair of legs, which, instead of being placed beneath the thorax, as in most other insects, are situated immediately beneath the head; the antennæ are short, large, and consist of five joints; and at a small distance beneath there is placed the proboscis, which is strong, sharp-pointed, tubular, and placed between a pair of the hind feet of the insect, which may be still further strengthened at the base by a pair of pointed scales; the eyes are large, round, and black. The general appearance of the animal is too well known to require particular description: it may only be necessary to observe, that the male is considerably smaller than the female, with the back rather sinking than convex, as it always is in the female insect.

Nothing can exceed the curious disposition and polished elegance of the shelly armour with which the animal is covered,
nor can the structure of the legs be contemplated without admiration.

There was nothing to make it difficult to prove that there exists in Europe more than one genuine species of flea, yet it is certain that some permanent varieties or races may be traced, which a practiced eye can readily distinguish from the common domestic kind. Of these the most remarkable seems to be that infesting some of the smaller quadrupeds, and particularly mice and bats. This variety is of a much larger size than the common flea, and of a paler colour, and the fly-like insect nearly in the same proportion that a greyhound does from the more common race of dogs.

Puls, a penetrant, or chigger, is a native of South America and the West Indian Islands. According to Catesby's microscopic figure of this insect, it may properly be arranged under the present genus; but it is probable, from the different descriptions of authors, that some insects of the genus carus, which excite similar swellings under the skin, have been confounded with it under the general name of chigger or chigoe. Catesby's accurate remark, 'It is a very small flea, that is found only in warm climates. It is a very troublesome insect, e- preaching to negroes, and others that go barefoot and are slovenly. They penetrate the skin in the limbs, they lay hard eggs, or bag of eggs, which swell to the bigness of a small pea or tare, and give great pain till taken out,' to perform which great care is required, for fear of breaking the bag, which, ending in the side of the leg, and sometimes life itself. This insect, in its natural size, is not above a fourth part so big as the common flea. From the month issues a hollow tube like that of the common flea, between a pair of antennae. It has six jointed legs, and something resembling a tail. The egg is so small as to be scarcely discerned by the naked eye. These chiggers are a nuisance to most parts of America between the tropics.'

PULLEY. See MECHANICS.

PULMONARIA, lungwort, a genus of the monogynia order, in the pentadria class of plants, and in the natural method ranking under the 43rd order, asperifolia. The corolla is funnell-shaped, with its throat per- cious; the calyx is prismatic and pentagonal. There are seven species, of which the most remarkable is the officinalis, common spotted lungwort, or Jerusalem cow-sip. This is a native of woods and shady places in Italy and Germany, but has been cultivated in Britain for medical use. The leaves are of a green colour, spotted with white, and of a mucilaginous taste, without any smell. They are recommended in phthisis, ulcers of the lungs, &c., but their virtues in these diseases are not widely acknowledged by authors.

PULSATILLA. See ANEMONE.

PULSE, in the animal economy, denotes the beating or throbbing of the heart and arteries. See PHYSIOLOGY.

PULSATILLA. See Leguminosae.

PULLENIAE, a genus of the class and order decandria monogynia. The calyx is five-toothed; corolla papilloseous; legume one cell, two-seeds. There are six species, shrubs of New Holland.

PUMICE-STONE, or porous glasses. When the compact glasses are exposed to the heat of our furnaces, they emit a great number of air-bubbles, which renders them susceptible of a higher polish. It has the same base as compact glass. The texture is fibrous; the fibres have a silky lustre. Colours various; white, brown, yel- low, black. Before the blow-pipe, they hold into a white enamelled. According to Klaproth, the punice consists of

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09.75. See Fulmination.

PUMP, an hydraulic machine for raising water, or the pressure of the atmosphere. It would be an entertaining and not an uninstructive piece of information to learn the progressive steps by which the ingenuity of man has invented the various methods of raising water, so that it might be considered as the last step of this process. Common as it is, and overlooked even by the curious, it is a very abstruse and refined invention. Nothing like it has been found in any of the primitive nations. The piston is placed in a tube covered, either in the new continent of America or the islands of the Pacific Ocean. Nay, it was unknown in the cultivated em- pace of China at the time of our arrival there. It is to be found nowhere in Asia, in places unfrequented by the Euro- peans. It does not appear to have been known by the Greeks and Romans in early times; and perhaps it came from Alexandria, or the place of the mathematical sciences; at which it was much cultivated by the Greek school under the protection of the Ptolemies. The performances of Ctesibius and Hero are spoken of by Pliny and Vitruvius as curious novelties. There are two sorts of pumps, which essentially differ; and all the varieties are but modifications of these. One has a piston with a perforation and valve; the other has a piston A to the form it is given the name of the common sucking-pump; the latter is denominated the forcing-pump.

Fig. 1 represents the common sucking-pump. AA is a cylinder of cast iron, bored smooth within; it has a piston D at the top, by which it is screwed to the wooden cistern B, which conveys the water away from the pump. It has also a flanch D at its lower end, to screw on the pipe E, which brings the water to the pump. In the same flanch is a pair of valves, aa; and the bucket or piston F, which slides within the barrel, has another similar pair of valves in it. This bucket is screwed to an iron rod G, which is moved up and down by some machine. When the bucket F descends, its valves bb open as in the figure, and allow the water which fills the barrel to pass through them. When the piston F, which is at the bottom of the barrel, it is drawn up again; and as the valves shut, and prevent the water from re- turning through the bucket, it lifts all the water contained in the barrel into the cistern B. At the same time the bucket, in rising, makes a vacuum beneath it: the pres- sure of the atmosphere upon the surface of the water in the well, causes it to mount up through the pipe E, open the valves aa, and fill the barrel AA. When the bucket begins to descend, the column of water beneath it descends also, till it is stopped by the shut-
cause the valve in the piston remains shut by its own weight. The air, therefore, is driven through the valve, into the piston rod, expands into the upper part of the working-barrel; and its elasticity is so much diminished thereby, that the atmosphere presses the water of the cistern into the suction-pipe, where it rises until an equilibrium is again produced. The next stroke of the piston downwards, allows the two pipes, and comes from the suction-pipe into the barrel during the ascent of the piston, to get through its valve. Upon drawing up the piston, the air is also driven off through the rising-pipe. Repeating this process, brings the water at last into the working-barrel, and it is then driven along the rising-pipe by the piston.

This is one of the best forms of a pump. The cistern may be very perfect, because the piston can be brought so near to the bottom of the working-barrel: and for forcing water in opposition to great pressures, it appears preferable to the common forcing-pump. In that, the piston-rod is compressed and exposed to bending, which greatly hurts the pump, by wearing the piston and barrel on one side. This soon renders it less tight, and much water spirits out by the side of the piston. But in this pump the piston-rod is always drawn, or pulled, which keeps it straight, and rods exert a much greater force in opposition to a pull than to compression. The collar of leather round the piston-rod, is found by experience to be very impervious to water; and though it needs but little repair, yet the whole is very accessible; and in this respect much preferable, in the common to the rising-pipe pump, in which every fault of the piston obliges us to draw up some hundred feet of piston-rod.

By this addition too, any common pump, for the service of a house, may be converted into an engine for extinguishing fire, or may be made to convey the water to every part of the house; and this without hurting or obstructing its common uses. All that is necessary, is to have a large cock on the upper part of the working-barrel, opposite to the lateral pipe in this figure. This cock serves for a spout, when the pump is used for common purposes; and the merely shutting this cock, converts the whole into an engine for extinguishing fire, or for supplying distant places with water. It is scarcely necessary to add, that, for these services, it will be requisite to connect an air-veil with some convenient part of the rising-pipe, in order that the current of water may be continual.

It is of considerable importance, that as supply a motion as possible is produced in the machine; otherwise it diminishes the effect of the pump, which it is otherwise liable to. The application of an air-veil at the beginning of the pipe, answers this purpose. In great works, it is usual to effect this by the alternate action of two or more pumps. It will be more uniform, if four pumps are employed, succeeding each other at the interval of one quarter of the time of a complete stroke.

Men have attempted the same thing with a single pump; and many different constructions for this purpose have been proposed and executed. Fig. 5, represents one of the best. It consists of a working-barrel, ah, closed at both ends; the piston, a, being a solid piston, and movable through a collar of leathers at the top of the barrel. This barrel communicates laterally with two pipes, and k, the communications being as near as the top and bottom of the barrel as possible. At the commencement of the discommuni- cations are two valves, opening upwards. The two pipes unite in a larger rising-pipe at b, which bends a little back, to give room for the piston-rod. Support the piston almost close to the upper part of the barrel h; when it is drawn up, it compresses the air above it, and drives it through the valve in the pipe k, whence it escapes through the rising-pipe; rising pipe k, and at length the water rises into the barrel, and the weight of the atmosphere. Therefore the weight of the atmosphere shuts the valve m, and causes the water in the cistern to rise through the valve n, and fill the lower part of the pump. When the piston is pushed down again, water is first driven through the valve n, because n immediately shuts; and then most of the air which was in this part of the pump at the beginning, goes up through it, some of the water coming back in its stead. The air which remained in the upper part of the pump after the ascent of the piston, is rarified by its descent; because the valve o shuts as soon as the piston begins to descend, the valve p opens, the air in the suction-pipe expands into the barrel, and the water rises into the pipes by the pressure of the atmosphere.

The next rise of the piston must bring more water into the lower part of the barrel, and the water must drive all the air upwards, through the valve o, namely, part that had come out of the suction-pipe h; and the next descent of the piston must drive more water into the barrel, and the water which remains above the piston, must drive all of the air which remained below the piston, and must rarely still more the air remaining above the piston; and more water will come in through the pipe h, and get into the barrel, as before; so that, if the piston is of sufficient power, the water will rise in the pipe m, as high as the water in the barrel will allow of its being raised; and there will be a continual influx into the barrel through the valves n and p, and a continual discharge through the rising-pipe I through the valves m and o.

This machine is certainly equivalent to two forcing-pumps, although it has but one barrel and one piston; but it has no sort of opposition in its construction. It is easily executed in most cases; because, probably, the ex- pense of the additional workmanship will equal that of the barrel and piston, which is saved. There is, indeed, a saving in the rest of the machinery, because one lever produces both motions. It therefore cannot be called inferior to two pumps; and there is undoubtedly some ingenuity in the contrivance.

Fig. 6, is another pump for furnishing a continued stream, invented by Mr. Nobile, AB, the working-barrel, contains two pistons, C and B, which are moved up and down alternately by the rods fixed to the lower F. The pipe, the barrel B is carried through the piston or bucket C. This pump is very simple in its principle, and may be executed at little expense.

The pump invented by M. De la Hire, raises water equally quick by the descent as by the ascent of the piston in the pump-barrel.

AA (fig. 7), is a well, in which the lower end of the barrel is placed. D is the pump-barrel, into the lowest part of the well the piston is placed. D is the pump-barrel, into the lowest part of the well the piston is placed. D is the pump-barrel, into the lowest part of the well the piston is placed. D is the pump-barrel, into the lowest part of the well the piston is placed.
pipe N, to the spout O, by the descent of the plunger, as by its ascent; and, in each case, as much water is discharged at O, as if it were part of the barrel which the plunger moves up and down in.

On the top of the pipe O is a close air-vessel P. When the water is forced up above the spout O, it compresses the air in the vessel P, and forces it out through the opening acting on the water, causes the water to rush off by the spout O, in a constant and (very nearly) equal stream.

Whatever the height of the spout O is above the surface of the well, the top of the pipe O must not be 52 feet above that surface; because if that pipe could be entirely exhausted of air, the pressure of the atmosphere in the well would not force the water up the pipe to a greater height than 32 feet; for the water cannot in the air-vessel P, under the effect of its weight, be raised without the force of the pressure of the atmosphere. If, by some agency, the column of water, in the air-vessel P, be raised to a considerable height, then the height of the water above the spout O, would be determined only by the density of the atmosphere, and the temperature of the water and the air.

As the collar of leather within the neck M, is apt to dry and shrink when the pump is not used, and consequently let air get into the barrel, and thereby would affect the operation of the atmosphere in the pipe C; collars of old hats might be used instead of leathers, as they would not be liable to that inconvenience.

It matters little what the size of the pipe N is, through which the water is forced up to the spout; but a great deal depends on the size of the pulse-barrel; and according to the height of the spout O, above the surface of the well, the diameter of the barrel should be as follows:

For 10 feet high the bore should be 6.9 inches; for 15 feet 5.6; for 20 feet 4.9; for 32 feet 4.4; for 30 feet 4.0; for 35 feet 3.7; for 40 feet 3.5; for 45 feet 3.3; for 50 feet 3.1; for 55 feet 2.9; for 60 feet 2.8; for 65 feet 2.7; for 70 feet 2.5; for 75 feet 2.3; for 80 feet 2.5 will do; for 85 feet 2.4; for 90 feet 2.3; for 95 feet 2.2; and for 100 feet, the diameter of the bore should not exceed 2.1 or 2.2 inches at most. If these proportions are attended to, a man of common strength may raise water 100 feet high by one pump, as easily as he could raise it ten feet high by another.

In this pump the pipes B and C seem to be rather small, which will cause the water rising in them to have a great deal of friction from the quickness of its motion; and whoever makes such a pump, will find it very difficult to make the leather in the neck M water-tight, so that no water shall be forced out that way when the piston is drawn up.

The hair-rope machine for raising water was invented by sieur Vera:

A (fig. 8), is a wheel four feet over, having an axis and a witch; C, a hair-rope, near one inch diameter; D, a reservoir to collect the water: E, a spout to convey the water from the reservoir; G, the surface of the water in the well; I, a pulley under which the rope runs, in order to keep it tight.

When the handle is turned about with a considerable velocity, the water, which rushes into the rope, in wells of no great depth, is very considerable: the rope thus passes through the tubes in D, which, being five or six inches higher than the bottom of the reservoir, hinders the water from returning back into the well, and is conveyed in a continual stream through the spout E. Some of the above engines, improved by Mr. Starn- ton, having a great number of flat pistons, or valves, fixed upon it at proper distances. This chain passes round a kind of wheel-work, fixed at one end of the machine. The teeth of this are so contrived as to receive one-half of the flat pistons, which go free of the sides of the barrel by near a quarter of an inch, and let them fall in, and they take hold of the links as they rise. A whole row of the pistons, which go free of the sides of the barrel by near a quarter of an inch, are always lifting when the pump is at work; and as this machine is generally worked with briskness, they bring up a full bore of water in the pump. It is wrought either by one or two handles, according to the labour required.

The many fatal accidents which happen to ships from the choking of their pumps, makes it an important object, in naval affairs, to find some machine for freeing a ship from water liable to such danger. The chain-pump being found least exceptionable in this respect, was adopted in the British navy; but the chain-pump itself is not free from imperfections. If the wheels are not well fitted to the cylinder through which they move, much water will fall back; if they are well fitted, the friction of many valves must be considerable, besides the friction of the chain round the sprocket-wheels, and that of the wheels themselves. To which may be added, the great wear of leathers, and the disadvantage which attends the surging and breaking of the chain. The preference, therefore, which has been given to chain-pumps over those which work by the pressure of the atmosphere, must have arisen from one circumstance, that they have been found less liable to choke.

In point of friction, of coarseness, and of strength, the sucking-pump has the advantage over the chain-pump, that it will not fail to gain the preference, whenever it shall be no longer liable to be choked with grime and mud chips.

Buchanan's pump, which, like the common pump, acts by the pressure of the atmosphere, is not liable to the defects incident to other pumps upon that principle, being essentially different from any other.

The principal object of its invention was to remove the imperfection of its choking. In attaining this important end, a variety of collateral advantages have also been produced, which enhance its utility.

The points in which it differs essentially from the common pump, and by which it excels, are, that it discharges the water below the piston, and has its valves lying near each other.

The advantages of this arrangement are, that the sand or other matter, which may be in the water, is discharged without injuring the barrel or the piston-leathers; so that beside avoiding unnecessary wear and tear, the power of the pump is preserved, and not a particle diminished or destroyed in moments of danger, as is often the case with the common chain pumps; that the valves are not subjected to any particular dispassions, but may be made capable of discharging every thing that can rise in the suction-piece, without danger of being choked: that accidents do not happen upon any occasion to be an obstruction in the valves, they are both within the reach of a person's hand, and may be cleared at once, without the disjunction of any part of the pump; and that the pump is rendered capable of being instantaneous converted into an engine for extinguishing fire. Besides, it occupies very little space in the hold, and thus saves room for stowage.

But this pump is not confined to nautical uses alone; its adaptation extends to the raising of water in all situations, and with peculiar advantage where it happens to be mixed with sand or substances which destroy other pumps, as, for instance, in alum-works, in mines, in quarries, or in the clearing of foundations; and in its double capacity it will be very convenient in gardens, biscuit grounds, in stable and farm yards, and in all manufactories, or other places, where there are a necessity for raising water and the risk of fire.

With all these advantages, it is a simple and durable pump, and may be made either of metal or wood at a moderate expense.

Fig. 9, is a vertical section of the pump, as made of metal, in which A is the suction-piece, B the inner valve, C the outer valve.

The valves are of the kind called clack valves. Their hinges are generally made of metal, as being more durable than leather. D is the working-barrel, E the piston, and G the spout.

The following parts are necessary only when the pump is intended to act as a fire-engine:

If an air-vessel, which is screwed like a hose-pipe, that it may, at pleasure, the more readily be fixed or unixed.

There is a perforated stopple for the spout, made for receiving such pipes as are common to fire-engines. It is over and taper, and being introduced transversely, a piston being pulled back becomes immediately tight.

These parts being provided, all that is necessary to make the pump act as a fire-engine after having been used as a sucking-pump, is to plug up the spout with the stopple.

No particular mode being essential in the working of this pump, it may, according to choice or circumstances, be wrought by all the methods practised with the common pump. In many cases, however, it may be advantageous to have two of them so connected, as to have an alternate motion; in which case, one air-vessel, and even one suction-piece, might serve both.

Its principles admit of various modifications; but as what is already mentioned may be sufficient to indicate its superiority over the common and chain pumps, and the advantages likely to result from its general use, a further detail is unnecessary.

To this we may add, that the testimonies of several navigators confirm the fullest manner, the hopes that were conceived of its
PUMP.

utility, and warrant the recommendation of it, as the best adapted for the purpose of any pump hitherto invented.

The great desideratum in a piston is, that it acts light as possible, and has as little friction as is consistent with this indispensable quality.

The common form, when carefully executed, has these properties in an eminent degree, and accordingly keeps its ground amidst all the improvements which ingenious artists have made. It consists of a hollow cylinder, having a piece of strong leather fastened round it, so that it fits exactly the bore of the barrel, and a valve or flap to cover the hole through which the water rises. The greatest difficulty in the construction of a piston, is to give a passage through it for the water, and yet allow a firm support for the valve and fixture for the pistons-red. It occasions a considerable expense of the moving power to force a piston with a narrow perforation through the water lodged in the working-barrel. When we are raising water to a small height, such as 10 or 20 feet, the power expended amounts to a fourth part of the whole, if the water-way in the piston is less than one-half of the section of the barrel, and the time of the piston two feet per second, which is very moderate. There can be no doubt, therefore, that metal pistons are preferable, because their greater strength allows much wider apertures. For common purposes, however, they are made of wood, as elm or beech.

There are many ingenious contrivances to avoid the friction of the piston in the pumps; but this is of little importance in great works, because the friction which is completely sufficient to prevent all escape of water in a well-constructed pump, is but a trifling part of the whole force.

In the great pumps which are used in mines, and are worked by a steam-engine, it is very usual to make the pistons and valves without any leather whatever. The working-barrel is bored truly cylindrical, and the piston is made of iron, of a size that will just pass through in a given length without sticking. When this is drawn up with a velocity competent to a properly loaded machine, the quantity of water which escapes round the piston is insignificant. The piston is made without leather, except the operation of friction, which is also insignificant in such works, but to avoid the frequent necessity of drawing it up for repairs through such a length of pipes.

If a pump absolutely without friction is wanted, the following seems preferable, for simplicity and performance, to any we have seen, when made use of in proper situations.

Let NO (fig. 10), be the surface of the water in the pit, and K the place of delivering. The pit must be as deep in water as from K to NO. A is a wooden trunk, round or square, open at both ends, and having a valve, V, at the bottom. The top of this trunk must be in a level with K, and has a small cistern, F. It also communicates radially with a rising-pipe G, furnished with a valve opening upwards. L is a beam of timber, so fitted to the trunk, as to fall in without sticking, and is of at least equal length. It hangs by a chain from a working-beam, and is loaded on the top with weights exceeding that of the column of water which it displaces.

Now, suppose this beam to descend from the position in which it is drawn in the figure; the water must rise all round it, in the crevice which is between it and the trunk, and also in the rising-pipe; because the valve P shuts, and O opens; so that when the plunger L has got to the top, the water will stand at the level of K. When the plunger is again drawn up to the top by the action of the moving power, the water sinks again in the trunk, but not in the rising-pipe, because it is stopped by the valve O. Then allowing the bar to descend again, the water must again rise in the trunk to the level of K, and it must now flow out at K; and the quantity discharged will be equal to the part of the beam below the surface of the water, deducting the quantity which fills the small space between the beam and the trunk. This quantity may be reduced almost to nothing: for if the inside of the trunk, and the outside of the beam, are made slippery, the hinge is nearly 2 or 3 inches, and this may be let down till they exactly fit; and as this may be done in square work, a good workman may make it exceedingly accurate. But, in this case, the lower half of the beam, and not the whole length of the trunk must be of sufficient width round the beam, to allow free passage into the rising-pipe; or, which is better, the rising-pipe must branch off from the bottom of the beam, to discharge made from the cistern, F, so that as little water as possible may descend along the trunk when the piston is raised.

The requisite of a valve are, that it is tight, and of sufficient strength to resist the great pressures to which it is exposed; that it affords a free passage to the water; and that it does not allow much to go back whilst it is shutting. The clack-valve is of all others the most durable and common. It consists merely of a leather flap covering the aperture, and having a piece of metal on the upper side, both to strengthen and to make it heavier, that it may shut of itself. Sometimes the hinge is of metal. The hinge being liable to be worn by such incessant motion; and as it is troublesome, especially in deep mines, and under water, to undo the joint of the pump, in order to put in a new valve, it is frequently annexed to a box, like a piston, made a little conical on the outside, and dropt into a conical seat made for it in the pipe, where it sticks fast; and to draw it up again, there is a handle like that of a basket, fixed to it, which can be held hold of by a long grappling-iron. The only defect of this valve is, that by opening very wide when pushed up by the stream of water, it allows a good deal to go back during its shutting again.

The butterfly-valve is free from most of these inconveniences, and seems to be the most perfect of the clack-valves. It consists of two rings, their flaps revolving round their diameters, which are fixed to a bar placed across the opening through the piston. Some engineers make their great valves of a pyramidal form, consisting of four clacks, whose hinges are in the circumference of the water-way, and which meet with their points in the middle, and are supported by four ribs, which rise up from the sides, and unite in the middle. This is a most excellent form, affording a more spacious water-way, and shutting very readily.

There is another form of a valve, called the bottom or tail valve. It consists of a plate of metal turned conical on the edge, so as exactly to fit the conical cavity of its box. A tail projects from the under side, which passes through a cross bar in the bottom of the box, and has a little hole at the end to hinder the valve from rising too high. The valve, when nicely made, is unexceptionable. It has great strength, and is therefore proper for all severe strains; and it may be made cheaply by planing. Accordingly, it is used in all cases where tightness is of indispensable consequence. It is most durable, and the only kind that will do for passages where steam or hot water is to pass through.

The pressure on the pipes in pump-work, is in proportion to the standing height of the fluid above the part considered; but the weight incumbent on the bucket (or moving valve) of a pump in action, is nearly proportionable to that of a column of water raised; for though the push of the atmosphere on the surface of the spring, when the bucket rises, is really equal to the weight of 33 feet of water; yet is this resistance counterbalanced by the rise of the atmosphere, ever incumbent on the surface of the water thereby raised; so that in fact, all the advantage to be obtained by hydraulic machines, as well in pumps as in all other pieces of machinery whatever, is only the putting manners into a convenient mode of being executed; and the performance depends on the moving power entirely, under the disadvantage of friction always against it.

A pump intended to raise water to any height whatever, will always work as easy, and require no greater power to give motion to the bucket, if both the valves are placed nearly at the bottom of the pipe, than if they were fixed 33 feet above the surface of the water.

The playing of the piston thus low in the pipe will, besides, prevent an inconvenience which might happen was it placed above, viz. in case of a leak beneath the bucket, instead of the piston, the water might be forced up, and may very easily happen, the outward air getting through, would hinder the necessary rarefaction of the air in the barrel on moving the piston, and consequently the pump might fail in its operation. This can only effectually be prevented, by placing the pump-work in or near the water; in which case, should any leak happen upward, in will only occasion the loss of some of the water, with any other inconvenience; and the leather valves being kept under water, will always be found supple, plant, and in condition to perform their office.

Placing the pump-work (that is, the valve and action) pretty low and near together, will also prevent the inconvenience of not being able in all cases, to fetch up water from the equal bore, by the ordinary pressure, of an equal column of water; and that the pump might not rarely be made so as not to bring the air sufficiently to bring the water up to the piston from the lower valve. For instance: Take a smooth-barrelled pump, 21 feet long, having its piston fetching, suppose a foot place placed above, and the clack or fixed valve at the other end below. By the playing of the piston, admit it possible for water
A horizontal pipe is formed of iron or any other substance sufficiently strong, expanding at one end like the mouth of a trumpet, and at the other furnished with a valve that may be opened or shut at pleasure; near this mouth is a piston mounted in a vertical pipe, at right angles to the horizontal one, furnished at the juncture with a valve opening upwards, and open at the other end. This machine is let down into a stream of water, so deep as to cover the entire vertical length of the trumpet-like mouth of which is placed so as to meet the current: in this situation the valve being open, a current passes through the pipe, of equal velocity with the current of the stream; if the valve is then suddenly closed, the recoil of the current will force open the valve of the vertical pipe, through which will rush a column of water: the force of the recoil will then be checked, and in the place vacated by the water, a column of water will pass into the vertical pipe, causing it to rise to the original height, and thus a part of its new current will be directed into the horizontal pipe. As this instrument is made to draw water, from a depth below that of the impelling current, it is to raise it to any height, will be mentioned hereafter.

The use to which this engine may be applied, are serious; besides the raising of water for the use of brewers, &c. it may be employed in raising water from the sea for salt-work, in draining marshes and pumping ships, and supplying with water those canals that are carried over by the sides of rivers.

For the more clear description of this important apparatus, its physical principle of action, is as follows:

First, when water moves or runs through a pipe, or close channel, or tube, if the end at which the water issues is suddenly stopped, the water will (by its acquired motion, momentum, or impetus) act upon the sides or circumference of the pipe; which being supposed strong enough to resist that impetus, the water will issue, with violence or velocity, at any aperture which may exist in or near the shut end of the pipe; and if to that aperture an ascending pipe is joined, a portion of water will rise in it.

Secondly, if a pipe, open at both ends, with an ascending pipe, such as has been described, is moved along, through standing water, in the direction of its length; upon shutting the hinder part of the pipe, a portion of the water will rise in the ascending-pipe, in the manner which has been stated in the former case: Hence it is relatively in motion in respect to the pipe.

Thirdly, if in either of the cases recited, a pipe communicating with water at any lower level is joined to the main pipe, at or near the end at which water enters into it; and if, when such water has acquired motion relatively to that pipe (by the pipe being put in motion), the mouth or end at which the water enters is suddenly shut; the water, continuing its motion relatively to the pipe, will draw or suck up water from the lower level; and the ascending pipe, in order to fill up the vacuity occasioned by the water in the main pipes, percolating in its previous motion. What has been said respecting water, is also true in respect to air and gas.

The several cases above stated are resolvable into the general principle of the resistance which water and other fluids (and in general all bodies) make to a change of their state of rest, or at a velocity, whether absolute or relative; and this principle has hitherto been applied to the raising of water only in a comparatively small and weak degree, and in a defective manner. But the improved apparatus contains its own action when once set going, unless some accident should stop or damage it; and is capable of raising water in great quantities, and to great heights, and they also differ, in other respects, from any thing which has been executed hitherto.

The nature of the said improved invention consists in using valves, of various constructions, instead of cocks, to open or shut the end, or ends, of a main pipe; and in the application of machinery thereby to assist in opening and shutting the valves at proper times; whereby water is raised independently of any other power than a current of water through the main pipe.

The manner in which the said invention is to be performed, and the said improved apparatus and methods carried into effect, is as follows, viz.

The first and most simple method is shewn in fig. 12, in which CC is the main pipe; DD the ascending pipe; A the valve of exit for the water to be raised; B the stop-valve; and E a weight, which, by the lever F, attached to the axis G of the stop-valve B, opens it at the proper time. The said apparatus acts in the following manner: The main pipe being situated or fixed in the ground, or in some vessel, of either produced by the natural current or delivery of the river or other stream; or (which is preferable) by penning up water by a dam, weir, or bank; and by inserting the end of the main pipe under the water of the dam, weir, or bank, so as to obtain the greatest head or current of water the natural circumstances admit of; the stop-valve being opened to the position shown in the figure, the water will run through the main pipe, until, by its action upon the stop-valve in its retracted position, it raises the weight, shuts the stop-valve, and the water, by its impetus or momentum, opens the exit-valve, and a portion of it rises in the ascending-pipe; after which, the last-mentioned valve shuts the water in the main pipe recedes, the weight descends and opens the stop-valve, and the water in the lower part regains its velocity. The like operations are repeated, and the water gradually rises in the ascending-pipe, until it reaches its summit, and a quantity issues thence every stroke; which quantity is more or less, according as the height to which it is raised is less or greater.

Is an air-vessel, or reservoir of air, whereby the bursting of the pipes is prevented, or the danger thereof much diminished. Inte
PUN. To a but is the enters (the great机票, the receiving jaain jietal, raised, aised Puncheon, the Puncheon vessel mechanism be through of the dimensions of the air-vessel, as well as its form and position, whether above, or laterally affixed to, the main pipe, are in great measure arbitrary; but its contents of air ought not to be much less than ten times the quantity of water to be raised through the pipe each stroke; and if much larger still the better, the principal boundary being expense.

The stop-valve may be opened and shut, as has been described in the first method, by the mechanism shown in the figure, or by any of the mechanisms shall be adapted to the opening of valves.

Another method is shown by figs. 13, 14, and 15; in which, whether the water to be raised is below the level of the main pipe, and is to be discharged at that level: which cases occur in the drainage of marshy lands, where the action of the current of water in an embanked river, or other stream or source of water on a higher level, can be employed; or this method can be applied in raising water out of the holds of ships, or other vessels, by the motion of the crane through the water.

This is explained by figs. 13, 14, and 15, where C is the main-pipe, A the receiving valve, B the stop-valve, opening upwards, D the ascending or sucking pipe; J the air-vessel, and E the weight.

The water in the main pipe having acquired a proper velocity, the stop-valve opens: the water in the main pipe, continuing its motion for a time, draws air out of the air-vessel. Then the momentum of the water in the main pipe being expended, the receiving valve shuts, and the stop-valve opens, the water regains its velocity, and the operation continues in cycles, in a few strokes, (the exhaustion increasing), the air-vessel sucks up water from below, by the ascending pipe; and this being continued, the latter pipe fills by degrees to the top, after which, it is unnecessary to fill the air-vessel, the water, in the case, a portion of the water from below passes into the main pipe, and is carried off, with the upper water, to the place of delivery.

Air-Pump. See Pneumatics.

PUNcheon, a little block or piece of steel, on one end whereof is some figure, letter, or mark, engraved either in creux or relevo, impressions of which are taken on metal, or some other matter, by striking it with a hammer on the end not engraved. There are various kinds of these puncheons used in the mechanical arts; such for instance are those of goldsmiths, cutters, pewterers, &c. See also Couting.

Puncheon, in carpentry, is a piece of timber placed upright between two posts, whose bearing is too great, serving, together with them, to sustain some large weights. This term is also used for a piece of timber framed upright, under the ridge of a building, wherein the little forces, &c. are jointed. Puncheon is also used for the arbor, or principal part of a machine, wherein it turns vertically, as that of a crane, &c.

Puncheon is also a measure for liquids, containing a hogshead and one-third, or eighty-four gallons.

PUNICA, the pomegranate-tree: a genus of the monogynia order, in the icisiodia class of plants, and in the natural method ranking under the 39th order, pomaceae. The calyx is quinquefid, superior; there are five petals. Fruits is a multiiocular and polyspermous apple.

The species are, 1. The granatum, or common pomegranate, with a three stem, branching numerously all through the bottom, of five feet high; with spear-shaped, narrow, opposite leaves; and the branches terminated by most beautiful large red flower, succeeded by large roundish fruit as big as an orange, having a hard rind filled with soft pulp and numerous seeds. There is a variety with double flowers, remarkably beautiful; and one with striped flowers. 2. The man, or dwarf American pomegranate, with a shrub stem, bearing the flowers of five feet high, with narrow short leaves, and small red flower, succeeded by small fruit; begins flowering in June, and continues till October. Both these species are planted in the young branches of the tree to be chosen for this purpose, and autumn is the proper time for laying them.

The dried flowers of the double-flowered pomegranate, possessed of an astringent quality; for which reason they are recommended in diarrheas, dysenteries, &c. where astringent medicines are proper. The rind of the fruit is also a strong astringent, and as such is generally made use of.

Pupil. See Anatomy, Optics, and Physiology.

PURCHASE, in law, the buying or acquiring of lands, &c. with money, by a deed or agreement, by right of inheritance. A joint purchase is when two or more persons join together in the purchase. Purchasers of lands are to take notice of all charges thereon: there are, however, certain exceptions against fraudulent incumbrances. The court of chancery will relieve the purchaser of a term against a title that lay dormant, where money has been laid out on improvements.

PURLINS, those pieces of timber that lie across the rafters on the inside, to keep them from sinking in the middle of their length.

PURPLE, a colour composed of a mixture of scarlet and indigo.

A beautiful transparent purple for painting may be made by boiling four ounces of rasper Brasil-wood in a pint of stale beer, and half an ounce of logwood, till the liquor is heightened to the colour you desire, which may be known by dipping a piece of paper in it. If you find it too red, add a quarter of an ounce more of logwood, which will render it still deeper; and by this method you may bring it to any degree of purple, by putting either more or less logwood to the former composition, and mixing it with alum. This will produce such a clear purple, as no mixture of reds and blues will produce. Madam Mariana of Amsterdam, famous for painting in miniature, and for her excellent manner of illuminating prints, says, "This purple that can be made, may be composed between the carmine and indigo;" to strengthen which on the red side, you may add lake, between the lighter and darker part; and lake, when it is used in the same way, produces a very fine effect. See Dyeing.

PURPURA. See Murca.

PURSER, an officer aboard a man of war, who receives her victuals from the victualler, that is it is well stowed, and keeps an account of what he every day delivers to the steward. He also keeps a list of the ship's company, and sets down exactly the day of each man's admission, in order to regulate the quantity of provisions to be delivered out; and that the purser be the only treasurer of the ship, who should lay out the disbursements, and pay off the men, according to his book.

PUS. The liquid called pus is secreted from the surface of an inflamed part, and usually moderates and terminates the inflammation. It presents different appearances according to the state of the sore. When it indicates a healing sore, it is called healthy or good-conditioned pus. This liquid possesses the following properties.

It is of a yellowish-white colour, and of a viscid and gummy nature. It is insipid, and has no taste when cold. Before the microscope it exhibits the appearance of white globules swimming in a transparent fluid.

It produces no change on vegetable drugs.

When exposed to a moderate heat it gradually dries, and assumes the appearance of horn. When exposed to destructive distillation, Bergman obtained a substance different from all others, and had the odour of carvone, with a sweetish, acidulous and pungent atmosphere. The pure residue obtained by sublimation, accompanied by empyreumatic oil. A light brilliant coal remained of difficult incineration. The ashes gave traces of iron.

When pus is left exposed to the air, it gradually becomes acid, according to Hildebrand; and Haller affirms that it sometimes gives a red colour to litmus even when recent. When thrown into water it sinks to the bottom. When exposed to the sun, the mixture becomes milky; but the pus separates again when allowed to remain undisturbed. By repeated agitation, however, and especially by the application of heat, a milky liquid is obtained, which passes in this state through the filter.

Alcohol thickens pus, but does not dissolve it; neither does pus unite with oils.

Sulphuric acid dissolves it, and forms a purple-coloured solution, which, when diluted with water, the dark colour disappears, and the pus separates; either sinking to the bottom, or rising to the surface, according to the quantity of water added, and the time that it has been allowed to stand. Diluted sulphuric acid does not act upon it.
When nitrate of silver is dropped into the solution of pus in water, a white precipitate separates. Nitrate and oxymuriate of mercury occasion a much more copious daily precipitate.

Such are the properties of healthy pus hitherto observed by chemists. Various observations have been made to enable physicians to distinguish pus from the mucus of the internal cavities, especially of the lungs. In cases of copious expectoration, it is sometimes of consequence to know whether the matter thrown out of the lungs is pus or mucus. Mr. Charles Darwin with his usual exactness pointed out three criteria to distinguish pus: 1. Sulphuric acid dissolves it. When the solution is diluted, the pus precipitates; but mucus treated in the same manner remains clear. But this distinction depends upon the quantity of water added, and is therefore ambiguous. 2. Pus is divisible through diluted sulphuric acid, through water, and through brine; but mucus is not. 3. Alkaline leys dissolve pus; water precipitates pus, but not mucus. If these two last distinctions prevail it is rather doubtful. Grahn's theory has the following method, which he considers as complete: Triturate the substance to be tried, with an equal quantity of warm water; then add to it an equal portion of a saturated solution of carbonate of potash, and set the mixture aside. If it contains pus, a transparent jelly subsides in a few hours; but this does not happen if only mucus is present.

2. When the ulcer is ill-continued, the pus secreted in it possesses different properties. It has usually a fetid smell, is much thinner, and to a certain degree acrid. We are in possession of two sets of experiments on this unhealthy pus: one by Mr. Cruickshank on the pus discharged from what is called the hospital sore; another by Dr. Crawford on the matter of cancers.

The pus from the hospital sore possesses most of the properties of healthy pus; but is distinguished by its odour, and by some shades of difference when exposed to the action of the metallic precipitates. Line water changes its fetid odour, but does not destroy it; sulphuric acid increases it, as do alcohol and the solution of oxide of arsenic in potas. Bark has no effect upon it; but it is destroyed by the nitrat and oxymuriat of mercury, by nitric acid, and by acetic acid. Nitrat of silver does not destroy it. Mr. Cruickshank supposes that the fetid smell is occasioned by the alteration of some part of true pus. He considers the pus in the hospital sore a matter sui generis, which is capable of generating more, and even of producing an alteration in the system. Hence to heal the sore the matter must be destroyed, and prevented from appearing again. This was done by washing the sores with nitrat of mercury, dilute sulphuric acid, and oxymuriatic acid, at every dressing. This method constantly succeeded with Dr. Rollo, except when the sore was too large to admit it to be put in practice completely.

3. The matter of cancer, examined by Dr. Crawford, gave a green colour to syrup of violets. Potas produced no change; but sulphuric acid etracted a gas which possessed many of the properties of sulphuric acid. This gas he supposed to exist in the matter united to ammonia. The presence of this compound explains the effects of the matter of cancer and virulent matter in general upon metallic salts. Dr. Crawford found that the odour of this matter was completely destroyed by oxymuriatic acid; and therefore recommends it as a proper substance for washing cancerous ulcers.

4. Besides the substances mentioned above, there are many others which we know from their effects to be peculiar, though we cannot find any chemical distinctions between them sufficiently well marked. But that they are specifically different is almost certain; we consider every one of them produces a disease peculiar to itself. The matter of small-pox, of venereal ulcers, of cowpox, &c., may be mentioned as instances.

The liquor which fills the cavities of the body is a yellowish-green colour, and seems sometimes turbid, sometimes nearly transparent. As far as it has been examined, it agrees exactly with the serum of the blood; and the liquid which makes its appearance when the epidermis is raised into blisters, is perfectly transparent and liquid. When the blisters are artificial, it is usually yellow, and has the odour of the blistering-plaster. From the experiments of Margueron, we learn that it is composed of the same constituents as the serum of the blood. From 200 parts of this liquor, we obtained:

| 36 albumen | 4 nitrat of soda |
| 3 carbonat of soda | 2 phlogist of lime | 156 water |

200.

PUTLOGS, or POUTLOCKS, in building, are short pieces of timber about seven feet long, used in building scaffolds. They lie at right angles to the wall, with one of their ends resting upon it, and the other upon the poles which lie parallel to the side of the wall of the building.

PUTREFACTION. The rapidity with which animal bodies undergo decomposition, and the disgusting fœtus which accompanies this decomposition, have long been considered as some of their most striking peculiari-

The spontaneous and minute putrefaction. Considerable attention has been paid to it by chemists. Bec-

Char and Stahl have described with fidelity the phenomena with which it is attended, and the circumstances necessary for its take-

Sir John Pringle we are indebted for some important experiments on the method of retarding putrefaction; neither are the experiments of Dr. Macbride less valuable, though the consequences which he

We are indebted also to Crelly and Priestley for many valuable facts; and to Berthollet and Lavoisier for the first attempts to determine the real changes which take place in the matter in which the new products which appear during putrefaction are formed. Resisting the labours of these philosophers, and of many others, much is still wanting to enable us to trace the complicated changes which take place during putrefaction, and to account for them in a satisfac-

It has been ascertained long ago, that putrefaction never takes place in those animal substances which contain only two or three ingredients, such as oils, resins, sugars; but even then it may be, it does not putrefy unless moisture is present; for dry animal substances are not susceptible of alteration. A certain degree of heat is also necessary. Animal bodies may be kept without decomposition at the freezing temperature. In general the higher the temperature, the more rapid is the putrefaction, provided the heat is not great enough to reduce the animal body to dryness. It is then, that putrefaction advances with more rapidity in the open air; but exposure to the air is not necessary, though it modifies the decomposition.

When these conditions are observed, and dead animal matter is left to itself, its colour becomes gradually paler, and its consistence diminishes; if it is a solid part, such as flesh, it softens, and a serum flows out, the colour of which quickly changes; the texture of the part becomes relaxed, and its organization destroyed; it acquires a disagreeable smell; the substance gradually sinks down, and is diminished in bulk; its smell becomes stronger and ammoniacal. If the subject is contained in a close vessel, the progress of putrefaction, at this stage, seems to slacken; no other smell but that of a pungent alkali is perceived; the purges of acids and nitric acid, and converts syrup of violets to a green. But if the communication with the air is admitted, the unius exhalation is dissipated, and a peculiar putrid smell is spread around with a kind of impetu-

The matter is then digested, and in a manner confined, by ammonia. When the latter is volatilized, the putrefactive process becomes active a second time, and the substance suddenly swells up, becomes filled with bubbles of air, and soon after subsides again. Its colour changes, the tawny texture of the flesh being then scarcely distinguishable; and the whole is changed into a soft brown, or greenish matter, of the consistence of a putrid, whose smell is faint, nauseous, and very active on the bodies of animals. The odorous principle gradually loses its force; the fluid portion of the flesh assumes a kind of consistence, its colour becomes deeper, and it is finally reduced into a friable matter, rather deliquescent; which

drawn from them were erroneous. We are
being rubbed between the fingers, breaks into a coarse powder like earth. This is the last state observed in the putrefaction of animal substances; they do not arrive at this term but at the end of a considerable time.

During this decomposition, a variety of gaseous bodies are emitted; these vary according to the substance to which putrefaction; but they consist chiefly of hydrogen gas, holding sulphur, phosphorus, and carbon, in solution; of ammonia, water, and carbolic acid, and perhaps also of nitric gas. Nitric acid is in some cases to be formed and emitted. The earth-like residuum, which remains after the decomposition is completed, consists of the fixed parts of the animal substance, mixed with charcoal, oil, and amonnia. Thus it appears that putrefaction consists in a total decomposition of the animal body; the elements of which combine together two and two, and thus form a new set of less complicated bodies. But as attempts to explain the manner in which these changes take place would be exceedingly imperfect indeed; not only because we are ignorant of the strength of the action of the different elementary parts of animal bodies, in this, as in other cases, but because we do not even know the manner in which these elements are combined, and consequently we cannot know by what particular force these compounds are destroyed.

In carcases buried in the earth, putrefaction takes place much more slowly; but it is scarcely possible to observe its progress with accuracy. The abdomen is gradually diluted with elastic fluids which make their appearance in it, and at last it bursts and discharges a horrible fetid and noxious gas; at the same time a dark-coloured liquid flows out. If the earth is very dry, and the heat considerable, the moisture is often absorbed so rapidly, that the carcass, instead of putrefying, dries, and is transformed into what is called a mummy.

Such are the phenomena when dead bodies are left to putrefy separately; but when great numbers of carcases are crowded together, and are so abundant as to exclude the action of external air and other foreign agents, their decomposition is entirely the consequence of the reciprocal action of the ingredients themselves upon each other, and the result is very different. The body is not entirely dissipated or reduced to mould, but all the soft parts are found diminished remarkably in size, and converted into a peculiar sapopaneous matter. This singular change was first accurately observed in the year 1786.

The burial-ground of the Innocents in Paris having become noxious to those who lived in its neighbourhood, an account of the disagreeable and hurtful odour which it exhaled, it was found necessary to remove the carcases to another place. It had been usual to dig very large pits in the burial-ground, and to fill them with the carcases of the superfluous part of the people, each in its proper hier; and when they were quite full, to cover them with about a foot deep of earth, and to dig another similar pit, and fill it in the same manner. Each pit held between one thousand and fifteen hundred bodies; and in removing the bodies from these pits that the sapopaneous substance was found. The grave-diggers had ascertained by long experience, that about thirty years were required before all the bodies had undergone this change in its full extent. Every part of the body acquired the properties of this substance. The intestines and viscera of the thorax had completely disappeared; but what is singular enough, the skin had lost but little of its size or appearance, though it was also converted into the same substance.

This sapopaneous matter was of a white colour, soft and unctionous to the touch, and melted, when heated, like tallow. It exhibited all the properties of a soap, containing, however, an excess of fatty matter. Fourier, who analysed it, found that it was composed of a fatty matter combined with amonnia, and that it contained also some phos phoric and carbonate of lime. Diluted acids decomposed it, and separated the fatty matter; alkalies and lime, on the other hand, drove off the ammonia. When exposed to the air, it gradually lost its white colour; the amonnia, in a great measure, evaporated; and what remained had something of the appearance of wax. It absorbed water with great avidity, and did not part with it readily. Its white colour was owing to the presence of that fatty matter, when separated by means of a diluted alkali, was converted, and of a white colour, owing to the mixture of a quantity of water. When dried, it acquires a greyish-brown colour, with a lamellar or crystalline texture, like that of spermaceti; but if it has been rapidly dried, it assumes the appearance of wax. It melts when heated to 136°; when properly purified, by passing it through a linen cloth while fluid, it has the consistence of Alcohols does not act upon it while cold, but at the temperature of 120° it dissolves it; when the solution cools, the fatty matter precipitates, and forms a gritty mass. With alka lies it forms a soap; and when set on fire it burns precisely like oil or fat, only that it exahes a more unpleasant odour.

Mr. Smith Gibbes found the same substance in the pit into which animal matters were thrown at Oxford after dissection. A small stream of water constantly passes through this pit; a circumstance which induced him to try whether animal muscle exposed to the action of a running stream underwent the same change. The experiment succeeded completely; he attempted, in consequence, to render this substance, to which he gave the name of spermaceti, useful in those manufactures which require tallow; but the felid odour which it constantly exhales was an insurmountable objection. Attempts were indeed made to get over it; and a manufacturer of Mr. Smith Gibbes's spermaceti was even established at Bristol.

Many attempts have been made to retard the destructive progress of putrefaction, in order to preserve animal bodies either as food or for other useful purposes; and several methods have been ascertained which prevent it from operating for a considerable time.

1. The freezing temperature is a complete preservation from putrefaction, as long as the animal substance is exposed to it. Hence the common practice of keeping meat in snow in the frozen climates of the north; and of putting fish in ice, and sending them in that state from Scotland to the London market.

2. Almost all bodies which have a strong affinity for water retard putrefaction for a longer or shorter time, doubtless by depriving the animal substances of their water, or preventing that liquid from acting upon these bodies in its usual manner. In this way the action of sugar, alcohol, &c, seem to prevent or retard putrefaction.

3. It is well known that common salt is a powerful antiseptic. Hence the practice of salting meat, and the length of time which that has undergone this operation may be kept. Several other salts, especially nitre, possess the same property. In what it seems these bodies act has not been ascertained; but they undoubtedly produce some chemical change upon the meat; for they alter its taste, its colour, and other sensible properties.

4. Many aromatics, such as camphor, resins, volatile oils, bitumens, and other similar substances, act with considerable efficacy in preserving animal bodies from putrefaction. Hence their utility in embalming. In what the action of these substances consists has not been ascertained. Part of their efficacy can be accounted for to the rapidity with which the animal substances are applied to their moisture; and something may be ascribed likewise to their odour, which keeps insects at a distance, and thus prevents the lodging of excrementitious matters, which always acts powerfully as a putrefactive ferment.

PUTI coruja, in botany, is a genus of Indian plants, of which the characters, as given by Sir William Jones in the Asiatic Researches, vol. ii, p. 331, are these: The calyx is five-cleft; the corolla has five equal petals; the pericarpium a thorny leuqemum and two seeds, the leaves oval and pinnated, and the stem armed. "The seeds (says the learned president) are very bitter, and perhaps toxic; since one of them, bruised and given in two doses, will cure the intermittent fever."

PUTTICA, in the arts. When tin is melted in an open vessel, its surface soon becomes covered with a grey powder, which is an oxide of the metal; but when it is boiled, the colour of the powder gradually changes, and at last becomes yellow. In this state it is known by the name of putty, and employed in polishing glass and other hard substances.

PUTTY is also a kind of paste compounded of whiting and linseed-oil, beaten together to the consistence of a thick dough. It is used by glaziers for the fastening in the squares of glass in sash-windows, and by painters for stopping up the crevices and clerfs in timber and wainscots, &c.

PUZZULANA or PUZZOLANA, terras, is a greyish kind of earth used in Italy for building under water. The best is from the island of Procida, Baie, and Cuma, in the kingdom of Naples, and for the first of which places it derives its name. It is supposed to be a volcanic product, composed of heterogeneous substances, thrown out from the burning mouths of volcanoes in the form of ashes; sometimes in such large quantities, and with so great violence, that whole provinces have been covered with it at a considerable distance. This volcanic earth is of
PYRAMID, in architecture, a solid massive building, which from a square, triangular, or other base, rises diminishing to a vertex or point.

Pyramids are sometimes used to preserve the memory of singular events; and some tombs to transmit to posterity the glory and magnificence of princes. But as they are esteemed a symbol of immortality, they are easily transitioned into funeral monuments. Such are that of Cestius of Rome; and those that exist on the bank of the Seine are Pyramids of Egypt, as famous for the enormity of their size as their antiquity. These are situated on the west side of the Nile, almost opposite to Grand Cairo; the base of the largest covers more than ten thousand square feet; and it, according to some, near seven hundred feet high, though others make it six hundred, and some but little more than five hundred. The pyramid is said to have been, among the Egyptians, a symbol of the union of the two parts of which is represented by the base, and the end by the apex; on which account it was, that they used to erect them over sepulchres.

PYRAMIDALIA CORPORA. See Anatomy.

PYRITES, a genus of innumerable substances, composed of sulphur, which has dissolved or saturated itself with metal. Thus there are many kinds of pyrites; as of gold, arsenic, iron, &c. It is also the principal ore of sulphur; particularly called martail pyrites, pyrites-copper-stone, or marcasite. This is very common, containing a quantity of sulphur in proportion to the iron, and, when thoroughly inflamed, burns by itself. It is either of a compact texture, steel-grained, coarse-grained, or crystallized. In the last form, it is also a cube and octahedral figures, though it is met with also in innumerable other forms. The liver-coloured marcasite has an appearance between that of the preceding and the blue-copper-stone, but contains in this kind, so that it is less fit than the other for extracting sulphur for it, or for the smelting of copper ores. It is formed of a compact texture, coarse-grained, or steel-grained. See Sulphur, Iron, &c.

PYROLA, winter-green, a genus of the monogynia order, in the decandra class of plants; and in the natural method ranking under the 18th order, bines. The calyx is quinquosepalate; there are five petals; the capsule is quinquefructate, opening at the angles. There are six species, natives of Britain.

PYROMETER, an instrument for measuring the expansion of bodies by heat. Mischenbroeck, who was the original inventor of this machine, has given a table of the expansion of the different metals in the same degree of heat. Having prepared cylindrical rods of iron, steel, copper, brass, tin, and lead, he exposed them first to a pyrometer with one flame in the middle; then with two flames; and finally to one with three, four, and five flames. But previous to this trial, he took care to cool them equally, by exposing them some time upon the same stone, when it began to freeze, and Fahrenheit's thermometer was at thirty-two degrees. The effects of this experiment are digested in the following table, where the degrees of expansion are marked in parts equal to 1/2500th of an inch.

<table>
<thead>
<tr>
<th>Metal</th>
<th>1 flame</th>
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<th>3 flames</th>
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<td>60</td>
<td>67</td>
<td>70</td>
</tr>
</tbody>
</table>

It is to be observed of tin, that it will easily melt when heated by two flames placed together. Lead commonly melts with three flames placed together, especially if they burn long.

From these experiments, it appears at first view that iron is the least rared of any of these metals, whether it is heated by one or more flames; and therefore is most proper for making machines or instruments which we should have free from any alternations by heat or cold, as the rods of pendulums for clocks, &c. So likewise the measures of yards or feet should be made of iron, that their length may be as nearly as possible the same in summer and in winter. The expansion of lead and that of tin are nearly the same; that is, almost double the expansion of iron. It is likewise observable, that the flames placed together, cause a greater rarefaction than when they have a sensible interval between them; iron in the former case being expanded 117 degrees, and only 109 in the latter; the reason of which difference is obvious.

By comparing the expansions of the same metal produced by one, two, three, or more flames, it appears that two flames do not cause double the expansion of one, nor three flames three times the expansion, as was always supposed; and these expansions differ so much the more from the ratio of the number of flames, as there are more flames acting at the same time.

It is also observable, that metals are not expanded equally at the time of their melting, but some more and some less. Thus tin began to run when rared 219 degrees; whereas brass was expanded 377 degrees, and yet was far from melting.

Mr. Elliot found, upon a medium, that the expansion of bars of different metals, as nearly of the same dimensions as possible, by the same degree of heat, were as follows:

<table>
<thead>
<tr>
<th>Metal</th>
<th>By 1 flame</th>
<th>By 2 flames</th>
<th>By 3 flames</th>
<th>By 4 flames</th>
<th>By 5 flames</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gold</td>
<td>50</td>
<td>55</td>
<td>60</td>
<td>65</td>
<td>70</td>
</tr>
<tr>
<td>Silver</td>
<td>55</td>
<td>60</td>
<td>65</td>
<td>70</td>
<td>75</td>
</tr>
<tr>
<td>Brass</td>
<td>60</td>
<td>70</td>
<td>80</td>
<td>90</td>
<td>100</td>
</tr>
<tr>
<td>Copper</td>
<td>70</td>
<td>80</td>
<td>90</td>
<td>100</td>
<td>110</td>
</tr>
<tr>
<td>Iron</td>
<td>80</td>
<td>90</td>
<td>100</td>
<td>110</td>
<td>120</td>
</tr>
<tr>
<td>Lead</td>
<td>90</td>
<td>100</td>
<td>110</td>
<td>120</td>
<td>130</td>
</tr>
</tbody>
</table>

The great difference between the expansions of iron and brass has been applied with good success to remedy the irregularities in pendulums arising from heat.

Mr. Graham used to measure the minute
alteration in length of metal bars, by advancing the point of a micrometer-screw, till it sensibly stopped against the end of the bar to be measured. This screw, being small and very lightly hung, was capable of agreement within the three or four thousandth part of an inch. In this general principle, Mr. Swaton contrived his pyrometer, in which the measures are determined by the contact of a piece of metal with the point of a micrometer-screw.

The following table shows how much a foot is length of each metal grows longer by an increase of heat corresponding to 180° of Fahrenheit's thermometer, or to the difference between freezing and boiling water, expressed in parts of which the unit is equal to the 10,000th part of an inch.

1. White glass barometer-tube, 100
2. Martial regulus of antimony, 139
3. Blistered steel, 138
4. Hard steel, 147
5. Iron, 131
6. Bismuth, 107
7. Copper hammered, 204
8. Copper eight parts, with tin one 218
9. Brass six parts, with tin one 225
10. Brass sixteen parts, with tin one 290
12. Speculum-metal, 232
13. Spelter-solder, viz. brass two parts, 247
14. Fine pewter, 274
15. Grain tin, 298
16. Soft solder, viz lead two, tin one, 301
17. Zinc eight parts, with tin one, a little hammered, 343
18. Lead, 344
19. Zinc or spelter, 353
20. Zinc hammered half an inch per foot, 473

PYROPS, a mineral found in Bohemia, which was formerly distinguished by the name of Bohemian garnet. It is never found crystallized, but only in round or angular fragments, usually small. Colour deep red, which passes to orange when the mineral is exposed to the sun. It is very hard; the specific gravity is from 3.7 to 3.9. Fracture conchoidal, very brilliant. It is composed of

40.00 silica
28.50 alumina
10.00 magnesia
3.30 lime
16.30 oxide of iron
0.55 oxide of manganese.

98.75

PYROPHIUS, a substance which has the property of catching fire whenever it is exposed to the open air. See SULPHURS.

PYROSTRIA, a genus of the tetraneura monogynia class and order. The cal. is emarginated; cor. bell-shaped; nuts eight, one-seeded. There is one species, a small tree of Mauritius.

PYROTECHNY, the art of fire, or a science which teaches the management and application of fire in several operations. But the term is more particularly used to denote the doctrine of artificial fireworks.

Of ingredients and compositions.

1. Saltpetre is the principal ingredient in fire-works; but will not answer so well when mixed with earthy, and only when purified from its crude and earthy parts, which greatly retard its velocity; when, therefore, any quantity of fire-works are to be made, it should be examined; for if it is not well cleansed, and of a good sort, your works will not have their proper effect; and this will agree with the statements of compositions.

To refine it, put into a copper, or any other vessel, 100 lb. of rough nitre with 14 gallons of clean water; let it boil gently half an hour, and as it boils take off the scum; then stir it, and before it sets put it into your filtering-bags, which must be hung on a rack, with glazed earthen pans under them, in which must be sticks laid across for the crystals to adhere to; it must stand in the pans two or three days to shoot; then take out the crystals, and let them dry. The water that remains in the pans boil again an hour, and strain it into the pans as before, and the saltpetre will be quite clear and transparent; if not, it wants more refining; to which end it is necessary to proceed as usual, till it is well cleansed of all its earthy parts.

N.B. Those who do not chuse to procure their saltpetre by the above method, may buy it in bags, which are better for fire-works in general will answer.

To pulverise saltpetre. Take a copper kettle, whose bottom must be spherical, and put into it 14 lb. of refined saltpetre, with 2 quarts or five parts of clean water; then put in a pint of saltpetre, and when the kettle is boiled, and the saltpetre dissolved, if any impurities arise, skim them off, and keep constantly stirring it with two large spatulas, till all the water vanishes; and when done enough, it will appear like white sand, as fine as flour; but if it should boil too fast, take the kettle off the fire, and set it on some wet sand, which will prevent the nitre from sticking to the kettle. When you have pulverised a quantity of saltpetre, be careful to keep it in a dry place.

2. Sulphur is one of the principal ingredients in gunpowder, and almost in all compositions of fire-works; and therefore great care must be taken of its being good, and brought to the highest perfection. To know when sulphur is good, you are to observe that it is of a high yellow; and if, when held in one's hand, it crackles and bounces, it is a sign that it is fresh and good: but as the method of reducing brimstone to a powdery state is very troublesome, it is better to buy the flour ready-made, which is done in large quantities, and in great perfection; though when a grand collection of fire-works is to be made, the strongest and best sulphur is the lump-brimstone well ground.

3. Charcoal for fire-works must always be soft and well burnt, which may be bought ready-done.

4. See Gunpowder in the order of the alphabet. It is unclealed or ground in mortars, &c.

5. Camphor may be had in the shops; and is of two kinds, differing in regard to the degree of their purity, and distinguished by the name of rough and refined. Refined camphor must be chosen of a perfectly clean white colour, very bright and pellicuid, of the same smell and taste with the rough, but more acid and pungent.

6. Benzoic acid is one of the ingredients in coloriferous fire-works, when reduced to a fine flour; which may be done by putting into a deep and narrow earthen pot between three and four ounces of benzoin gum, pounded; cover the pot with paper, which tie very closely round the edge; then set the pot on a slow fire, and once in an hour take your hand to the pot; and you will find some flour sticking to it, which, when mixed with the ingredients in the pot; this you must continue till the flour appears white and fine. There is also an oil of began, which is sometimes drawn from the dregs of the flower; it affords a very good scent, and may be used in wet compositions.

7. Spur-fire. As the beauty of this composition cannot be seen at so great a distance as brilliant fire, it has a better effect in a room than in the open air. I may be fired in a chimney without any danger; it is of so innocent a nature, that, though with an improper phrase, it may be called a cold fire; and so extraordinary is the fire produced, that if well made, the sparks will not burn a hand when held in the midst of them; you may hold them in your hand while burning, with as much safety as a candle; and if you do it in your hand with the mouth of the case, you will feel the sparks like drops of rain. When any of these spur-fires are fired singly, they are called artificial flowers; but some of them placed round a tapering pyramid of paper, and fired in a large room, make a very pretty appearance.

The composition consists of saltpetre 4 lb. 8 oz., sulphur 2 lb., and lamp-black 1 lb. 8 oz.; of which 1 lb. is burnt in 1 lb. 4 oz. of lampblack 3 parts. This composition is very difficult to mix. The saltpetre and brimstone must be first sifted together, and then put into a marble mortar, and the lamp-black with them, with you work down by degrees with a wooden pestle, till all the ingredients appear of one colour, which will be something greyish, but very near black; then drive a little air into the case for trial, and fire it in a dark place; and if the sparks appear as called stars, or pinks, come out in clusters, and afterwards spread well without any other sparks, it is a sign of its being good, other- wise not; for if any dusky sparks appear, and the stars not come out, then it is not mixed enough; but if the pinks are very small, and soon break, it is a sign that you have rubbed it too much. The reason of its being called spur fire, is because the sparks it yields have a great resemblance to the ruffles of a spur.

8. To prepare cast iron for gerbes, white fountains, and Chinese fire. Cast iron being of so hard a nature as not to be cut by a file, we are obliged to reduce it into grains, though somewhat difficult to perform; but if we consider what beautiful sparks this sort of iron yields, no pains should be spared to granulate such an essential material to such a degree, as to get at it; by very some thin pieces of iron, such as generally run over the mould at the time of casting; then have a square block made of cast iron, and an iron square hammer about four pounds weight; then, having covered the floor with cloth or something to catch the beatings, lay the thin pieces of iron on the block, and beat them with the hammer till reduced into small grains; which afterwards seare with a very fine sieve, to separate the fine dust, which is sometimes used in small cases of brilliant fire instead of steel-dust; and when you have got
out all the dust, sift what remains with a sieve a little larger, and mix well on which sieve you have sifted, till the iron passes through about the bigness of small bird-shot: your iron thus beaten and sifted, put each sort into wooden boxes or oiled paper, to keep it from rusting, and store it in a dry place. In the difference of its size, in proportion to the cases for which the charge is intended; for the coarse sort is only designed for very large gerbes of 6 or 8 lb.

9. Charges for sky-rockets, &c. Rockets of four ounces each, may have powder one lb. of saltpetre four oz. and charcoal two oz. Rockets of eight ounces. I. Meal-powder one lb. saltpetre four oz. brimstone three oz. and charcoal one and a half oz. II. Meal-powder one lb. and brimstone one and a half lb. and a half oz. Rockets of one pound. Meal-powder two lb. saltpetre eight oz. brimstone four oz. charcoal two oz. and steel filings one and a half oz. Sky-rockets in general. I. Saltpetre eight lb. brimstone one lb. and charcoal one and a half lb. II. Saltpetre four lb. brimstone one half and a half lb. charcoal one and a half lb. III. Meal-powder one lb. and brimstone one lb. and charcoal one lb.

10. For rocket-stars. White stars. Meal-powder four oz. saltpetre twelve oz. sulphur vivum six oz. oil of spike two oz. and camphor five oz. Blue stars. Meal-powder eight oz. saltpetre four oz. sulphur two oz. spirit of wine two oz. and oil of spike two oz. Coloured or variegated stars. Meal-powder eight drams. rockphatre four oz. sulphur vivum two oz. and camphor two oz. Brilliant stars. Saltpetre three and a half lb. sulphur one lb. and charcoal meal-powder three and a half lb. worked up with spirits of wine only. Common stars. Saltpetre one lb. brimstone four oz. antimony four and three-fourths, isinglass a half, camphor a half, spirit of wine six oz. II. Meal-powder one lb. saltpetre one oz. and charcoal. Failed stars. Meal-powder three oz. brimstone two oz. saltpetre one oz. and charcoal (coarsely ground) three-fourths. Drove stars. I. Saltpetre three lb. sulphur one lb. brass dust twelve oz. and antimony one half lb. II. Saltpetre one lb. antimony four oz. and sulphur eight oz. Fixed pointed stars. Saltpetre eight and a half oz. sulphur two oz. antimony one oz. ten dr. Stars of a fine colour. Salpeter one oz. meal-powder one oz. saltpetre one oz. camphor four dr. oil of turpentine four dr.

11. Rain. Gold rain for sky-rockets. I. Saltpetre one lb. meal-powder four oz. sulphur four, brass dust one oz. sawdust two and a quarter, and glassyBeginners do not ask for a ceiling of importance. 975. 8. Meal-powder twelve oz. saltpetre two oz. charcoal four. III. Saltpetre eight oz. brimstone two oz. glass-dust one, antimony three-fourths, brass dust one-quarter, and saw dust twelve oz. Silver rain. I. Meal-powder one oz. sulphur, meal-powder, and antimony, of each two oz. sal prunella one half oz. II. Saltpetre one half lb. brimstone two oz. and charcoal four. III. Saltpetre one lb. brimstone one quarter lb. antimony one oz. and charcoal four oz. IV. Saltpetre four oz. brimstone one oz. powder two oz. and steel-dust three-fourths oz.

12. Water-rockets. I. Meal-powder six lb. saltpetre four, brimstone three oz. charcoal five. Vol. II. II. Saltpetre one lb. brimstone four and a half oz. charcoal three oz. III. Saltpetre one lb. of brimstone four oz. charcoal twelve. IV. Saltpetre four lb. brimstone 1 1/2 lb. charcoal one lb. twelve oz. V. Brimstone two lb. saltpetre four lb. and meal-powder four oz. VI. Saltpetre one lb. meal-powder one lb. and brimstone eight and a half, and charcoal two. VII. Meal-powder one lb. saltpetre three, brimstone one oz. sea coal one oz. charcoal eight and a half, and saw dust three-fourths, steel dust one-half, and charcoal four oz. VIII. Meal-powder one and three-fourths lb. saltpetre three, sulphur one and a half, charcoal twelve oz. saw dust two oz. Sinking charge for water rockets. Meal-powder eight oz. charcoal four and three-fourths oz. Large tourbillons. Meal-powder two lb. saltpetre four oz. charcoal twelve oz. and antimony six and a half oz. Tourbillons may be made very large, and of different coloured fires: only you have to observe, that the longer they are, the weaker must be the charge: and, on the contrary, the smaller, the stronger. For illuminations.

20. Water balloons. I. Saltpetre four lb. brimstone two, meal-powder two oz. antimony four oz. saw dust four, glass dust one and one-half. II. Saltpetre nine lb. brimstone three lb. meal-powder six oz. and antimony eight oz. and charcoal six oz.

21. Water squibs. I. Meal-powder one lb. and charcoal one lb. II. Meal-powder one lb. and charcoal nine oz.

22. Mine pots or serpents. I. Meal-powder one lb. and charcoal one oz. II. Meal-powder nine oz. charcoal one oz.

23. Port-fires. For firing rockets, &c. I. Saltpetre twelve oz. brimstone four oz and meal-powder two oz. II. Saltpetre eight oz. brimstone four oz. and meal-powder two oz. III. Saltpetre one lb. meal-powder one oz and one-half lb. and charcoal ten oz. This composition must be moistened with one gill of water before use. IV. Meal-powder oz. saltpetre two lb. two oz. and brimstone ten oz. V. Saltpetre one lb. four oz. meal-powder four oz. brimstone five oz. saw dust eight oz. VI. Saltpetre eight oz. brimstone two oz. and meal-powder two oz.

24. Cones or spiral wheels. Saltpetre one and one-half lb. brimstone six oz. meal-powder fourteen oz. and glass dust fourteen oz.

25. Crowns or globes. Saltpetre six oz. brimstone two lb. antimony four oz. and camphor two oz.

26. Air-balloon fuses. I. Saltpetre one lb. meal-powder one oz. brimstone eight oz. and charcoal one lb. six oz. II. Saltpetre one oz. charcoal eight oz. and meal-powder one oz.

27. Serpents for pots des bras. Meal-powder one lb. eight oz. saltpetre twelve oz. and charcoal two oz.

28. Fire pumps. I. Saltpetre five lb. brimstone one lb. meal-powder one oxide and one-half lb. and glass dust one lb. II. Saltpetre five lb. eight oz. brimstone two lb. meal-powder one lb. eight oz. and glass dust one lb. eight oz.

29. A slow white flame. I. Saltpetre two lb. brimstone three lb. antimony one oz. II. Saltpetre three and one-half lb. sulphur two lb. sulphur one and one-half lb. meal-powder one lb. antimony one lb. glass dust four oz. brass dust one oz. N. B. These compositions, driven one-fourth inch in a one-oz. case, will burn one minute; which is much longer than an equal quantity of any composition, yet known will last.

30. Amber lights. Meal-powder nine oz. amber three oz. This charge may be drove in small cases, for illuminations.

31. Lights of another kind. Saltpetre three lb. brimstone one lb. meal-powder one lb. antimony ten and one-half oz. All these must be mixed with the oil of spike.

32. A red fire. Tourbillon three lb. brimstone charcoal twelve oz. and saw dust eight oz.

33. A common fire. Saltpetre three lb. charcoal ten oz. and brimstone two oz.
34. To make an artificial earthquake. Mix the following ingredients to a paste with water, and then bury it in the ground, and in a few hours the earth will break and open in several places, and such colour composition: sulphur 4 lb., and steel-dust 4 lb.

35. Compositions for stars of different colours. 1. Meal-powder 4 oz. saltpetre 2 oz. brimstone 2 oz. steel-dust 14 oz. and camphor, white amber, antimony, and mercury sublimate, of each half an ounce. 2. Rockepetre 10 oz. brimstone, charcoal, antimony, meal-powder, and camphor, of each 1 oz. moistened with oil of turpentine. These compositions are made into stars, by working into a paste, with aqua vitae, in which has been dissolved some gum tragacanth; after you have rolled them in powder, make a hole through the middle of each, and string them on quick-match, leaving two inches between each.

3. Saltpetre 8 oz. brimstone 2 oz. yellow amber 1 oz. antimony 1 oz. and powder 3 oz. 4. Brimstone 2 oz. saltpetre 6 oz. alumbrum or frankincense in drops 4 oz.; mastix, and mercury sulphate, of each 4 oz. meal-powder 5 oz. white amber, yellow amber, and camphor, of each 1 oz. antimony and operaquin ½ oz. each. 5. Saltpetre 1 lb. brimstone ½ lb. meal-powder 6 oz. moistened with petrolio-oil. 6. Powder ½ lb. brimstone and salt-petre of each 4 oz. 7. Saltpetre 4 oz. brimstone 2 oz. and meal-powder 1 oz.

Stars that carry tails of sparks. 1. Brimstone 6 oz. antimony crude 2 oz. saltpetre 4 oz. and powder 4 oz. 2. Saltpetre, resin, and charcoal, of each 2 oz. brimstone 1 oz. and pitch 1 oz. These compositions are sometimes melted in an earthen pan, and mixed with chopped cotton match, before they are rolled into stars; but will do as well if wetted, and worked up in the usual manner.

Stars that yield some sparks. 1. Camphor 2 oz. saltpetre 1 oz. meal-powder 1 oz. 2. Saltpetre 1 oz. ditto melted ¼ oz. and camphor 2 oz. When you would make stars of either of these compositions, you must wet them with gun water, or spirit of wine, in which has been dissolved some gum arabic, or gum tragacanth, that the whole may have the appearance of a pretty thick liquid; having thus done, take 1 oz. of lint, and stir it about in the composition till it becomes dry enough to roll into stars.

Stars of a yellowish colour. Take 4 oz. of gum tragacanth or gum arabic, pounded and sifted through a fine sieve, camphor dissolved in brandy 2 oz. saltpetre 1 lb. sulphur ¼ lb. coarse powder of glass 4 oz. white amber 1 oz. orpiment 2 oz. Being well incorporated, make them into stars after the common method.

Stars of another kind. Take 1 lb. of camphor, and melt it in a pint of spirit of wine over a slow fire; then add to it 1 lb. of gum arabic that has been dissolved, with this liquor mix 1 lb. of saltpetre, 6 oz. of sulphur, and 5 oz. meal-powder; and after you have stirred them well together, roll them into stars proportionable to the rockets for which you intend the ingredients.

36. Colours produced by the different compositions. As variety of fires adds greatly to a collection of works, it is necessary that every artist should know the different effect of each ingredient. For this reason we shall here explain the colours they produce of themselves, and likewise how to make them retain the same when mixed with other bodies. As, for example, sulphur gives a blue, camphor a white or pale colour; saltpetre a colour inclining to yellow, sal ammoniac a green, antimony a reddish, resin a copper-colour, and Greek pitch a kind of bronze, or between red and yellow. All these ingredients are such as show themselves in a flame, viz.

White flame. Saltpetre, sulphur, meal-powder, and camphor: the saltpetre must be the chief part.

Blue flame. Meal-powder, saltpetre, and sulphur vivum; sulphur must be the chief; or meal-powder, saltpetre, brimstone, spirit of wine, and oil of spike; but let the powder be the principal part.

Flame inclining to red. Saltpetre, sulphur, antimony, and Greek pitch: saltpetre the chief.

By the above method may be made various colours of fire, as the practicant pleases; for taking a few trials, he may cause any ingredient to be predominant in colour.

37. Ingredients that show is sparks when rammed in clogged cases. The set colours of fire point out the following four sorts, viz. the black, white, grey, and red. The black charges are composed of two ingredients, which are meal-powder and charcoal: the white of three, viz. saltpetre, sulphur, and charcoal; the grey of our, viz. meal-powder, saltpetre, brimstone, and charcoal; and the red of three, viz. meal-powder, charcoal, and sawdust.

38. Cotton quick-match, is generally made of such cotton as is put in candles, of several sizes, from one to six threads thick, according to the pipe it is designed for; which pipe must be large enough for the match, when made, to be pushed in easily without breaking it.

The ingredients for the match are, cotton 1 lb. 1 oz. saltpetre 1 lb. spirit of wine 2 quarts, water 3 quarts, singlass 3 gills, and meal-powder 16 lbs. To dissolve 4 oz. of singlass, take 3 pints of water.

39. Touch-paper for capping of serpents, crackers, &c. Dissolve in spirit of wine or vinegar, a little saltpetre; then take some purple or blue paper, and wet it with this liquor, and when dry it will be fit for use. When you paste this paper, any of your works, take care that the paste does not touch that part which is to burn.

Dimensions for Rocket Moulds, if the Rockets are rammed solid.

Weight of rockets. Length of moulds without their feet. Interior diameter of the moulds. Height of the nippes.


6 0 347 2,5 1,5
2 0 335 2,0 1,4
1 0 323 2,1 1,0
8 0 10,125 1,395, &c. 0,6
4 0 5,72 1,124 0,5
0 2 6,2 0,9 0,45
0 1 4,9 0,7 0,35
0 1 4,9 0,55 0,25
6 drams 2,5 0,5 0,25
4 drams 1,9 0,3 0,2

41. Moulds for wheel-cases or serpents. Lay your cases, and let one end of the board lie on the table; then press hard on it, and push it forwards, which will roll the paper very tight; do this three or four times before you roll it on all. Having thus done, you must have a smooth board, about 20 inches long, and equal in breadth to the length of the case. In the middle of this board must be a handle placed lengthwise. Under this board you must let the edge of the board lie on the table; then press hard on it, and push it forwards, which will roll the paper very tight; do this three or four times before you roll it on all. This must be repeated every other sheet of paper, till the case is thick enough; but if the rolling-board is drawn backwards, it will loosen the paper: you are to observe when you roll on the last sheet, that the edge is placed at the small end of the roller. When the cases are hard to chock, let each sheet of paper (except the first and last, in that part where the neck is formed), be a little moistened with water; immediately after you have stuck the concave stroke, bind the neck of the case round with small twine, which must
not be field in a knot, but fastened with two or three hitches.

Having thus pinched and tied the case so as not to give way, put it into the mould without its foot, and with a mallet drive the former hard on the end piece, which will force the neck close and smooth. This done, cut the case to its proper length, allowing from the neck to the edge of the mouth half a diameter, which is equal to the height of the nipple; then with a mallet, if it is to be, open the case over the piercer with the long rammer, and the vent will be of a proper size. Wheel-cases must be driven on a nipple with a point to close the neck, and made to count of the size required; which, in most cases, is generally one-quarter of their interior diameter. As it is very often difficult, when the cases are rolled, to draw the roller out, you may make a hole through the handle, and put in it a small iron pin, by which you may easily turn the former round and pull it out.

Cases are commonly rolled wet, for wheels and fixed pieces; and when they are required to be of a great length, the method of making such cases is this: your paper must be cut as usual, only the last sheet must not be cut with a slope; having your paper ready, paste each sheet on one side; then file the first sheet as the binder is directed; but be careful that the paste does not touch the upper part of the fold, for if the roller is wetted, it will tear the paper in drawing it out. In pasting the last sheet, observe what you are not wet; or it will stick to the paper where it is to be pinched; for if that part is damp, the pinching-cord will stick to it, and tear the paper; therefore, when you choke the case, be sure to keep the pinching-cord; and this bit of paper must be taken off after the case is choked. The rolling-board, and all other methods, according to the former directions for making cases, are to be used to these as well as all other cases.

43. To make Tourbillons. This sort of cases are generally made about eight diameters longer, even when sufficient. Tourbillons will answer very well from 4 oz. to 2 lbs. when larger than is no certainty. The cases are best rolled wet with paste, and the last sheet must have a straight edge, so that it may be all of the same thickness. When you have rolled your cases after the manner of wheel-cases, pinch them at one end quite close; then with the rammer drive the ends down flat, and afterwards ram in about one-third of a diameter of dried clay. The diameter of the former for these cases must be the same as for sky-rockets.

44. Balloons, or paper shells. First, you must have an oval former turned of smooth wood; then paste a quantity of brown or cartridge paper, and let it tie till the paste has quite soaked through: this done, rub the former with soap or grease, to prevent the paper from sticking to the wood; then lay the paper on in small slips, till you have made it one-third of the thickness of the shell intended. Having thus done, set it to dry, and when dry, cut it off; then half of the halves will easily come off; but observe, when you cut, to leave about one inch not cut, which will make the halves join much better than if quite separated. When you have some ready to join, place the halves even to-gether, paste a slip of paper round the opening to hold them together, and let that dry; then lay on paper all over as before, every where equal, excepting that end which goes downwards in the mortar, which may be a little thicker than the rest; for that part which receives the blow from the powder in the chamber of the mortar consequentially requires the greatest strength. When the shell is thoroughly dry, put a vent at top, with an edge large enough for the fuse: this method will do for balloons from 4 inches 2-3ths, to 8 inches diameter; and 54 inches long. For a balloon of 3 inches, the diameter of the former must be 5 inches and 15-16ths, and 11 inches 7-8ths long. For a 10-inch balloon, let the former be 7 inches 3-6ths diameter, and 14 inches long. For a balloon of 4 inches 2-3ths must be half an inch. For a balloon of 3 inches, let the thickness of the paper be 5-8ths of an inch; for an 8-inch balloon, 7-8ths of an inch, and for a 10-inch balloon, 8-9ths of an inch thick. Shells that are designed for stars only, may be made quite round, and the thinner they are at the opening, the better; for if they are too thick, the stars are apt to break at the bursting of the shell. When you are making the shell, make use of a pair of calibers, or a round gauge, so that you may not lay the paper thicker in one place than another; and all the pieces must be of a proper thickness. Balloons must always be made to go easy into the mortars.

Cases for Illumination Port-fires. These must be made very thin of paper, and rolled off for 2-3 inches of an inch diameter, and from 2 to 6 inches long: they are pinched close at one end, and left open at the other. When you fill them, put in but a little composition at a time, and ram it in well from the top, as much as the case will hold; three or four rounds of paper, with the last round pasted, will be strong enough for these cases.

Cases and moulds for common port-fires. Common port-fires are intended purposely to fire the works, their fire being very slow, and the heat of the flame so intense, that, if applied to rockets, leaders, &c. it will fire them immediately. Port-fires may be made of any length, but are seldom made more than 21 inches long; the interior diameter of port-fire moulds should be 10-16ths of an inch, and the diameter of the former half an inch. The cases must be rolled wet with paste, and one end pinched, or folded down. The moulds should be made of brass, and to take two pieces lengthwise, when the case is in the two sides, they are held together by brass rings, or hoops, which are made to fit over the outside. The bore of the mould must not be made quite through, so that there will be no occasion for a foot. Those port-fires, when used, are held in copper sockets, fixed on the end of a long stick: these sockets are made like port-crayons, only with a screw instead of a ring.

45. Of mixing the compositions. The performance of the principal part of fire-works depends much on the compositions being well mixed; therefore great care must be taken in this part of the work, particularly for the composition for sky-rockets. When you have four or five pounds of 5-8ths of an inch, which is a sufficient quantity at a time, first put the different ingredients together, then work them about with your hands till you think they are pretty well incorporated; after which put them into a lawn sieve with a receiver and top to it; and, if after it is sifted, any remains that will not pass through the sieve, grind it again till fine enough, and if it is twice sifted it will not be amiss; but the compositions for wheels and common works are not so material, nor need be so fine. But in all fixed works, from which the fire is to play regularly, the ingredients must be very fine, and great care taken in mixing them well together; and observe, that in all compositions wherein are steel or iron filings, the hands must not touch; nor will any works which have iron or steel in their charge keep long in damp weather, unless properly prepared; according to the following directions:

46. To preserve steel or iron filings. Melt in a glazed earthen pan some brimstone over a slow fire, and when melted throw some filings, which keep stirring about till they are well mixed: then put in a lawn sieve with a receiver; and you have broken it as fine as composition; after which you may store it as much as you like of brimstone as you can. There is another method of preparing filings, so as to keep two or three months in winter: this may be done by rubbing them between the strongest sort of brown paper, which before has been moistened with linseed oil.

PYROTECHNIA.
those things must be put in at the fuzehole; but冒出 are being too large to put in at the fuzehole, must be put in before the inside shall be joined. When the shells are loaded, glue and drive in the fuzes very tight. For a coehorn balloon, let the diameter of the fuzehole be 1 inch, for a royal balloon, which is near 5 inches in diameter, make the fuzehole 1 inch \( \frac{1}{4} \) diameter; for an 8-inch balloon, 1 inch \( \frac{3}{4} \)s and for a 10-inch balloon, \( 1 \) inch 4ths.

To make ballon-fuzes. Fuzes for air-balloon fuses are sometimes turned out of dry beech, with a cup at top to hold the quick-match; but if made with pasted paper, they will do as well. The diameter of the former for centre of gravity of each case, must be 1 inch; for a royal faze, \( \frac{4}{3} \)ths of an inch; for an 8-inch fze, \( \frac{3}{4} \)ths of an inch and for a 10-inch fze, \( 2 \)ths of an inch. Having rolled your cases, pinch and tie them almost close at one end; then drive them down, and let them dry. Before you begin to fill them, mark on the outside of the case the length of the charge required, allowing for the thickness of the bottom; and when you have rammed in the composition, take pieces of quick-match about six inches long, and lay one end of each on the charge, and then a little meal-powder, which run down hard; the loose ends of the match double up into the head hole, and cover it with a little meal powder, to keep it dry. When you put the shells in the mortars, uncap the fuzes, and pull out the loose ends of the match, and let them hang on the sides of the balloon.

52. Pots des saucions. These are generally fired out of large mortars without chambers, the powder being put in when the cases, which are placed at the ends, and the other half two diameters, so that when fired they may give two volleys of reports.

53. To fix one rocket on the top of another. When sky-rockets are thus managed, they are called towering rockets, on account of their mounting, and so are called. To fix two or more rockets are made after this manner: Fix on a pound-rocket a head without a collar; then take a four-ounce rocket, which may be headed or boused, and run the mouth of it with meal-powder, powdered with spirit of wine; when done, put it in the head of the large rocket with its mouth downwards; but before you put it in, stick a bit of quick-match in the hole of the mud Molly, which match should be long enough to go a little way up the bore of the small rocket, to fire it when the large one is burnt out. The four-ounce rocket being too small to fill the head of the other, roll it round as much as will make it stand upright in the centre of the head: the rocket being thus fixed, paste a single paper round the opening of the top of the head of the large rocket. The large rocket must have only a half a diameter of charge rammed above the piercer; for, if filled to the usual height, it would turn before the small one takes fire, and entirely destroy the intended effect. When one rocket is headed with another, it must be tied to the neck of the case; and the other half the diameter, and take two pieces of tapewire, and cover it with a little meal powder, and tie them to the two heads, with stars, serpents, &c. Rockets which are to be boused must have their cases made \( \frac{1}{3} \) or 2 diameters longer than the common proportion; and after they are filled, drive in the heads, and, when they are all played, pinch them after the usual manner, and fix on each a cap. Signal sky-rockets without bouses, are only sky-rockets closed and trim them as before; but some, very light, therefore do not require such heavy sticks as those with loaded heads; for which reason you may cut, one length of the rocket off the stick, or else make them thinner. Signal rockets with reports are fired in small flights; and often both these, and those without reports, are used for a signal to begin firing a collection of works.

54. To fire sky-rockets without sticks. You must have a stand of a block of wood, a foot higher than the block, so that it may stand steady. In the centre of the top of this block draw a circle \( \frac{1}{3} \) inches in diameter, and divide the circumference of it into three equal parts; then take 5 pieces of tapewire, and drive them into the block, 1 at each point made on the circle; when these wires are driven in deep enough to hold them fast and upright, so that the distance from one to the other is the same at top as at bottom, the stand is complete. The stand being thus made, prepare your rockets thus: take some common sky-rockets, of any size, and head them; iron these, then get some balls of lead, and tie to each a small wire 2 or 24 feet long, and the other end of each wire tie to the neck of a rocket. These balls answer the purpose of sticks when made of a proper weight, which is about 25 lbs. the weight of the rocket; but when they are of a proper size, they will balance the rocket in the same manner as a stick, at the usual point of poise. When you have these, hang them one at a time, between these, between the heads, their heads rest on the point of the wires, and the balls hang down between them. If the wires should be too wide for the rockets, press them together till they fit; and if too close, force them open. The wires for this purpose must be softened, so as not to have any spring, or they will not keep their position when pressed close or opened.

Aquatic fire-works.

57. Water rockets may be made from 4 oz. to 2 lb. If larger they are too heavy, so that it will be difficult to make them keep upright, which must be tied to the neck of the case; but the rockets will not drive so well with as without floats. Cases for these are made in the same manner and proportion as for sky-rockets, only little thicker of paper. When you lift those which are driven solid, put in first one ladleful of slow fire, then two of the proper charge, and on that one or two ladles of sinking charge, then close up the top with the sinking charge again, and so on till you have filled the case within three diameters; then drive in the composition one ladleful of clay,
through which make a small hole to the charge; then fill the case half a diameter with corn-powder, on which turn down two or three rounds of the case in the inside; then pinch and tie the end very tight; having done this, according to the lower directions, dip their ends in melted rosin or sealing-wax, or else secure them well with grease. When you fire these rockets, throw six or eight at a time; but, if you would have them all flying straight, as in a swimming ascent, at any time, you must drive them with an equal quantity of composition, and fire them all together.

58. To make pipes of commission, which may be used under water. Pipes for this purpose must be a little thicker of paper than those for land. Having rolled a sufficient number of pipes, and kept them till dry, wash them over with dry water; but when you open them, leave about 1½ inch at each end, for joints; if they were oiled all over, when you come to join them the paste would not stick where the paper is grooved, if the water and water-pots are not hot. The pipes will lie many hours under water, without receiving any damage.

59. Horizontal cheeks for the water. First get a large stick about half a hand in diameter; then have an octagon wheel made of a flat board 18 inches in diameter, so that the length of each side will be near seven inches; in all the sides cut a groove for the cases to slip into. This wheel, put it on the top of the bowl; then take four 8-oz. cases, filled with a proper charge, each about six inches in length. Now, to clothe the wheel with these cases, get some white-wash brown paper, and cut it into slips of four or five inches broad and seven or eight long. These slips being pasted all over on one side, take one of the cases, and roll one of the slips of paper about 1½ inch on its end, so that there will remain about ½ inch of the paper hollow from the end of the case: this case tie on of the sides of the wheel, near the corners of which must be holes bored, through which you put the other cases. Having done this, put on each, on the first case at the neck and end, put a little meat-powder in the hollow paper; then paste a slip of paper on the end of another case, the head of which put into another hole; on the paper on the first, a whitish brown paper, and so on, until slips are joined, all the way round, to the last which must be closed at the end, unless it is to communicate to any thing on the top of the wheel, such as fire-pumps or brilliant fires, fixed in holes cut in the wheel, and fired by the wheel or second case, as the fancy directs; six, eight, or any number, may be placed on the top of the wheel, provided they are not too heavy for the bowl. You tie on the cases, cut the upper part of all their sides, and make a little slot that the fire from one may play over the other, without being obstructed by the case. Wheel-cases have no clay driven in their ends, nor plashed, but are always left open; only the last, or those which are not to lead fire, which must be well secured.

The devices in fire-works are endless, varying with the fancy of the operator; but in the above sketch we have given all the theory, and enough of the practice to enable any person to adopt with ease whatever in the art he may chance to see practised by others.

PYRUS, the pear-tree, a genus of the P东西ania class of plants, and in the natural method ranking under the 36th order, pomaceae. The calyx is quinquied; there are five petals; the fruit is an apple, inferior, quinquicellular, and polyspermous. The genus Linus has the apple and quince. There is 13 species; the most remarkable are:

1. The communis, or common pear-tree. Under this species are comprehended almost endless varieties for eating till four or five weeks after they are taken from the beginning of July till the months of May and June next year; which, according to their times of ripening, may be divided into three classes, summer-pears, autumn-pears, and winter-pears. The summer-pears ripen in different sorts from the beginning of July, or at least do not begin before the 1st of August. The autumn-pears come to their perfection in October, November, and December; some ripening nearly on the tree in October and the beginning of November, others requiring a longer time. In the fruiteries, while some will keep two months; but all the winter-pears, though they attain their full growth on the tree by the end of October and in November, yet do not ripen for consumption till the end of November to April and May. Those of each class have different properties; some being melting, others breaking, some mealy, and some hard and astringent fit only for the kitchen. As many of the finest sorts were first obtained from France, they are still continued in most catalogues by French names.

2. The malus, or common apple-tree. The varieties are three; their pulp greatly varies with respect to the difference of the fruit. The botanists contend that the wilding, or crab-apple of the woods and hedges, is the original kind, and from the seed of which the cultivated apple is derived. The varieties of this last no doubt are multiplied to some hundreds in different places, having been all first accidentally obtained from the seed kernels or fruit, and the approved ones continued and increased by grafting upon crab or any kind of apple-stocks; but although the number of varieties is very considerable, there are not above 40 or 50 sorts retained in the nurserymen's catalogues. These varieties arrive at full growth in successive order from July to the end of October, improve in perfection after being gathered, and several of the winter kinds in particular keep good for many months, even till the arrival of the next summer.

Among these various kinds of apples, some are used for the dessert, some for the kitchen, and some for cider-making. Those used for the dessert are the following: placed as they successively ripen after one another. The white greening, the margaret apple, the summer pearmain, the summer quince, the embroidered apple, the golden rennet, the summer white calville, the summer red calville, the silver pippin, the aromatic pippin, the la reine grise, la haute honte, the royal russetting, Wheeler's russet, Sharp's russet, the spine apple, the golden pippin, the nonpareil, and the lapin or pomme d'api. Those for the kitchen use, in the order of their ripening, are these: the codlin, the summer morello, the summer pearmain, the Hollander russet, the Kentish pippin, the compords, Leman's pearmain, the French rennet, the French pippin, the royal russet, the monstrous rennet, the winter pearmain, the pomme violette, Spencer's pippin, the stone pippin, and the oaken pippin. Those most esteemed for cyder are, the Devonshire royal wilding, the redstock apple, the whitbouie, the Herefordshire under-leaf; and the John apple, or deu caences, everlasting, flowering, and sweet-scented flowers, succeeded by small round crabs, remarkably sour and astringent. There is one variety, called the evergreen Virginia crab-tree.

4. The cydonia, or quinces, of which there are three varieties.

All the varieties of the pear-tree are hardy, and will succeed in any common soil of a garden or orchard. They are propagated by grafting and budding upon the kind of pear-stocks; also occasionally upon mulberry stocks, and sometimes upon white-thorn stocks; but pear-stocks are generally preferable to all others for general use. All kinds of apples are propagated in the same manner, using apple-stocks instead of pear-stocks. They will succeed in any common soil of a garden or orchard, and in any free situation, except in a low and very moist soil, in which they are apt to rot, and very soon go off. In a friable loam they are generally very successful.

PYTHIAN GAMES, in antiquity, solemn games celebrated near Delphi, in honour of Apollo, and in remembrance of his having killed the serpent Python.

These were held every two years, about the month of Elaphobolon, which answereth to our February, and the celebration of these games was attended with the Pythian song, in which was celebrated the fight of Apollo and the serpent. The victors were crowned with branches of laurel; though, at the first institution, the crown was of beech-leaves. See Game.
QUA or q, the sixteenth letter of our alphabet. As a numeral it stands for 509; and with a dash over it, thus Q, for 50000. Used as an abbreviation, q signifies quantity, or quantum; thus, among physicians, q. pl. is quantum placit, i.e. as much as you please of a thing; and q. s. quantum sufficient, i.e. as much as is necessary. Q. E. D. among mathematicians, is quod erat demonstrandum, i.e. which was to be demonstrated; and Q. E. F. quod erat faciendum, i.e. which was to be done. Q. D. among grammarians, is quid dictum, i.e. as if it was said, or, as who should say. In the notes of the antients, Q stands for Quintus, or Quintus; Q. B. V. for quod bene visum; Q. S. S. for quod supra scripta sunt; Q. M. for Quintus Mutius, or quonmodo; Quint, for Quintillus; and Qvs, for quorust.

QUADRANGLE, in geometry, the same with a quadrilateral figure, or one consisting of four sides and four angles.

QUADRANS, the quarter or fourth part of any thing, particularly the as, or pound.

QUADRANT, in geometry, is either the quarter or fourth part of a circle, or the fourth part of its circumference; the arch of which therefore contains 90 degrees.

QUADRANT also denotes a mathematical instrument, of great use in astronomy and navigation, for taking the altitudes of the sun and stars, as also taking angles in surveying, heights and distances, &c.

This instrument is variously contrived, and furnished with different apparatus, according to the various uses it is intended for; but they have all this in common, that they consist of the quadrant of a circle, whose limb or arch is divided into 90, &c. Some have a plummet suspended from the centre, and are furnished either with plain sights, or a telescope to look through.

The principal and most useful quadrants are as follows:

QUADRANT, the common, or surveying.

This instrument ABC, fig. 1. Plate Quadrants, is made of brass, or wood, &c.; the limb or arch of which BC is divided into 90°, and each of these is farther divided into many equal parts as the space will allow, either diagonally or otherwise. To one of the radii AC, are fitted two moveable sights; and to the centre is sometimes also annexed a label, or moveable index, AD, bearing two other sights; but instead of these last sights, there is sometimes fitted a telescope. Also from the centre hangs a thread with a plummet; and on the under side or face of the instrument are fitted a ball and socket, by means of which it may be put into any position. The general use of it is for taking angles in a vertical plane, comprising the upper right lines going from the centre of the instrument, one of which is horizontal, and the other is directed to some visible point. But besides the parts above described, there is often added on the face, near the centre, a kind of compartment EF, called a quadrant, or geometrical square, which is a kind of separate instrument, and is particularly useful in altimetry and longimetry, or measuring heights and distances.

This quadrant may be used in different situations; in each of them, the plane of the instrument must be set parallel to that of the eye and the objects whose angular distance is to be taken. Thus, for observing heights or depths, its plane must be disposed vertically, or perpendicular to the horizon; but to take horizontal angles or distances, its plane must be disposed parallel to the horizon.

Again, heights and distances may be taken two ways, viz. by means of the fixed sights and plummet, or by the label; as also, either by the degrees on the limb, or by the quadrant. Thus, fig. 2 shews the manner of taking an angle of elevation with this quadrant; the eye is applied at C, and the instrument turned vertically about the centre A, till the object R is seen through the sights on the radius AC; then the angle of elevation RAI, made with the horizontal line RAII, is equal to the angle BAD, made by the plummet line and the other radius of the quadrant, and the quantity of it is shown by the degrees in the arch BD cut off by the plummet line AD.

QUADRANT, astronomical. See Observatory.

QUADRANT, Cole's, is a very useful instrument, invented by Mr. Benjamin Cole. It consists of six parts, viz. the staff AB, fig. 3; the quadrantal arch DE; three vanes A, B, C; and their vernier FG. The staff is a bar of wood about two feet long, an inch and a quarter broad, and of sufficient thickness to prevent it from bending or warping. The quadrant of this arch is also of wood, and is divided into degrees and third parts of degrees, to a radius of about nine inches; and to its extremities are fitted two vanes, which meet in the centre of the quadrant by a pin, about which it easily moves. The vane A is a thin piece of brass, near two inches in height and one broad, set perpendicularly on the end of the staff A, by means of two screws passing through its foot. In the middle of this vane is drilled a small hole, through which the coincidence or meeting of the horizon and solar spot is to be viewed. The horizontal vane B is about an inch broad and two inches and a half high, having a slit cut through it near an inch long, and a quarter of an inch broad; this vane is fixed in the centre-pin of the instrument, in a perpendicular position, by means of two screws passing through its foot, by which its position with respect to the sight-vane is always the same, their angle of inclination being equal to 45 degrees. The shade-vane C is placed of two brass plates. The one which serves for the ascension, is about 4½ inches long, and ¼ of an inch broad; being pinned at one end to the upper limb of the quadrant by a screw, about which it has a small motion; the other end lies in the arch, and the lower edge of the arm is directed to the middle of the centre-pin. The other plate, which improperly the vane, is about two inches long, being fixed perpendicularly to the other plate, at about half an inch distance from that next the arch; this time may be used either by its shade, or by the solar spot cast by a convex lens placed in it. And because the wood-work is often subject to warp or twist, therefore this vane may no be recollected by means of a screw, so that the warming of the instrument may occasion no error in the observation, which is performed in the following manner: set the line G on the vernier against a degree of the upper limb of the quadrant; and then the screw on the backside of the limb forward or backward, till the hole in the sight-vane, the centre of the glass, and the sun's spot in the horizon-vane, lie in a right line.

To find the sun's altitude by this instrument. Turn your back to the sun, holding the stuff of the instrument with the right hand, so that it is in a vertical plane passing through the sun, and one eye looking through that line and the horizon-vane till the horizon is seen; with the left hand slide the quadrantial arch upwards, till the solar spot or shade, cast by the shade-vane, falls directly upon the spot of the horizon-vane; then will that part of the quadrantial arch which is raised above G or S (according as the observation respects either the solar spot or shade), show the altitude of the sun at that time. But for the meridian altitude, the observation must be continued; and as the sun approaches the meridian, the sea will appear through the horizon-vane, which completes the observation, and takes the minutes, being counted as before, will give the sun's meridian altitude; or the degrees counted from the lower limb upwards, will give the zenith distances.

QUADRANT, Collins's or Sutton's, fig. 4, is a stereographic projection of one quarter of the sphere between the tropics, upon the plane of the ecliptic, the eye being in its north pole; and fitted to the latitude of London. The lines running from right to left, are parallels of altitude; and those crossing them are azimuths. The smaller of the two circles bounding the projection, is one quarter of the tropic of Capricorn; and the greater is a quarter of the tropic of Cancer. The two ecliptics are drawn from a point on the left edge of the quadrant, with the characters of the signs upon them; and the two horizons are drawn from the same point. The limb is divided both into degrees and time; and by having the sun's altitude, the hour of the day may be found to a minute. The quadrantal arches next the centre contain the calendar of months; and under them, in another arch, is the sun's declination. On the projection are placed several of the most remarkable fixed stars between the tropics; and
QUADRANT.

the next below the projection are the quadrant and line of shadows.

To find the time of the sun's rising or setting, its altitude, his azimuth, hour of the day, &c., by this quadrant. Lay the thread on the day of the month, and bring the bead to the proper ecliptic, either of summer or winter, according to the season, which is called rectifying; then, by moving the thread bring the bead to the horizon, in which case the time is that printed on the top of the time of the sun's rising or setting before or after 6; and at the same time the bead will cut the horizon in the degrees of the sun's amplitude. Again, observing the sun's altitude with the quadrant, and supposing it to be 43° on the 5th of May, lay the thread over the 5th of May, then bring the bead to the summer ecliptic, and carry it to the parallel of altitude 43°; in which case the thread will cut the limb at 55° 17', and the hour will be seen among the hour-lines to be either 41 m. past 9 in the morning, or 19 m. past 2 in the afternoon.

Lastly, the bead shows among the azimuths the sun's distance from the meridian.

But if the sun's altitude is less than what it is at 6 o'clock, the operation must be performed among those parallels above the upper horizon; the bead being rectified to the winter horizon.

QUADRANT, Gunter's, fig. 5, sometimes called the gunner's square, is used for elevating and pointing cannon, mortars, &c. and consists of two branches, either of wood or brass, between which is a quadrantal arch divided into 20', and furnished with a thread and plummet.

The use of this instrument is very easy; for, if the thread be placed in the mouth of the piece, and it is elevated till the plummet cuts the degree necessary to hit a proposed object, the thing is done.

Sometimes on the sides of the longer bar, are noted the division of diameters and weights of iron balls, as also the bores of pieces.

QUADRANT, Gunter's, so called from its inventor, Edmund Gunter, (fig. 6) besides the apparatus of other quadrants, has a stereographic frustum of a sphere, the surface of the equinoctial; and also a calendar of the months, next to the divisions of the limb; by which, besides the common purposes of other quadrants, several useful questions in astronomy, &c. are easily resolved.

Use of Gunter's quadrant. 1. To find the sun's meridian altitude for any given day, or conversely the day of the year answering to any given meridian altitude. Lay the thread to the day of the month in the scale next the limb; then the degree it cuts in the limb is the sun's meridian altitude. And, contrariwise, the thread being set to the meridian altitude, it shows the day of the month.

2. To find the hour of the day. Having put the bead, which slides on the thread, on the sun's place in the ecliptic, observe the sun's altitude by the quadrant; then if the bead is laid over the same in the limb, the bead will fall upon the hour required. On the converse, by laying the bead on a given hour, having first rectified or set it to the sun's place, the degree cut by the thread on the limb gives the altitude.

Note: the bead may be rectified otherwise, by bringing the thread to the day of the month, and the bead to the hour-line of 12. 3. To find the sun's declination from its place given, and the contrary. Bring the bead to the sun's place in the ecliptic, and move the thread to the line of declination E F, shall the bead cut the degree of declination required. On the contrary, the bead being adjusted to a given declination, and the thread moved to the ecliptic, the bead will cut the sun's place.

4. There is a method of giving, to find the right ascension, or contrariwise. Lay the thread on the sun's place in the ecliptic, and the degree it cuts on the limb is the right ascension sought. And the converse.

5. The sun's arc; for to find his azimuth, and contrariwise. Rectify the bead for the time, as in the second article, and observe the sun's altitude; bring the thread to the complement of that altitude; then the bead will give the azimuth sought, among the azimuth-lines.

QUADRANT, Hadley's, (fig. 7) so called from its inventor, John Hadley, esq. is now universally used for the best of any for nautical and other observations.

Description of Hadley's quadrant. Fig. 7, represents a quadrant, or octant, of the common construction. The following parts are indispensibly requisite to give the particular attention of the observer:

I. BC the arc.
II. AD the index, ab the nomius scale.
III. E the index-glass.
IV. F the horizon-glass.
V. G the back-horizon-glass.
VI. K the dark glasses or screens.
VII. H the vane's or sights.
VIII. The arc BC is called the limb or quadrantal arc; any point, lying from 0 towards the right, is called the arc of excess.

The quadrant consists of an arc BC, firmly attached to the two radii, or bars, AB, AC, which are strengthened and bound together by the two braces LM.

The index D is a flat bar of brass, that turns upon the centre of the octant. At the further end of the index opening; to one side of this opening a vernier is fixed, to subdivide the divisions of the arc; set the bottom or end of the index there is a piece of brass, which bends the arm, carrying a spring to make the vernier lie close to the divisions; it is also furnished with a screw to fix the index in any desired position.

See NIVIER.

The circular arcs on the arc of the quadrant are drawn from the centre on which the index turns; the smallest eccentricity in the axis of the index would be productive of considerable errors.

The position of the index on the arc after an observation, points out the number of degrees and minutes contained in the observed angle.

Upon the index E, and near its axis, is fixed a plain specimen of a mirror of glass, quicksilvered. It is set in a brass frame, and is placed so that the face of it is perpendicular to the plane of the instrument; this mirror being fixed to the index, moves along with it, and has its direction changed by the motion thereof.

This glass is designed to receive the image of the sun, or any other object, S, and reflect it upon either of the two horizon-glasses F and G, according to the nature of the observation.

The brass frame with the glass is fixed to the index by the screw C; the other screw serves to replace it in a perpendicular position, if the object be so placed that it has been displaced.

The index-glass is often divided into two parts, the one silvered, the other black with a small screen in front. A single black surface has indeed some advantages; but if the glasses are well selected, there will be apprehended of error from a want of parallelism; more is to be feared from the surfaces not being flat.

On the radius AB of the octant, are two small spectacles F and G. The surface of the upper one is parallel to the index-glass, when the counting division of the index is at 0 on the arc; but the surface of the lower one is perpendicular to the index-glass, when the index is at 0 degrees on the arc; these mirrors receive the reflected rays from the object, and transmit them to the observer.

The horizon-glasses are not entirely quicksilvered; the upper one F, is only silvered on its lower part, or that side of the quadrant, the other half being transparent; and the back part of the frame is cut away, that nothing may impede the sight through the uncovered part of the glass. The edge of the foil of this glass is nearly parallel to the plane of the instrument, and ought to be very sharp, and without a flaw.

The other-horizon-glass G, is silvered at both ends, in the middle there is a transparent slit, through which the horizon, or other object, may be seen.

Each of these glasses is set in a brass frame, to which there is an axis; this axis passes through the wood-work, and is fitted to a lever on the under side of the quadrant; by this lever the glass may be turned a few degrees on its axis, in order to set it parallel to the index-glass. The lever has a contrivance to turn it slowly, and a button to fix it. To set the glasses perpendicular, there are two small screws, one before and one behind each glass; these screws pass through the plate on which the index is fixed, and have a nut that can be turned to loosen one and tightening the other of these screws, the direction of the frame with its mirror may be altered, and thus be set perpendicular to the plane of the instrument.

There are two red or dark glasses, and one green one K; they are used to prevent the bright rays of the sun, or the glare of the moon, from hurting the eye at the time of observation. They are each of them set in a brass frame, which turns on a centre; so that they may be used separately, or together, as the brightness of the sun may require. The green glass may be used also alone, if the sun is very faint; it is also used for taking the altitude of the moon, and in ascertaining her distance from a fixed star.

When these glasses are used for the fore observation, they are fixed as at K; when used for the back observation, they are removed to N.

Each of the vane's H and I, is a perforated piece of brass, designed to lie next the quadrant parallel to the plane of the quadrant. That which is fixed at I is used for the fore, the other for the back, observation.
QUADRANT.

The vane has two holes: one exactly at the right of the mid-silvered edge of the horizon-glass; the other somewhat higher, to direct the sight to the middle of the transparent part of the mirror, for those objects which are bright enough to be reflected from the glass. 

Directions to hold the instrument. It is recommended to support the weight of the instrument by the right hand, and reserve the left to govern the index. Place the thumb of the right hand against the edge of the quadrant, under the swelling part of which the fore sight stands, extending the fingers across the back of the quadrant, so as to lay hold on the opposite edge, placing the fore finger above, and the other fingers below the swelling part, or near the horizon-glass; thus you may support the instrument conveniently, in a vertical position, by the right hand only: by resting the thumb of the left hand against the side, or the fingers against the middle bar, you may move the index gradually either way.

In the back observation, the instrument should be supported by the left hand, and the index be governed by the right.

Of the two objects which are made to coincide in the instrument, the one is seen directly by a ray passing through, the other by a ray reflected from, the same point of the horizon-glass to the eye. This ray is called the visual ray; but when it is considered merely as a line drawn from the middle of the horizon-glass to the eye-hole of the sight vane, it is called the axis of vision.

The axis of a tube, or telescope, used to direct the sight, is called the axis of vision.

The quadrant, if it is held as before directed, may be easily turned round between the fingers and thumb, and thus nearly on a line parallel to the axis of vision; thus the plane of the quadrant will pass through the two objects when an observation is made, a circumstance absolutely necessary, and which is more readily effected when the instrument is furnished with a telescope. Within the telescope, parallel wires, which by turning the eye-glass tube may be brought parallel to the plane of the quadrant, so that by bringing the object to the middle between them, you are certain of having the axis of vision parallel to the plane of the quadrant.

Of the observations. There are two sorts of observations to be made with this instrument: the one is when the back of the observer is turned towards the object, and therefore called the back observation; the other when the face of the observer is turned towards the object, which is called the fore observation.

To rectify the instrument for the fore observation. Slacken the screw in the middle of the handle behind the glass F; bring the index close to the button B; hold the instrument in a vertical position, with the arch downward: by this means, the two button holes in the vane I, and through the transparent part of the glass F, for the horizon; and if it lies in the same right line with the image of the horizon, the silvered part, the glass F, is rightly adjusted; but if the two horizontal lines disagree, turn the screw which is at the end of the handle backward or forward, till those lines coincide; then fasten the middle screw of the handle, and the glass is rightly adjusted.

To take the sun's altitude by the fore observation. Having fixed the screens above the horizon-glass F, and suited them proportionally to the strength of the sun's rays, hold the instrument with your right hand, by the braces I and M, in a vertical position, with the arch downward; put your eye close to the right-hand hole in the vane I, and view the horizon through the transparent part of the horizon-glass F, at the same time moving the index D with the left hand, till the radial solar spot coincides with the line of the horizon; then the degrees counted from that end next your body, will give the sun's altitude at that time, observing to add or subtract 16 minutes according as the upper or lower edge of the sun's reflex image is made use of.

But to get the sun's meridian altitude, which is the thing wanted for finding the latitude, the observation must be continued: and as the sun approaches the meridian, the index D must be continually moved towards B, to maintain the coincidence between the reflex solar spot and horizon; and consequently as long as this motion can maintain the same coincidence, the observation must be continued till the sun has reached the meridian, and begins to descend, when the coincidence will require a retrograde motion of the index, or towards C; and then the observation is finished, and the degrees counted as before will give the sun's meridian altitude, or those from D which will give the zenith distance, observing to add or subtract the semidiameter, as before, when his lower edge is brought to the horizon, or to subtract 16 when the horizon and upper edge coincide.

To take the altitude of a star by the fore observation. Through the vane II, and the transparent slit in the glass G, look directly to the star; and at the same time move the index, till the image of the horizon seen behind you, being reflected by the great speculum, can be seen in its proper position; but if not, set it and then will the index show the degrees of the star's altitude.

To rectify the instrument for the back observation. Slacken the screw in the middle of the handle behind the glass F; turn the button B on one side, and bring the index as many degrees before 0 as are equal to double the dip of the horizon at your height above the water; hold the instrument vertical, with the arch downward; look through the hole of the vane II; and if the horizon seen through the transparent slit in the glass G, coincides with the image of the horizon seen in the silvered part of the same glass, then the glass G is in its proper position; but if not, set it by the handle, and fasten the screw as before.

To take the sun's altitude by the back observation. Put the screens as at K; and in proportion to the strength or faintness of the sun's rays, let either one or both of the frames of those glasses be turned close to the face of the limb; hold the instrument in a vertical position, with the arch downward, by the horizon, with the left hand; turn your back to the horizon and put one eye close to the hole in the vane II, observing the horizon through the transparent slit in the horizon-glass G; with the right hand move the index D, till the reflected image of the sun is seen in the silvered part of the glass G, and a right line with the horizon; swing your body to and fro, and if the observation is well made, the sun's image will be observed to brush the horizon, and the degrees reckoned from G, or that part of the arch farthest from your body, will give the sun's altitude at the time of observation; observing to add 16, or the sun's semidiameter, if the sun's upper edge is used, and subtract the same for the lower edge, or the sea, and the other on account of the refraction of the atmosphere, especially in small altitudes.

The following tables, therefore, shew the corrections to be made on both these accounts:

<table>
<thead>
<tr>
<th>TABLE I.</th>
<th>TABLE II.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dip of the vane</td>
<td>Refractions of the stars, &amp;c. in altitude.</td>
</tr>
<tr>
<td>Height of the</td>
<td>Appar. alt. in.</td>
</tr>
<tr>
<td>horizon, in</td>
<td>Feet.</td>
</tr>
<tr>
<td>Degrees</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>0 57</td>
</tr>
<tr>
<td>2</td>
<td>0 29</td>
</tr>
<tr>
<td>3</td>
<td>1 39</td>
</tr>
<tr>
<td>5</td>
<td>2 81</td>
</tr>
<tr>
<td>10</td>
<td>5 1</td>
</tr>
<tr>
<td>12</td>
<td>3 42</td>
</tr>
<tr>
<td>20</td>
<td>4 16</td>
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<tr>
<td>25</td>
<td>4 46</td>
</tr>
<tr>
<td>30</td>
<td>4 59</td>
</tr>
<tr>
<td>40</td>
<td>6 2</td>
</tr>
<tr>
<td>45</td>
<td>6 34</td>
</tr>
<tr>
<td>50</td>
<td>6 44</td>
</tr>
</tbody>
</table>

General rules for these corrections. 1. In the fore observations, add the sum of both corrections to the observed zenith distance, for the true zenith distance; or subtract the said sum from the observed altitude, for the true one. 2. In the back observation, add the dip and subtract the refraction for altitudes; and for zenith distances do the contrary, viz. subtract the dip, and add the refraction.

Example. A back observation, the altitude of the sun's lower edge was found by Hadley's quadrant to be 23° 12'; the eye being 30 feet above the horizon. By the tables, the dip on 30 feet is 3° 14', and the refraction on 25° 12' is 2° 14'. Hence:

Appar. alt. from limb = 23° 12' + 3° 14' - 2° 14' = 24° 08' 
Sun's semidiameter, sub. 30 feet = 3° 14' 
Appar. alt. of centre = 24° 08' 
Dip of horizon, add 0 5 14
Refraction, subtract 0 2 1

True alt. of centre = 24° 50' 13'

In the case of the moon, besides the two corrections above, another is to be made for her parallaxes. But for all these particulars, see the requisite tables for the Nautical Al-
Quadrant. In Roman antiquity, a vessel every way square like a die, serving as a measure of liquids; its capacity was eighty librae or pounds of water, which made 48 sextaries, two uraei, or eight coasae.

QUADRANT, a mathematical instrument, called also a geometrical square, and line of shadows; it is frequently an additional member on the face of the common quadrant, as also on those of Gunter's and Sutton's quadrant; but we shall describe it by itself, as being a distinct instrument.

It is made of any solid matter, as brass, wood, &c. or of any four plane rules joined together at right angles, as represented in Plate Quadrant's fig. 9, where A is the centre, from which hangs a thread with a small weight at the end, serving as a point of the instrument is fixed on the meridian, and moveable round upon the pivot to all points of the horizon, as represented in the figure referred to. Its use is to serve as a scale in measuring altitudes and azimuths.

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QUADRATURA, in astronomy, that aspect of the moon which is 90° distant from the sun; or when she is in a middle point of her orbit, between the points of conjunction and opposition, namely, in the first and third quarters.

Quadrature-lines are two lines placed on Jupiter’s sector: they are marked with Q and S, 6, 7, 8, 9, 10: of which Q signifies the side of the square, and the other figure the side of the polygons of 5, 6, 7, &c. sides, and S on the same instrument, stand for the semidiameter of a circle, and 90 for a line equal to 90° in circumference.

QUADRATUS, in anatomy, a name given to several muscles on account of their square figures.

QUADRIGA, in antiquity, a car or chariot drawn by four horses. On the reverse of medals we frequently see the emperor or Victory in a quadriga, holding the reins of the horses; whence these coins are, among the curious, called nummi quadrigati, and Victoriati.

QUADRILATERAL, in geometry, a figure whose perimenter consists of four right lines, making four angles; whence it is also called a quadrangular figure. The quadrilateral figures are either a parallelogram, trapezium, rectangle, square, rhombus, or rhomboid.

QUADRIL, a game at cards, sometimes practised by persons from ombre by three, in being played by four persons; and having all the forty cards dealt out, to each person, at ten each.

The general laws of this game are, 1. It is not permitted to deal the cards any otherwise than by three, the dealer being at liberty to begin with which of those numbers he pleases. 2. If he who plays either sans prendre, or calling a king, names a trump of a different suit from that his game is in, or names two several suits, that which he first named must be the trump. 3. He who plays must name the trump by its proper name, as he likewise must the king he calls. 4. He who has said 1 pass, must not be again admitted to play, except he plays by force, upon account of his having spadille. 5. He who has asked the question, and has left given him to play, is obliged to do it; but he must not play the cards previously forced to do it. 6. He who has the four kings may call the queen of either of his kings. 7. Neither the king nor queen of the suit which is trumps must be called. 8. He who has one or several cards of the king in his hand, may in such case, if he wins, alone make six tricks; if he wins, it is all his own; and if he loses, he pays all by himself. 9. Every one ought to play in his turn, but for having done otherwise, he loses a trick, and in such case, if he wins, he alone makes six tricks; if he wins, it is all his own; and if he loses, he pays all by himself. 10. In his turn it is not to play, having in his hand the king the ombre has called, and who shall trump with either spadille, manille, or kasto, or shall even play down the king that was called, to give notice of his being the friend, must not pretend to undertake the sole; nay, he must be condemned to be beasted if it appears that he did it with any fraudulent design. 11. He who has drawn a card from his game, and presented it openly in order to play it, is obliged so to do, if his retaining it may be either prejudicial to the game, or give any intimations, especially the four kings, is a matador; but he who plays sans prendre, or calls his own king, is not subject to this law. 12. None ought to look upon the tricks, nor to count aloud what has been played; and this person, to whom it happens, must let every one reckon for himself. 13. He who, instead of turning up the tricks before any one of his players, shall turn up and discover his game, must be equally beasted with him whose cards he had so discovered, the one paying one half and the other the like. 14. He who renounces must be beasted as many times as he has so done, but if the cards are mixed he is to pay but one beast. 15. If the reverse prejudges the game, and the deal is not played out, every one may take up his cards, beginning at the trick where the renounce was made, and play them over again. 16. He who shews the game kings, may call any king he has in hand, except he plays sans prendre. 17. None of the three matadores can be commanded down by an inferior trump. 18. If he who plays sans prendre with the matadores in his hand, demands only one of them, he must receive only that which he mentioned. 19. He who, instead of sans prendre, shall demand matadores, not having them; or he who shall demand sans prendre instead of matadores; cannot compel the players to pay him what is really due. 20. Matadores are only paid when they are in the hands of the ombre, or of the king his majesty has in his hand, or separately in both. 21. He who has paid 1 pass, to the vola and does not make it, must pay as much as he would have received had he won it. 22. He who plays and does not make three tricks is to be beasted alone, and must pay all that is to be made at the tricks at all, he must also pay to his two adversaries the vola, but not to his friend.

QUADRUPEDS, in zoology, a class of land animals, with hairy bodies, and four limbs or legs proceeding from the trunk of their bodies: add to this, that the females of this class are viviparous, or bring forth their young alive, and nourish them with milk from their teats.

QUADRUPLE, a sum or number multiplied by four, or taken four times.

QUAKERS, by stat. 7 and 8 W. III. c. 27, and 8 G. I. c. 6, quakers making and subscribing electors is not permitted in 1 W. and M. shall not be liable to the penalty against others refusing to take such calls; and not subscribing the declaration of fidelity, &c. are disabled to vote at the elections.

By 7 and 8 W. III. c. 34, made perpetual by 1 G. I. c. 6, quakers, where an oath is required, permitted to make a solemn affirmation or declaration of the truth of any fact; for want of witnesses: or being of any criminal cause, serving on juries, or bearing any office or place of profit under government, unless they are sworn like other protestants; but this clause does not extend to the freedom of a corporation. 1 lord raym. 337.

By stat. 22 G. II. c. 46, an affirmation shall be allowed in all cases (except criminal) where by any act of parliament an oath is required, though no provision is therein made for admitting a quaker to make his affirmation. See FRIENDS.

QUAKEL, a genus of the monandria mo- noecious class and order. The calyx is four-lobed; corolla is usually a fruit: a berry. There are two species, trees of Guiana.

QUAMDIU SE BENGE GESERI, a clause frequently to be found in letters patent of the favor of the bards, as in those to the barons of the exchequer, &c. whereby it intimates that they shall hold the same as long as they shall behave themselves well. It is said that these words intend what the law would imply if no office was granted during.

QUANTUM MERUIT, in law, is an action upon the case, founded on the necessity of paying a person for doing any thing as much as he deserves.

QUARE, in law, a term affixed to the title of several writs: as, 1. Quare ejus infranterrin, is a writ that lies for a lessee cast out of his farm before his term is expired. 2. Quare impedit, a writ that lies for a person who has prevented others against whom he has a right from entering their house without his permission. 3. Quare, a writ that lies for a person who has prevented others against him who disputes him in the right thereof by presenting a clerk to it when the church is vacant. This writ differs from what is called a darren presentment, because that is brought where a person or his ancestor formerly presented; but this lies for him that is purchaser himself. Yet in both these writs, the plain-
tiff recovers the presentation and damages; though the title to the adxivon is recovered only by a quare impedit. 3. Quare incaviat is a writ that lies against a bishop, who, within six months after the vacancy of a benefice, enters on it his clerk, while two others are contesting the right of presentation. 4. Quare non admittis is a writ that lies where any one has recovered an adxivon or presentation, and sending his clerk to be admitted, the bishop refuses to admit him; in which case the person that has the presentation may have this writ against the bishop. 5. Quare non permittas is a writ that lies for one who has a right to present for a turn against the proprietary. 6. Quare obstruxit, is a writ that lies for him who, having a right to pass through another's grounds, cannot enjoy the same, because the owner has fenced them up.

QUARTER, the fourth part of any thing, the fractional expression for which is 1/4. Quarter, in weights, is generally used for the fourth part of a hundred-weight avoirdupois, or 25 lb.

Used as the name of a dry measure, quarter is the fourth part of a ton in weight, or eight bushels.

QUARTER, in heraldry, is applied to the parts or members of the first division of a coat that is quartered or divided into four quarters.

QUARTER of a point, in navigation, is the fourth part of the distance between two cardinal points, which is 9°.

QUARTER of a ship, is that part of a ship's hold which lies between the steerage-room and the transom.

QUARTER-MASTERS, or quartermen, in a ship of war, are officers whose business it is to rummage, stow, and trim, the ship in the hold; to overlook the steward in his delivery of victuals to the cook, and in pumping or drawing out beer, or the like. They are also to keep their watch duly, in coining the ship, or any other duty.

QUARTER-SESSIONS. See Sessions.

QUARTEERING, in gunnery, is when a piece of ordnance is so traversed that it will shoot on the same line, or on the same point of the compass, as the ship's quarter bears.

QUARTERING, in heraldry, is dividing a coat into four or more quarters, or quarterings, by parted, coupling, &c. that is, by perpendicular and horizontal lines, &c.

QUARTERS, a name given at sea to the several stations where the officers and crew of a ship of war are posted in action.

The number of men appointed to manage the artillery is always in proportion to the nature of the guns, and the number and condition of the ship's crew. They are, in general, as follow, when the ship is well manned, so as to fight both sides at once occasionally:

<table>
<thead>
<tr>
<th>Powder</th>
<th>No. of men.</th>
</tr>
</thead>
<tbody>
<tr>
<td>To a 9</td>
<td>13</td>
</tr>
<tr>
<td>To a 8</td>
<td>12</td>
</tr>
<tr>
<td>To a 7</td>
<td>11</td>
</tr>
<tr>
<td>To a 6</td>
<td>10</td>
</tr>
<tr>
<td>To a 5</td>
<td>9</td>
</tr>
<tr>
<td>To a 4</td>
<td>8</td>
</tr>
<tr>
<td>To a 3</td>
<td>7</td>
</tr>
</tbody>
</table>

This number, to which is often added a boy to bring powder to every gun, may be occasionally reduced, and the guns in all cases well managed. The number of men appointed to the small arms on board his majesty's ships and sloops of war, by order of the admiral, are:

<table>
<thead>
<tr>
<th>Rate of the ship.</th>
<th>No. of men to the small arms</th>
</tr>
</thead>
<tbody>
<tr>
<td>1st.</td>
<td>150</td>
</tr>
<tr>
<td>2d.</td>
<td>120</td>
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<tr>
<td>3d.</td>
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<tr>
<td>4th.</td>
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<tr>
<td>5th.</td>
<td>60</td>
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<tr>
<td>6th.</td>
<td>40</td>
</tr>
<tr>
<td>Sloops of war</td>
<td>30</td>
</tr>
</tbody>
</table>

The lieutenants are usually stationed to command the different batteries, and direct their efforts against the enemy. The master superintends the movements of the ship, and whatever relates to the sails. The boatswain, and a sufficient number of men, are stationed to repair the rigging, and the gunner and carpenters, whenever necessary, according to their respective offices.

QUARTERS, close, in a ship, those places where the seamen quarter themselves, in case of boarding, for their own defence, and for clearing the decks, &c.

QUARZIT. This stone, which is very common in most mountainous countries, is sometimes crystallized, and sometimes amorphous. The primitive form of its crystals, according to Mr. Hauy, is a rhomboidal parallelohedron; the angles of whose rhombs are 94° and 86°, so that it does not differ much from a cube. The most common variety is a dodecahedron, composed of two six-sided pyramids, applied base to base, whose sides are isosceles triangles, having the angle at the vertex 45°, and each of the angles at the base 70°; the inclination of a side of one pyramid to the contiguous side of the other pyramid is 104°. There is often a six-sided prism intersected between the two pyramids, the sides of which always correspond with those of the pyramids. For a description and figure of the other varieties of quartz crystals, a demonstration of the law which they have followed in crystallizing, we refer the reader to Romé de Lisle and Mr. Hauy.

The texture of quartz is more or less foliated. Fracture conchoidal or splintery. Its lustre varies, and also its transparency, and in some cases it is opaque. It causes a double refraction. Specific gravity from 2.64 to 2.67, and in one variety 2.69. Its colour and appearance are exceedingly various: this has induced mineralogists to divide it into numerous varieties. The common division is into five subseries.

1. Amethyst. Colour violet, of different degrees of intensity, sometimes greenish. Commonly found in crystals in the hollow cavities of angles, composed, according to Hauy, of iron and manganese.


4. Common quartz. A constituent of many mountains. Colours exceedingly numerous, white, grey, brown, yellow, red, green of various shades. Usually amorphous; sometimes, near Lantersberg upon the Hartz, cristobalite, distinguished from rock crystal. See CRYSTAL.


Constedt observes, that quartz in general, and especially its crystals, are very commonly supposed, when yet in their soft and dissoluble state, to have included within them some vegetables; for instance, a crust, this says he, I cannot absolutely deny; but it deserves carefully to be examined, if that which is shown as a grass is not an asbasta, or a straited cockle; and this mass, when it has reached a hardness filled with earth, which, by their being ramose, bear a vegetable appearance. It is very common in agates, and makes them of less value than they otherwise would be. It is most generally the case with those stones which are shown as including vegetables; and for my own part, I have never been so fortunate as to meet with any others.

M. Magellani remarks, that quartz is one of the principal kinds of stone which contain metals. Some of the Hungarian veins consist entirely of it, and the gold is so minutely dispersed, that it cannot be discerned by the best microscopes before it is separated by pounding and washing. The width of the veins, some of which are half a foot, and some still more, repay the trouble and expense, which the small quantity of gold would otherwise be so considerable. Nature has not any where produced mountains of pure quartz; for though some rocks in Sweden are ranked among the quartizes, they are undoubtedly mixed with heterogeneous matters. This is most generally the case with those stones which are shown as including vegetables; and for my own part, I have never been so fortunate as to meet with any others.

The imperial cabinet at Vienna, &c.

Quartz crystals are generally found upon or among quartizes, and are to be met with in all parts of the world. The greatest number are furnished to the European countries from the island of Madagascar, a place where these natural productions are of the most extraordinary size and perfection.
QUASSIA.

"When great quantities of quartz are continuously agitated by the sea or river water, the sand is reduced to such very minute parts as to be easily carried away, suspended in the water; and there are sands of so minute a size as to measure less than the two or three hundredth part of an inch. These are the finest littoral detritus of land consist only of loose sands, particularly along the sea-shore in many parts of Europe. When sand is about as big as peas, it is called gravel; and when it is free from salt and other extraneous particles it is employed in making mortar, and for other economical purposes. That which is very pure serves for making flint-glass, with red calices of lead, and the proper alkaline flux; but when mixed with ferruginous-black sand, the glass assumes a greenish-black colour. "This (says M. Magellen) I have seen among the various specimens of glass made by Mr. E. Delaval, F. R. S., who produced a very fine transparent and colourless glass out of the same sand with which he had made some of that black glass, and this only by separating from it all the ferruginous mixture."

QUASSIA, a genus of the monotypy order, in the decaedia class of plants, and in the order in the families, ranking under the 14th order, gramineae. The calyx is pentaphyllous; there are five petals; the nectarium is pentaphyllous; there are from two to five seed-cases, standing asunder, and monoporous. There are three species, the amara, simulaba, and excelsa.

1. The quassia amara grows to the height of several feet, and sends off many strong branches. The wood is of a white colour and light; the bark is thin and grey; the leaves are placed alternately on the branches, and consist of two pair of opposite pinnae, with an odd one at the end; the flowers are all hermaphrodite, of a bright red colour, and terminate the branches in long spikes. It is a native of South America, particularly of Surinam, and also of some of the West Indian islands. The root, bark, and wood, of this tree, have all the places in the materia medica. The wood is most generally used, and is said to be tonic, stomachic, antiseptic, and febrifuge.

2. The quassia simulaba is common in all the woody lands in Jamaica. It grows to a great height and considerable thickness. The trunks of the old trees are black and a little furrowed. Those of the young trees are smooth and grey, with here and there a broad yellow spot. The inside bark of the trunk and branches is white, fibrous, and tough. It tastes slightly bitter. The wood is hard, and useful for buildings. It splits freely, and makes excellent staves for sugar-hogsheads. It has no sensible bitter taste. The branches are alternate and spreading. The leaves are numerous and alternate. The flowers are white, yellow colour, and placed on spikes beautifully branched. The fruit is of that kind called a drupa, and is ripe to the end of May. It is of an oval shape, is black, smooth and glossy. The pulp is slightly fleshy and subacid; the taste nauseous and sweet. The nut is thinned, and on one side winged. The kernel is small, flat, and tastes sweet. The natural number of these drupes is five or on each common receptacle; but for the most part there are only two or three. The roots are thick, and run at a small depth under the surface of the ground to a considerable distance. The bark is rough, scaly, and warped. The inside when fresh is a full yellow, but when dry paler. It has but little smell. The taste is bitter, but not very disagreeable. This is the true tree simulaba of the shops. The shops are supplied with this bark from Guiana; but now we may have it from our own islands at a moderate expense.

Most authors who have written on the quassia simulaba agree, that in fluxes it restores the lost tone of the intestines, allays their spasmodic motion, promotes the secretions by urine and perspiration, removes that lowness of spirits attending dysenterics; and disposes the patient to sleep; the gripe and tenesmus are taken off, and the stools changed to their natural colour and consistence. In a moderate dose it occasions no disturbance or uneasiness, and but little effect on the stomach and vomiting. Negroes are less affected by it than white people. Dr. Cullen, however, says, "We can perceive nothing in this bark but that of a simple bitter, which is not affected to thin dry, the virtues of which have not been confirmed by my experience, or that of the practitioners in this country; and leaving what others are said to have experienced to be further examined and conspired against or approved of, I will only say, that my account of the effect of the bitter will perhaps explain the virtues ascribed to simulaba. In dysentery I have found an infusion of camomile-flowers a more useful remedy.

3. The quassia excelsa, or polysperma, was named by sir Joseph Banks, Dr. Solander, and Dr. Wright. It is very common in the woodlands of Jamaica, is beautiful, tall, and stately, some being 100 feet long, and 10 feet in circumference eight feet above the ground. The trunk is straight, smooth, and tapering, sending off its branches towards the top. The outside bark is pretty smooth, of a light greyish colour, from various hickies. The bark of the roots is of a yellow cast, somewhat like the cortex simulaba. The wood is of a yellow colour, tough, but not very hard. It takes a good polish, and is valued as firewood. Some flowers are small, of a yellowish-green colour, with a very small calyx. The male or barren tree has flowers nearly similar to the hermaphrodite, but in it there are only the rudiments of a style. The largest effects result from the use of this medicine in obstinate remitting fevers from malaria-miasmata, in agues which had resisted the use of Jesuits' bark, and in dysenteries of long standing. It is particularly efficacious in colics from debility, either in simple infusions or tincture by itself, or joined with aromatics and chalybeates. Dr. Drummond, an eminent physician in Jamaica, prescribes it with great success in the above cases, as well as in those of quinsy, in dropsies from debility, either in simple infusions or tincture by itself, or joined with aromatics and chalybeates. Dr. Drummond, an eminent physician in Jamaica, prescribes it with great success in the above cases, as well as in those of quinsy, in dropsies from debility, either in simple infusions or tincture by itself, or joined with aromatics and chalybeates.
pears, which always falls when this salt is dropped into pure water. 17. Muriaut and as-
serin of cobalt occasion no change. 18. Arsen-
iat of potassa produces no effect. 19. The
bile of a ruminant animal contains a peculiar ac-
cid, occasion no effect.

These properties are sufficient to convince
us that the bitter principle is a substance
iffering considerably from all the other ve-
table principles. The little effect of the dif-
erent reagents is remarkable. Nitrate of
silver and acetate of lead are the only two
bodies which throw it down. This precipita-
tion cannot be ascribed to the presence of a
ervorous acid was present, nitrate of lead would be also thrown
down. Besides, the flakes introduced by
nitrate of silver are too light, and indeed have
no resemblance whatever to acrust of silver.
The precipitate by acetate of lead is very co-
pious. This salt is therefore the best sub-
estance for detecting the presence of the bitter
principle, when we are certain that no other
stance is present which throws down lead.

The title of queen is also given by
way of courtesy to her who is married to a
king, who is called by way of distinction
queen-consort.

A queen-consort is inferior to the king, and
is really his subject, though, as the king's
wife, she has some prerogatives above other
women. Though an alien, she may purchase
lands in fee-simple, without either jus
ajunction or charter principles. She may present to a
benefice. She shall not be anerised if she is
not anerised in any action; and may not be
impeached till first petitioned. To conspire
her death, or violate her chastity, is high
treson. She has an ancient peculiar revenue
called queen-gold; besides a very large
dower, with a royal court, and officers of her
own. No person here must marry a queen
wronger without the consent of the succeeding
king, on pain of forfeiting his lands and
goods; but though she marry any of the
ility, or even one under that degree, she
does not lose her dignity.

QUECRA, a tree-twig, a genus of the
polyandra order, in the monocera class of
plants, and in the natural method ranking under the
50th order, amencata. The calyx
is nearly quinquefoil; there is no corolla; the
stamens are four, or to ten in number, is high
female calyx is monopblaetous, very entire,
and scabrous. There is no corolla; the styles
are from two to five; and there is an ovate
seed.

There are 26 species; the most remarkable
are: 1. The robin, or common English oak, from
about 60 or 70 to 100 feet high, with a
prodigious large trunk and spreading head.
There is a variety having the leaves finely
striped with a white edge to the leaf, is high
female calyx is monopblaetous, very entire,
and scabrous. There is no corolla; the styles
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seed.
be hollow, but by the trilling increase I conclude it not sound. 2. These dimensions, however, are exceeded by those of the Bod- dington oak. It grows in a piece of rich ground, called the old orchard ground, belonging to Boddington manor-farm, lying near the turnpike-road between Cheltenham and Tewkesbury, in the vale of Gloucester. The stem is remarkably collected at the root, the sides of its trunk being much more upright than those of large trees in general; and yet its circumference at the ground is about 20 paces; measuring with a two-foot rule, it is more than 18 yards. At three feet high it is 42 feet, and where smallest, i.e., from five to six feet high, it is 36 feet. At six feet it swells out larger, and forms an enormous head, which has been furnished with huge, and probably extensive, arms. But time and the fury of the wind have robbed it of much of its grandeur, and the greatest extent of arm in 1783 was eight yards from the stem.

In the Gentleman's Magazine for May 1794, we have an account of an oak-tree growing in a Peashunt-park in Kent, together with an engraving. It is called the bear or bare oak, from being supposed to resemble that which Camden thought gave name to the county of Berkshire. The dimensions of the tree are these:

<table>
<thead>
<tr>
<th>Diameter</th>
<th>Feet. inches.</th>
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<tbody>
<tr>
<td>Girth close to the ground</td>
<td>35 0</td>
</tr>
<tr>
<td>Ditto one foot from ditto</td>
<td>27 6</td>
</tr>
<tr>
<td>Ditto five feet from ditto</td>
<td>24 0</td>
</tr>
<tr>
<td>Height taken by shadow</td>
<td>73 0</td>
</tr>
<tr>
<td>Girth of lowest, but not largest limb</td>
<td>6 9</td>
</tr>
</tbody>
</table>

With respect to longevity, Linnæus gives account of an oak 260 years old; but we have had traditions of some in England (how far to be depended upon we know not) that have attained to more than double that age. Mr. Marsham, in a letter to Thomas Bever, Esq. Bath Papers, vol. i. p. 70, makes some very ingenious calculations on the age of trees, and concludes from the increase of the Bentley oak, &c., that the Fortworth chestnut is 1100 years old.

Besides the grand purposes to which the timber is applied in navigation and architecture, and the bark in tanning of leather, there are other uses of less consequence, to which the different parts of this tree have been referred. The Highlanders use the bark to dye their yarn of a brown colour, or, mixed with coppers, of a black colour. Oak sawdust is also a principal ingredient in dyeing drabs, especially in Fustian. The acorns are a good food to fatten swine and turkeys; and after the severe winter of the year 1700, the poor people in France were miserably constrained to eat them themselves. There are, however, acorns produced from another species of oak, which are eaten to this day in Spain and Greece, with as much pleasure as chestnuts, without the dreadful compulsion of hunger.

**Quercus marina**, the sea oak. See *Fucis.*

**Querria**, a genus of the trigyna order, in the triandria class of plants, and in the natural method ranking under the 22d order, carpyphyllae. The calyx is pentaphyllous; there is no corolla; the capsule is unilocular, 3-valved, with one seed. There are three species, viz. hispanica, canadensis, and trichotoma.

**QUICK**, or **QUICKSET** hedge, among gardeners, denotes all live hedges, of whatever species, that are thrown up, to distinguish them from dead hedges; but in a more strict sense of the word, it is restrained to those planted with the hawthorn, or cra-

tegus oxyacantha, under which name these young plants, or sets, are sold by the nursery garde-
ers, who raise them for sale. See Cyberus.

**QUICK**-SILVER. See *Mercury.*

**QUILTING**, a method of sewing two pieces of silk, linen, or stuff, on each other, with wool or cotton between them; by working them all over in the form of chequer or diamond work, or in flowers. The same name is also given to the stuff so worked.

**Quince.** See *Pyrus.*

**QUINCHAMALIA**, a genus of the pen-tandria monogynia class and order. The calyx is inferior, 4-lobed; corolla tubular, a super; anthers sessile; seed one. There is one species, a herb of Chili.

**Quincunx**, in Roman antiquity, denotes any thing that consists of five-eleventh parts of so many things; but there are five of each.

**QUINCUNX ORDER**, in gardening, a plan-
tation of trees, disposed originally in a square, and consisting of five trees, one at each cor-
er, and a fifth in the middle; or a quinquum is the figure of a plantation of trees, disposed in several rows, both length and breadthwise, in such a manner, that the first tree in the se-
cond row commences in the centre of the square formed by the two first trees in the first row, and the two first in the third, re-
ssembling the figure of the five at cards.

**QUINDECAGON**, in geometry, a plane figure with fifteen sides and 15 angles, which, if the sides are all equal, is termed a regular quindecagon, and irregular when otherwise.

The side of a regular quindecagon inscribed in a circle is equal in power to the half-diff-
ference between the side of the equilateral triangle, and the side of the pentagon inscribed in the same circle; also the difference of the perpendiculars let fall on both sides, taken together.

**Quinquina.** See *Cinchona,* and *Pharmacy.*

**Quintile,** in astronomy, an aspect of the planets when they are 72 degrees distant from one another, or a fifth part of the zodiac.

**Quire of paper,** a quantity of 24 or 25 sheets.

**Quisqualis,** a genus of the monogynia order, in the decandria class of plants, and in the natural method ranking under the 31st order, vepriculæ. The calyx is quincuncial and siliçiform; the petals five; the fruit is a quine-angular plum. There is only one species, *viz.* Indica, a shrub of the East Indi-

**Quit-am**, in law, is where an action is brought, or an information exhibited, against a person, on a penal statute, at the suit of the king and the party or informer, when the penalty for breach of the statute is directed to be divided between them; in that case, the informer prosecutes as well for the king as himself.

**QUIT-CLAIM,** in law, signifies a release of any action that one person has against another. It signifies also a quittance a claim or title to lands, &c.

**Quit-RENT,** in law, a small rent that is payable by the tenants of most manors, whereby the tenant goes quit and free from all other services. Anticly this payment was called white-rent, on account that it was paid in silver coin, and to distinguish it from rent-corn.

**Quo-in,** or **Coin,** on board a ship, a wedge fastened on the deck close to the breech of the carriage of a gun, to keep it firm up to the ship's side.

**Quoits,** a kind of exercise or game known among the ancients under the name discus.

**Quo Minus,** a writ which issues out of the court of exchequer to the king's farmer or debtor, for debt, trespass, &c. Though this writ was formerly granted only to the king's tenants or debtors, the practice now is become general for the plaintiff to sue, that by the wrong the defendant does him, he is the less able to satisfy his debt to the king, by which means jurisdiction is given to the court of exchequer to determine the cause. This writ is to take the body of the defendant in like manner as the capias in the common pleas, and the writ of latitatur in the king's bench.

**Quo-warranto,** in law, a writ which lies against a person or corporation that usurps any franchise or liberty against the king; as to have a fair, market, or the like, in order to oblige the usurper to shew by what right and title he holds or claims such franchise. This writ also lies for mis-user or non-user of privileges granted. The attorney-general may exhibit a quo-warranto in the crown-office against any particular per-
sons, or bodies politic or corporate, who use any franchise or privilege without having a legal grant or prescription for the same; and a judgment obtained upon it is final, as being a writ of right.
The seventeenth letter of our alphabet, R, in the notes of the ancients, R or R. O signifies Roma; R. C. Romana civitas; R. G. C. rei gerundae causa; R. F. E. D. ree tactum et dictum; R. G. F. regis fulus; R. P. res publica, or Romani principes; and R.R.R. P.E. res Romana rust ferro, fame, flamma.

Used as a numeral, R antiently—stood for eighty, and with a dash over it, thus R, for 80,000; but the Greek Ρ, or ρ, signifies 100.

In the prescrptions of physicians, R or α stands for recipe, i.e. take.

RABBETING, in carpentry, the planing or cutting of channels or grooves in boards. In ship-carpentry, it signifies the letting-in of the planks of the ship into the keel; which, in the rake and run of a ship, is bolted away, so that the planks may join the closer.

RABBIT. See LEPUS.

RACHITIS. See MEDICINE.

RACK. See ARACK.

RACK ROOF. See CURVES.

RADIAL CURVES, are curves of the spiral kind, whose ordinates, if they may be so called, all terminate in the centre of the including circle, appearing like radii of that circle, whence the name.

RADIALIS, or RADIUS. See ANATOMY.

RADIANT. See HERALDRY.

RADIATION, RADIATED FLOWERS. See BOTANY.

RADIATION, the act of a body emitting or diffusing rays of light all round, as from a centre.

RADCILE. See PLANTS, physiology of, BOTANY, and GERMINATION.

RADIUS, in geometry, the semidiameter of a circle, or a right line drawn from the centre to the circumference. See CIRCLE, and GEOMETRY.

RADIUS. See ANATOMY.

RAFF, a sort of float, formed by an assemblage of various planks or pieces of timber fastened together side by side, so as to be conveyed more commodiously to any short distance in a harbour or road than if they were separate. The timber and plank with which merchant-ships are laden, in the different parts of the Baltic Sea, are attached together in this manner, in order to float them off to the shipping.

RAFTERS, in building, are pieces of timber, which standing by pairs on the rafter-plate, meet in an angle at the top, and form the roof of a building. It is a rule in building, that no rafters should stand farther than 12 inches from one another: and as to their sizes or scantlings, it is provided by act of parliament, that principal rafters, from 12 feet six inches to 14 feet six inches long, shall be five inches broad at the foot, and eight at the bottom, and six inches thick. Those from 14 feet six inches to 18 feet six inches long, to be nine inches broad at the foot, seven inches at the top, and seven inches thick; and those from 18 feet six inches, to 21 feet six inches long, to be 10 inches broad at the foot, eight at the top, and eight thick. Single rafters, eight feet in length, must have four inches and a half, and three inches three quarters, in their square. Those nine feet long, must be five and four inches square. Principal rafters should be nearly as thick as at the bottom, and should diminish in their length one-fifth or one-sixth of their breadth; the king-rafters should be as thick as the principal rafters; and their breadth according to the size of those that are intended to be let into them, the middle part being left somewhat broader than the thickness.

RAG WORT. See SENECE.

RAGG, rowley, a genus of stones belonging to the siliceous class. It is of a dusky or dark-grey colour, with many small shining crystals, having a granular texture, and acquiring an oily crust by exposure to the air. The specific gravity is 2.748. It becomes magnetic by being heated in an open fire. In a strong fire it melts without addition, but with more difficulty than basaltes. It was analysed by Dr. Withering, who found that 100 parts of it contain 47.5 of siliceous earth, 52.5 of argil, and 20 of iron.

RAJA, ray, a genus of fishes of the class amphibia, and of the order Nantes. The generic character is, mouth situated beneath the head, transverse, beset with teeth; spiracles beneath, five on each side the neck; body in most species sub-robomoidal.

This genus, of which there are 19 species, is distinguished by the remarkable breadth and thickness of the body, the pectoral fins appearing like a continuation of the sides themselves, being covered with the common skin. Their rays are eel-like, straight, and furnished with numerous swellings or knots; the teeth are very numerous, small, and placed in ranges over the lips or edges of the mouth; the eyes are furnished with a nictitating membrane or skin, which can at pleasure be drawn over them like an eyelid; and at some distance above the eyes are situated the nostrils, each appearing like a large and somewhat semilunar opening edged with a reticulated skin, and furnished internally with a great many laminated processes divided by a middle partition; they are guarded by an exterior valve: behind the eyes are also a pair of holes communicating with the mouth and gills; these latter, taken together, present a vast extent of surface: the young are contained in oblong square capsules, with lengthened corners, and are discharged at distant intervals, the young animal gradually liberating itself from its confinement, and adhering for some time by the umbilical vessels. The rays in general feed on the smaller kind of crabs, testaces, marine insects, and fishes. They are constant inhabitants of the sea, lying concealed during part of the winter among the mud or sand, from which they occasionally emerge and swim to unlimited distances.

1. Raja batis, of a rhomboid shape. The skate is one of the largest of the European rays, sometimes weighing from one to two hundred pounds, and even, according to some accounts, not less than three. Its general colour on the upper parts is a pale cincinno brown, varied with several darker or blackish undulations; the under part is white, marked with numerous, distant, black spots: in the male, the pectoral fins are beset towards their tips or edges with numerous small spines; on each side the tail, at some distance from the base, is a sharp spine; several very strong ones run down the back of the tail, and in some specimens a row of smaller ones is visible on each side. As an edible fish, the skate is considered as one of the best of its tribe, and is an established article in the European markets, being found in great plenty in the adjoining seas, where it usually frequents the shores in the manner of flat fish. It breeds in the month of March and April, and deposits its ova from May to September. We are informed by Mr. Wilmot, that a skate of 200 pounds weight was sold in the fish-market at Cambridge to the cook of St. John's college in that university, and was found sufficient to dine the whole society, consisting of more than 120 persons. In October the skate is armed with some poor and thin, begins to improve in November, and grows gradually better till May, when it is considered as in its highest perfection.

2. Raja clarata, the thornback, grows to a very considerable size, and rarely equal in magnitude to the skate. In its general appearance it resembles that fish, but is somewhat broader in proportion, and is easily distinguished from the skate by the very strong curved spines with which its upper surface is covered: these are most conspicuous down the middle and on each side of the back, where four or six, of much larger size than the rest, are generally seen; the remaining parts being furnished with many scattered spines of smaller size, intermixed with still more minute ones, and the whole skin is of a rough or sharp-green-like surface; the back is marked with an uncertain number of pale or whitish round spots, of different sizes, and which are commonly surrounded with a blackish or dark-coloured edge: these spots are said to be caused by the shedding of the spines at different intervals; along the middle of the back runs a single row of strong spines, continued to the tip of the tail; and it often happens that there are three or even five rows of spines on this part: the colour
of the skin is a brownish grey, with irregular blackish or dusky variegation; the under part is white, with a slight cast of flesh-colour; and about the middle of the body, as well as on the fins, are disposed several spines, similar to those on the upper side, but less strong: in dividing the middle and lower portions of the body, in this species remarkably conspicuous; but since a similar appearance exists in several other species, it cannot be of much importance in the specific character.

The thornback is an inhabitant of the Mediterranean and other seas, and is in some esteem as a food, though not equal to the skate in goodness.

3. Raja chagrinea, shagreen ray. Body less broad in proportion than in most others of this division; snout long and pointed, and furnished with two rows of spines; several others are placed in a semicircle towards the eye of each side; when the animal is swimming, one or both sides of the tail are armed with numerous smaller ones; the whole upper surface of the animal is browned by numerous small granules like those on the skin of some of the shark-tried, and particularly of the great dog-shark, of the skin of which is prepared the substance known by the name of shagreen; colour above cinnereous brown, beneath white. Native of the European seas.

4. Raja pastinaca, sting ray, with slender tail, generally armed with a spine. Shape subrhomboidal, but somewhat approaching to ovate, the pectoral fins being less pointed than those of this division; snout short and thick; body more convex than in the preceding rays; colour of the whole animal above yellowish-olive, with the back darkest, and approaching, in some cases, to a blueish brown; beneath whitish; tail without fin, of considerable length, very thick at the base, and gradually tapering to the extremity, which is very slender; near the middle it is armed on each side with a spine, but not with a spine flattened, and very sharp-pointed base or spine, fixed serrated in a reversed direction on both sides; with this the animal is capable of inflicting very severe wounds on such as inadvertently attempt to handle it; and it seems the purpose both of an offensive and defensive weapon: it is annually cast, and as it frequently happens that the new spine has arrived at a considerable size before the old one has been cast, specimens, to a blueish brown, are sometimes found with two, in which state it has been sometimes erroneously considered as a distinct species. This fish is said not to grow so large a size as many others of the genus: it is an inhabitant of the Mediterranean, Atlantic, and Indian seas, and is numbered among the edible rays. On account of the danger attending the wounds inflicted by the spine, it is usual with the fishermen to cut off the tail before the fish is taken; and it is said to be illegal in France, and some other countries, to sell the animal with the tail still adhering. It is hardly necessary to observe, that the spine is perfectly void of any venomous quality, though formerly supposed to contain a most active poison; and that the effects sometimes produced by it are entirely those arising from deep puncture and laceration, which, if taking place in a tendinous part, or among the larger nerves and blood-vessels, have often proved fatal.

RAJA.

The general habits of the animal are similar to those of the rest of the genus, often lying flat and in ambuscade on the soft mud at the bottom of the shores which it frequents, and seizing its prey by surprise, and at other times pursuing it through the depths of the ocean.

5. Raja aquila, eagle ray. This species grows to a very great size, sometimes measuring ten, twelve, or even fifteen feet in length.

6. Raja sephen, pearl ray. Shape subrhomboidal; the upper part of the body, measured from the tips of the pectoral fins, which are obtuse, forming a half-circle; the lower part, from the tips of the pectoral fins to the tail, forming a half-circle; snout small and slightly pointed; ventral fins rather small and rounded; tail more than twice the length of the body, gradually tapering to a fine point, furnished beneath the middle part with a shallow fin running to a considerable distance, and above with a strong and sharp spine, as in the sting ray and many others, and sometimes two spines are found instead of one; ventral fins small; skin thinly skinned, finely spotted, in some cases tapering beyond the base of the tail, covered with pretty close-set tubercles or granules, three of which, in the middle of the back, are far larger than the rest, and resemble the three pointed spines disposed in a longitudinal direction on that part: colour of the whole animal deep cinnereous-brown above, and reddish white beneath; grows to a large size, sometimes measuring eleven feet from the snout to the end of the tail, and weighing upwards of one thousand pounds.

It is from the skin of this species, according to Cepedé, that the beautiful substance called galuchat by the French is prepared; and which being coloured with blue, green, or red, according to the fancy of the artizan, and afterwards polished, is so frequently used for various kinds of cases, telescope-tubes, &c. For this purpose the smaller or younger specimens are preferred; the tubercles in the more advanced or full-grown animals being too large for the uses above mentioned.

7. Raja diabolus, demon ray, with bilobate front. This highly singular animal, in point of general size, is allied to the eagle ray, but it appears of a much greater extent of pectoral fins, appearing exceedingly broad in proportion to its length; the head, which is of moderate size, is straight or rectilinear in front, each side projecting into a vertically flattened figure, and nearly two feet in length, and giving somewhat the appearance of a pair of horns; the pectoral fins are of a subtriangular figure, curving downwards on each side, and terminating in a point; the body is slightly elevated into a somewhat pyramidal form; and at its lower part is situated the dorsal fin, which is of a lengthened shape, and inclines backwards. This species is an inhabitant of the Mediterranean, Atlantic, and Indian seas. It is said to be chiefly observed about the Azores, where it is known by the name of modular.

8. Raja torpao, of a rounded shape. The torpedo has been celebrated both by antients and moderns for its wonderful faculty of causing a sudden numbness or painful sensation in the limbs of those who touch or handle it. This power of the animal, unaccompanied with the theory of electricity, were contented to admire, without attempting to explain; and, as usual in similar cases, magnified it into an effect little short of what is commonly ascribed to enchantment. Thus we are told by Oppian, that the torpedo, conscious of its latent faculty, when caught by a hook, exerts its electric shock along the line and rod, it bewilders the astonished fisherman, and suddenly reduces him to a state of helpless stupefaction. See ELECTRICITY, and GALVANISM.

The body of the torpedo is of a somewhat circular form, perfectly smooth, slightly convex above, and marked along each side of the spine by several small pores or foramina; the colour of the upper surface is usually a pale reddish-brown, sometimes marked by five large, equidistant, circular, dusky spots with paler centres; the under surface is whitish, or flesh-coloured. The torpedo, however, is observed to vary considerably in the cast and intensity of its colours. The general length of the torpedo seems to be about eighteen inches or two feet, but it is occasionally found of far larger dimensions; specimens having been taken on our own coasts as long as eight of fifty, sixty, and even eighty pounds.

The torpedo is an inhabitant of most seas, but seems to arrive at a larger size in the Mediterranean than elsewhere. It is generally seen within twenty miles of land, but has been sometimes known to take a bait. It commonly lies in water of about forty fathoms depth, in company with others of this genus. It preys on smaller fish, and according to Mr. Cuvier, a serpent and a plate have sometimes been found in the stomach of two of them; the surmullet, as Mr. Pennant well observes, is a fish of that subfamilies, that it would be impossible for the torpedo to take it by pursuit; we must therefore suppose that it stumps its prey by exerting its electric faculty. The torpedo often inhabits sandy places, hurrying itself superficially, by flinging the sand over it, by a quick flapping of all the extremities. It is in this situation that it gives its most formidable shock, which is said to throw down the astonished passenger that inadvertently treads on the animal.

The torpedo, with respect to its general aspect, does not materially differ from the rest of the ray tribe, except in its electric or galvanic organs. It appears that the electric organs of the torpedo consist of a pair of galvanic batteries, disposed in the form of regular and perpendicular hexagonal columns. In the gymnitis electricus, on the contrary, the galvanic battery is disposed lengthwise on the lower part of the animal.

Spallanzani informs us, that some few minutes before the torpedo expires, the shocks which it communicates, instead of being given at distant intervals, take place in quick succession, like the pulsations of the heart: they are weak, indeed, but perfectly perceptible to the hand when laid on the fish at this juncture, and resemble very small electric shocks. In the space of seven minutes, no less than 5000 shocks with the travel, were perceived. Spallanzani also assures us of another highly curious fact, which he had occasion to verify from his own experience, viz. that the young torpedo can not only exercise its electric faculty, but is even while it is yet a fetus in the body of the parent animal. This fact was ascertained by Spallanzani on
RAIL

RAI E is a ship, is all that part of her hull which hangs over both ends of her keel. That which is before is called the fore-rail, or rake-forward, and that part which is at the stern-post, the rake-af

RAILUS, the rail, in ornithology, a genus belonging to the order of rails. The beak is thickest at the base, compressed, and somewhat sharp on the back near the point. the nostrils are oval; the feet have four toes, without any web; and the body is compressed. Mr. Latham, in his Index Ornithologicus, enumerates 24 species, besides some varieties. They are chiefly distinguished by their colour. "These birds (says Buffon) constitute a large family, and their habits are different from those of the other shore-birds which reside on sands and shingle, and are found in frequented meadows; and from the disagreeable cry, or rather rattling in the throat, of this bird, is derived the generic name. In all the rails, the body is slender, and shrunken at the skull; and their voice is like the breathing of a horse. Some, indeed, have the hill like that of the galinaceous kind, though much longer, and not so thick; a portion of the leg above the knee is bare; the three fore-toes without membrane, and not long; the lesser toes of the legs, draw them by their feet under their belly in flying, but allow them to hang down; their wings are small, and very vociferous, and their flight is short. They seem to be more diffused than varied; and nature has produced each of them over the most distant lands. Captain Cook found them at the Straits of Magellan, in different islands of the southern hemisphere, at St. Domingo, at the Isle of Norfolk. In the Society Islands there are two species of rails; a little black-spotted one (poonane), and a little red-eyed one (moiho). It appears that the two acolias of Per
c 3. The crex, or corn-crex, has been supposed by some to be the same with the water-rail, and that it differs only by a change of colour at a certain season of the year: this error is owing to its habit of being chiefly observed in the winter, and that the bird being found under corn, is often called the corn-crex. It is sometimes called "halm-nash," from the sound of its notes, which are given when it is driven out of its house by a dog or the like. The bird, when driven, utters a loud cry, the sound being something like a crack, and is given in a low tone. The bird is of a dull white colour, marked with a few yellow spots: notwithstanding this they are very numerous in this kingdom. Their note is very singular; and, like the quail, it is destroyed into a note by the limitation of its crex crex crex, by rubbing hard the blade of a knife on an indented bone. Most of the names given in different languages to this

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bird are evidently formed to imitate this singular cry.

They are in greatest plenty in Anglesia, where they appear about the 20th of April, supposed to pass over from Ireland, where they abound. At their first arrival, it is common to shoot seven or eight in a morning. They are found in most of the Hebrides, and the Orkneys. On their arrival they are very leamy-looking only six ounces; but before they leave this island, grow so fat as to weigh above eight. The feathers on the crown of the head and hind part of the neck are black, edged with bay-colour; the coverts of the wings of the same colour, but not spotted; the tail is short, and of a deep bay; the belly white; the legs ash-coloured.

RALLYING, in war, re-assembling or calling together troops broken and put to flight.

RAM, in zoology. See Ovis.

RAM, in astronomy. See Aries.

Ram, battering, in antiquity, a military engine used to batter and beat down the walls of places besieged.

The battering ram was of two sorts; the one rude and plain, the other compound. The former has been no more than a great beam which the soldiers bore on their arms and shoulders, and with one end of it by main force assailed the wall. The compound ram is thus described by Josephus. It is a vast beam, like the mast of a ship, strengthened at one end by a head of iron, something resembling that of a ram, whence it took its name. See Plate Miscel, fig. 196. This beam was placed in the middle with ropes to another beam which lay across two posts; and hanging thus equally balanced, it was by a great number of men drawn backwards and pushed forwards, striking the wall with its iron head.

Puttarth informs us, that Mark Anthony, in the Parthian war, made use of a ram four-score feet long; and Vitruvius tells us, that they were sometimes 106, and sometimes 122 feet long. According to this, perhaps, the force and strength of the engine was in a great measure owing. The ram was managed at one time by a whole century of soldiers, and they being spent, were succeeded by another party, so that it played continually without any intermission.

In order to calculate the force of the battering-ram R, suppose it to be 28 inches in diameter, and 180 feet long; and consequently its solid content 750 cubic feet; which, allowing 50 pounds for each foot, will weigh 37500 pounds; and suppose its head of cast-iron, together with three iron-hoops, &c. to be 3612 pounds. Now all these weights added together, make 41112 pounds, equal the weight of the whole ram; which will require 1000 men to move it so as to cause it to strike against the point L of the wall A. A man moving a weight of 41 pounds. The quantity of motion produced by this action, when the ram moves one foot in a second, may be expressed by the number 41112; which, when compared with the quantity of motion in the iron ball B, shot out of the cannon C, will be found equal to it: for a cannon-ball is known to move as fast as sound for about the space of a mile; and if you consider, from what the weight of the ball, by 114, the number of feet which sound moves in one second, you will have the number 41112 for the quantity of motion or force, in the ball B striking at L. And if, after a few strokes given by the battering ram on theinner or crown is so loosened, that the piece of the wall ADDFE is at last by a stroke of the ram carried forward from F to K, and so beaten down: the same thing will be performed by a cannon-ball, after it has been blown out of a cannon. This shows how advantageous the invention of gunpowder is; since we are thereby enabled to give such a prodigious velocity to a small body, that it shall have as great a quantity of motion as a body immensely greater, and requiring more hands to work it: for three men will manage a cannon which shall do as much execution as the above battering-ram, wrought by 1000. The ram whose force is here calculated, is taken at a mean; being larger than some, and less than others, of those used by the ancients.

Ram's-head, in a ship, is a great block belonging to the sternpost. The ram has three shivers in it, into which the hal-lyards are put, and in a hole at the end of it are receed the tives.

RAMADAN, a solemn season of fasting among the Mahometans, kept in the ninth month of the lunar year.

RAMANT. See Heraldry.

RAMPART, in fortification, is an elevation of earth round a place capable of resisting the cannon of an enemy; and formed into bastions, curtins, &c. See Fortification.

RAMPHASTOS, in ornithology, a genus belonging to the order of perisses. The bill is very large, and serrated outwardly. The nostrils are situated behind the base of the beak; and in most of the species the feet are toed, and placed two forwards and two backwards. The tongue is long, narrow, and feathered on the edges. Mr. Latham enumerates fifteen different species, of which the toucans are the most remarkable, and were formerly divided into four or five varieties, though Mr. Latham proves that distinct species, of which we only should describe that called the red-beaked toucan.

This bird is about the size of a jack-daw, and of a deep carmine, with a large head to support its monstrous bill. This bill, from the angles of the mouth to its point, is six inches and a half; and its breadth in the thickest part is a little more than two. Its thickness near the head is one inch and a quarter; and it is a little rounded along the top of the upper chap, the under side being round also; the whole of the bill extremely slight, but a little thicker than parchment. The upper chap is of a bright yellow, except on each side, which is of a fine scarlet colour; as is also the lower chap, except at the base, which is purple. Between the head and the bill there is a black line separating the two; in the upper part of which the nostrils are placed, and are almost covered with feathers; which has occasioned some writers to say that the toucan has no nostrils. I observe that the eyes on each side of the head, is a space of blueish skin, void of feathers; above which the head is black, except a white spot on each side joining to the base of the upper chap. The hinder point, the horns, or crest, was long; tail, belly, and thighs, are black. The under-side of the head, throat, and the beginning of the breast, are white. Between the white on the breast, and the black on the belly, is a space of red feathers, in the form of a new moon, with the apex up, and the base down. The legs, feet, and claws, are of an ash-colour; and the toes stand like those of parrots, two before and two behind. It is reported, by travellers, that this bird, when furnished with so formidable a beak, is harmless and gentle, being so easily made tame as to sit and hatch its young in houses. It feeds chiefly upon pepper, which it devours very greedily. It builds its nest in holes of trees, which have been previously scooped out for this purpose. There is no bird secures its young better from external injury than the toucan. It has not only birds, men, and serpents, to guard against, but a numerous tribe of monkeys, still more prying, mischievous, and hungry, than all the rest. The toucan, however, scoops out its nest into the hollow of some tree, leaving the large baggage intact, and out at its own peril. There it sits, with its great beak, guarding the entrance; and, if the monkey ventures to offer a visit of curiosity, the toucan gives him such a welcome, that he presently thinks better of his intent and retires. It is said to fly with safety.

This bird is only found in the warm climates of South America, where it is in great estimation both for its flesh, which is tender and nourishing, and for the beauty of its plumage, particularly the feathers of the breast. The skin of this part of the Indians pluck off, and when dry glue to their cheeks, to make an irrestible addition to their beauty. See Plate Nat. Hist. fig. 342.

RANA, frog, a genus of amphibia of the order reptiles; the generic character is, body four-footed, without tail, and naked, or without any integument but the skin.

This genus may be divided into three sections, viz. 1. Frogs, commonly so called, or range, with light active bodies, and which leap about when alive, and move from hinder to fore legs, hyla, calamita, or range boarcre, viz. such as have light bodies, very slender limbs, and toes terminating in flat, circularly expanded, and adhesively toad-like feet, which adhere to the object, to which they are pressed, to the surface even of the smoothest bodies. Several of this division generally reside on trees, adhering by their toes to the lower surface of the leaves and branches. 3. Toads, bufones, or such as have large heavy bodies, short thick limbs, and which rather crawl than leap when disturbed.

1. Rana temporaria, the common frog, is the most common of all the European species, being almost every where seen in moist situations, or wherever it can command a sufficient quantity of insects, worms, &c. on which it feeds. In colour it varies considerably; the general tinge is light brown, variegated on the upper parts of the body and limbs with irregular blackish spots; those on the limbs being mostly disposed in a transverse direction: beneath each eye is a longitudinal line, and at the neck the setting on of the fore-legs, and which seems to form one of its principal specific distinctions. It is generally in the month of March that the frog deposits its ova or spawn, consisting of several globular, transparent eggs, containing a number transparent eggs, in each of which is
imbedded the embryos, or tadpole, in the form of a round black globule. The spawn commonly lies more than a month, or sometimes five weeks, before the larve or tadpoles are bunched from it; and during this period each egg gradually enlarges in size, and a few days before the time of exclusion the young animals may be perceived to move about in the surrounding gluten. When first bunched, they seem to lie in the gluten, in the manner of which they were imbedded; and in the space of a few days, if narrowly examined, they will be found to be furnished, on each side the head, with a pair of ramified branchial or temporary organs, whence and in the manner of which they disappear after a certain space. These tadpoles are so perfectly unlike the animals in their complete state, that a person not conversant in natural history would have great difficulty in bearing any relationship to the frog; since, on a general view, they appear to consist merely of head and tail. Their motions are extremely lively, and they are often seen in such vast numbers, as going round in the same direction, or moving with each other in their legions. They live on the leaves of duckweed and other small water-plants, as well as on various kinds of animakales, &c., and when arrived at a larger size, they may even be perceived swimming in the gluten on which they feed, their mouths being furnished with extreme minute teeth or dentilations. The tadpole is also furnished with a small kind of tubular splintcr or sucker beneath the lower jaw by the help of which it hangs at pleasure to the under surface of aquatic plants, &c. From this it is also occasionally hung, when very young, by a thread of gluten, which it seems to have been pasted in the gluten of some of the smaller bags which have been observed to practice. Its interior organs differ, if closely inspected, from those of the future frog, in many respects: the intestines, in particular, are always coiled into a flat spiral, in the manner of a cane in miniature. When the tadpoles have arrived at the age of about five or six weeks, the hind legs make their appearance increasing in size, length and size; and, in about a fortnight afterwards, or sometimes later, are succeeded by the fore legs, which are indeed formed beneath the skin much sooner, and are occasionally seen to appear on the surface before the animal through a small foramen on each side of the breast, and are not completely stretched forth till the time just mentioned. The animal now bears a kind of ambiguous appearance, partaking of the form of a frog and a lizard. The tail at this period begins to decrease, at first very gradually, and at length so rapidly as to become quite obliterated in the space of a day or two afterwards. The animal now ventures upon land, and is seen wandering about the brinks of its parent waters, and sometimes in such quantities as to cover a space of many yards in extent. This is the period when the animal embarks the minds not only of the vulgar, but even of some superior characters in the philosophic world; who, unable to account for the legions of these animals with which the ground is occasionally covered in certain spots, at the close of summer, have been led into the popular belief of their having descended from the clouds in showers.

As soon as the frog has thus assumed its perfect form, it feeds no longer on vegetables but on animal food; supporting itself on small snails, worms, &c., and insects. For the reader obtaining its prey, the structure of its tongue is extremely well calculated, being so situated that the root is attached to the fore rather than the hind part of the mouth; and when at rest, lies backwards, as if the animal was swallowing the tip. By this means the creature is enabled to throw it in the mouth, which is done with great celerity, and the bird and gluttonous extremity seizes the prey, which is swallowed with an instantaneous motion, so quick that the eye can scarcely follow it. The frog can hardly be sat. In its state at its full size till the age of about five years, and is supposed to live at least twelve or fifteen years. This frog is extremely tenacious of life, and, like other amphibians, will survive for a considerable space the loss of many of its organs. It has entirely under water, it is still enabled to support its existence for several days, and this was found by an experiment, who kept a frog under water six days. On the contrary, it cannot so well dispone with the want of water, and is unable to survive too long an exposure to a dry air at all. It is therefore especially careful to secure a retreat where it may enjoy the benefit of shade and a sufficient supply of moisture. It delights, however, to bask occasionally in a moderate sunshine, and is unable to support severe cold.

2. Rana esculenta, green frog. This species is the largest of the European frogs, and is found plentifully in France, Italy, Germany, and many other parts of Europe, but is rare in Britain. Its general appearance it extremely resembles the common frog, but is of larger size, and of olive-green colour, distinctly and strongly marked on the upper parts of the body with moderately large and somewhat rounded black spots or patches; the limbs are elegantly marked or barred transversely with bands of the same colour. The head is rather larger than that of the common frog; and the long deep-brown patch under each eye, which forms so constant and conspicuous a character in that animal, is much less distinct, and sometimes entirely wanting. The proportion of the limbs is nearly as the same as in the common frog; and the hind feet are very strongly palmed. The green frog is a very voracious animal, and will occasionally seize on young birds of various kinds, mice, and even young ducklings which happen to stray too far from their parents, swallowing them whole like the rest of its prey. It arrives at its full growth in about four months, begins to breed at the age of five years, and lives to about sixteen.

3. Rana catesbeiana, bull-frog. This remarkable species is not uncommon in many parts of North America, where it is known by the name of the bull-frog, its voice resembling the distant lowing of that animal. It grows to a very large size, and is about 18 inches from the nose to the end of the hind foot. Its colour, on the upper parts, is a dusky olive or brownish, somewhat irregularly marked with numerous deep-brown spots; while the under parts are of a pale or whitish cast, with a tincture of yellowish green.

4. Rana ignea, fire-frog, is native of Germany, Italy, and many other parts of Europe, but is not found in England. Its colour on the upper parts is a dull olive-brown, the legs are black with bright green underparts; and the edges of the mouth is placed a row of blackish streaks or perpendicular spots. The under parts both of the body and limbs are orange-coloured, spotted or variegated with irregular markings of call blue. It is from the colour of the under surface that this species has obtained its title of oculo igneus, fire-frog, &c.

This animal may be considered rather as an aquatic than terrestrial species, being frequently seen in large turbid stagnant waters, in which, in the month of June, it deposits its spawn, the eggs being much larger in proportion than in most others of the genus. The tadpoles are hatched towards the end of June, and are of pale yellowish-brown-colour; and when young are often observed to hang from the surface of leaves, &c., by a glutinous thread proceeding from the small tube or sucker beneath the lower lip.

The fire-frog is a lively, active animal; leaping and swimming with equal or even superior agility to the common frog. When surprised on land, or unable to escape, it squats close to the ground, at the same time bringing back its head and limbs in a singular manner; and if farther teased or irritated, evacuates from the hinder part of the thighs a kind of saponaceous frothy fluid, of no bad scent, but which in some circumstances has been found to excite a slight sensation of acrimony in the eyes and nostrils. This species is observed to breed at the age of three years, and may be supposed to live seven or eight years; but this is not entirely ascertained. Its voice, according to Roscel, is sharper or lighter than in other frogs, less disagreeable, and in some degree resembling a kind of mewing; according to authors, however, it rather resembles the tone of a bell, or the note of a cuckoo; for which reason the animal has been called rana bumbina. Its male only is vocal.

5. Rana plectrota, or tadpole. This animal is a native of South America, and is said to be more particularly found in Surinam than in other parts. In its general form it is very much resembles the rana temporalis, or common European frog; and is, when living, of a yellowish olive-colour, spotted and variegated on the body and limbs with russet or yellowish brown; the principal mark of distinction from others of the genus being the somewhat oblique longitudinal stripes on the hind legs: the fore feet have only four toes, and are unwelted; but the hind feet have five, and are very deeply palmed to the very ends or tips of the toes; and near the thumb or shortest toe is an oblique line, resembling an additional or spurious toe.

The tadpole of this frog, from its very large size, the strong and muscular appearance of the tail, and the ambiguous aspect which it exhibits in the latter part of its progress towards its complete or mature form, has long continued to constitute the paradox of European naturalists; who, however strong and well-grounded their suspicions might be relative to its real nature, and the mistake of most describers, were yet obliged, in some
measure, to sequence in the general testimony of those who have seen it in its native waters, and who declared it to be at length transmuted, not into a frog, but a fish! and it was even added by some, that it afterwards reverted to its tadpole form again! That it is really no other than a frog in its larva or tadpole state, will be evident to every one who considers its structure; and more especially, if it is collated with the tadpole even of some European frogs. Like our common European tadpoles, this animal, according to the more or less advanced state in which it is found, is furnished either with all the four legs, or with only the two hinder ones; it also sometimes happens that in the largest-sized of these tadpoles, exceeding perhaps the length of six or eight inches, the hind legs alone appear; while in those of far smaller size both the fore and hind legs are equally conspicuous.

It will readily appear that the larva of this frog is larger in proportion to the complete animal than in any other species hitherto discovered. From which we may observe, that perhaps all the specimens of these very large tadpoles occurring in museums, may not be those of the true para-doxa in particular, but of some other American, African, or Asiatic frogs, as the R. occulta, marina, &c. See FROG-FISH, Vol. I. p. 780.

Hylæ, or frogs with rather slender bodies, long limbs, and the tips of the toes flat, orbicular, or dilated.

6. Rana zebra, zebra-frog, appears to be by far the largest of all the Hylæ, or slender- bodied frogs, and is, according to Sota, a native of Carolina and Virginia. Its colour is an elegant pale russet-brown, beautifully marked on the back and limbs, and even to the ends of the toes, with transverse chestnut-coloured bands, which on the limbs are double and much more numerous than on the back; the fore feet are tetradactylous, and the hind pentadactylous; the head is large in proportion, the eyes prominent, and the mouth wide. It measures about five inches.

7. Rana purpurea, the fire-frog, is remarkable for its colours, as well as in the elegance of its form and the agility of its movements, the tree-frog exceeds every other European species. It is a native of France, Germany, Italy, and many other European regions, but is not found in the British islands. Its principal residence, during the summer months, is on the upper parts of trees, where it wanders among the foliage in quest of insects, which it catches with extreme celerity, seizing softly toward its prey in the manner of a cat toward a mouse, and while at the proper distance, seizing it with a sudden spring, frequently of more than a foot in height. It often suspends itself under the leaves of trees; it is thus concealed. The leaf is then continued concealed beneath their shade. Its size is smaller than any other European frog, except the fire-frog. Its colors vary in the upper part is green, more or less bright to its different individuals; the abdomen is white, and marked by numerous granules; the under surface of the limbs is reddish, and the body marked on each side by a longitudinal blackish or violet-coloured streak. The body is smooth above, and moderately short above; the hind legs are very long and slender; the toe feet have four and the hind feet five toes, all of which terminate in rounded, flat, and dilated tips, the under surface of which, being soft and glutinous, enables the animal to hang with perfect security from the leaves of trees, &c. The skin of the abdomen is also admirably adapted to this purpose, forming a kind of adhesion, covered with small granular granules in such a manner as to fasten closely even to the most polished surface; and the animal can adhere at pleasure to that of glass, in whatever position or inclination it is placed, by merely pressing itself against it.

Though the tree-frog inhabits the woods during the summer months, yet on the approach of winter it retires to the waters, and there submerging itself in the soft mud, or concealing itself beneath the banks, remains in a state of torpidity, and again emerges in the spring, at which period it deposits its spawn in the waters, like the rest of this genus.

During their residence among the trees, they are observed to be particularly noisy on the approach of rain; so that they may be considered, in some measure, as a kind of barometer; more especially the males, which, if kept in glasses, and supplied with proper food, will afford an infallible presage of the changes of weather.

Toads. 8. Rana bufo, common toad. Of all the European toads, this seems to be the most universally known; at least, in its complete or perfect form. It is found in gardens, woods, and fields; and frequently makes its way into cellars, or any obscure recesses in which it may occasionally conceal itself, and which it may, or may not, if found of sufficient security from the too great a degree of cold. In the early part of spring, like others of this genus, it returns to the waters, where it continues during the breeding-season, and deposits its spawn in the form of double necklace-like chains or strings of beautifully transparent glutens, and of the length of three or four feet.

The toad is an animal too well known to require any very particular description of its form. It may be observed, that it is always covered by tubercles, or elevations on the skin, of larger or smaller size in different individuals; and that the general colour of the animal is an obscure brown above, much paler and irregularly spotted beneath.

The toad arrives at a considerable age; its general term of life being supposed to extend to 15 or even 20 years; and Mr. Pennant, in his British Zoology, gives us a curious account, communicated by a Mr. Ascott of Tething in Devonshire, of a toad's having lived, in a kind of domestic state, for the space of more than 40 years, and of having been in a great degree tamed, or rather from its natural vivacity, to desire of concealment, since it would always regularly come out of its hole at the approach of its master, &c. In order to be fed. It grew to a very large size, and was considered as so singular a curiosity, that even ladies, laying aside their usual aversion and prejudices, requested to see the favourite toad. It was, therefore, often brought to table, and fed with various kinds of morsels; at least, with those which, by persons of unphilosophical minds, can support a long abstinence, and requires but a small quantity of air; but in the accounts generally given of toads discovered in stones, wood, &c. the animals are said to
have been completely impacted or imbedded, and without any space for air.

9. Rana viridis. The green toad is a native of Germany and some other parts of Europe, and seems to have been first described by Valenciennes, and afterwards by Lauter, who informs us that it inhabits the cavities of walls about Vienna, and is distinguished by its greenish and confluent spots on the upper parts, disposed on a pale or brownish ground, and usually reaching over the shoulders. Each of the green spots or patches is also bordered by a blackish margin, and the whole pattern has a somewhat rude and somewhat map-like appearance. The colour of the skin is very variegated, being that of the common black or garden nightshade, but much more powerful, so as to fill a whole room. The female is of a browner cast than the male. In winter this species lives under ground, and, like other species of the genus, frequents the waters at the breeding season.

10. Rana dubia, or musca. Of this animal a specimen is preserved in the national Museum, of which I have a map of the post: its size is that of a common toad, but the shape of the body differs, seeming gradually to decrease from the shoulders to the hind legs, somewhat in the manner of those of the night-frog. Its colour, so far as can be determined from the specimen long preserved in spirit of wine, appears to have been a moderately deep brown above, and pale or whitish beneath, yellowish or red at the back with brown. The whole upper surface is beset with distinct oval punctures or tubercles.

Whether this is the species intended by Linnaeus, under the name of rana musca, very probably is uncertain. In the former, Nature he refers to no author or figure, but informs us that the animal is a native of Surinam, and that it has a musical voice.

11. Rana pipa. pipa. This is also called the common toad. Among the whole tribe of amphibia, it is, perhaps, difficult to find an animal of more singular appearance than this, which may be regarded as a more deformed and ridiculous animal than even the common night-frog. This arises not so much from the general shape of the animal, as from the extraordinary structure of the upper eyelids, which are so formed as to resemble a pair of short sharp-pointed horns; the shape of the mouth is such as to exceed that of any other species, and even to equal half the length of the body itself. The skin of the body, both above and below, is of a most disgusting brown. Along the back runs a broad white band, commencing at the head, and thence decreasing gradually, so as to appear narrow over the hind parts; it is also imparted with small greenish spots. All the rest of the body is rough, with sharp spines, except the head, which is variegated with white, and the abdomen, which is of a deep ruby yellow. The legs are furnished with small quills; the hands and the toes are marked in a similar manner, and resemble in some degree the human fingers, and are four in number on the fore legs, and five on the hind; the hind feet are also furnished with small quills. The head is very large and thick, and when the mouth is opened, exhibits a broad and thick tongue, shaped somewhat like an oyster, and fastened in to the lower jaw, but loose behind as in frogs; it is also covered over with papillae. The female agrees in all respects with the male, except that the mouth is still wider, and the front is greater in a somewhat different manner. See Plate Nat. Hist. fig. 343.

Selma seems to have been misinformed as to the native country of this species, which he imagined to be Virginia; but the animal is now known to be a native of South America only.

12. Rana pipa. This is also one of those animals which, at first view, every one pronounces deformed and hideous; the general uncouthness of its shape being often exaggerated by a phenomenon unexampled in the rest of the animal world, viz. the young in various stages of exclusion, proceeding from cells dispersed over the back of the parent.

The size of the pipe considerably exceeds that of the common toad: the body is of a flattened form; the head male is longer, with the edges or corners furnished with a kind of short cutaneous and lacertated appendage on each side; in the male, however, the head is rather oval than triangular, and the pointed less distinct; the fore feet are tetrads, the toes long and thin, and each divided at the tip into four distinct processes or processes, each of which, if narrowly examined with a magnifier, will be found to be from an obscurely subdivided almost in a similar manner; the hind feet are five-toed, and very widely webbed; the web reaching to the very tips of the toes. The male pipe is larger than the female, measuring much less than seven inches from the nose to the end of the body; the nose in both sexes is of a somewhat truncated form, like that of a mole or hog, and the eyes very small, from each eye, in the female, run two rows of granules, or glandular points, to the middle of the back; the whole body is also covered with similar points or glandules, but smaller than the former. The granules proceed from each eye down the back, instead of a double row as in the female: these points or granules are also larger than in the female, and gradually decrease in size as they pass from the lower part of the back; the skin round the neck, in both sexes, forms a kind of loose or wrinkled collar: the abdomen of the male is of a brownish tinge than that of the female, and is sometimes obscurely spotted with yellow; but the general colour, both of the male and female pipe, is a dark or blackish brown.

It was for a long time supposed that the ova or eggs of this extraordinary animal were produced in the bursal cells, without having been first excluded in the form of spawn; but later observations have proved that a still more extraordinary process takes place; and that the spawn after exclusion is received into the open cells of the back, and then concealed till the young have arrived at maturity. The female pipe deposits her eggs or spawn at the brink of some stagnant water; and the male collects or amasses the heap of ova, and deposits them on the female, where, after impregnation, they are pressed into the cells, which are at that period open for their reception, and afterwards close over them; thus retaining them till the period of their second birth, which happens in somewhat less than three months, when they emerge from the back of the parent in their complete state. During the time of their concealment, however, they undergo the usual change of the rest of the genus, being first hatched from the eggs in the form of a tadpole; and generally acquire their complete shape some time before their exclusion.

According to Fermin, the pipe is calculated by nature for producing but one brood of young; and, compared with the rest of the genus, it can by no means be considered as a very prolific animal; the number of young produced by the female which he observed, amounted to 75, and were all excluded within the space of five days.

RANCIDITY, the effect of Oils.

RAN.

RANDOM SHOT, in gunnery, is a shot made when the muzzle of a gun is raised above the horizontal line, and is not designed to shoot directly or point blank. The utmost random of any piece is about 40°; the mouth very seldom goes 45°. To shoot a bullet will go farthest when the piece is mounted to about 45° above the level range. See GUNNERY, and PROJECTILE.

RANGE, in gunnery, the path of a bullet, or the line it describes from the mouth of the piece to the point where it lodges. If the piece is in a line parallel to the horizon, it is called the right or level range: if it is mounted to 45°, it is said to have the utmost range; all others between 60° and 45° are called the intermediate rangs.

RANGER, a sworn officer of a forest, appointed by the king's letters-patent, whose business is to act through his charge, to drive back the deer out of the purifier, &c. and to present all trespassers within his jurisdiction at the next forest-court.

RANGES, in a ship, two pieces of timber that go across from side to side; the one on the forecastle, a little abait the fore-mast; and the other in the beak-head, before the waulings of the bowsprit.

RANK, in war, is a row of soldiers placed side by side.

To double the ranks is to put two ranks into one. To close the ranks is to bring the men together and to open them, is to set them farther apart.

RANK, the order or place assigned a person suitable to his quality or merit. See PRECEDENCE.

Rank and precedence, in the army and navy, are as follows:

Engineer's rank. Chief, as colonel; di-rector, as lieutenant-colonel; sub-director, as major; engineer in ordinary, as captain; engineer extraordinary, as captain-lieutenant; sub-engineer, as lieutenant; practitioner engine-

Navy rank. Admiral, or commander-in-chief of his majesty's fleet, has the rank of a field-marshal; admirals with their flags on the main-topmast head, rank with generals of horse and foot; vice admirals, with lieute-


RAmap. See Brassica.

Rape, in law, is where a man has carnal knowledge of a woman by force, and against her will; by 18 Eliz. c. 7, if any person shall unlawfully and carnally know and abuse any woman-child under the age of ten years, whether with her consent or against it, he shall be punished as for a rape. And it is not a sufficient excuse in the ravisher, to prove that she is a common strumpet; for she is still under the protection of the law, and may not be forced. Nor is it the offence of a rape mitigated by showing that the woman at last yielded to the violence, if such her consent was forced by fear of death or torture; nor is it any excuse that she consented after the fact. 1 Haw. 108.

The civilians make another kind of rape, called rape of subordination or seduction; which is seducing a maid either to uncleanness or marriage, and that by gentle means; provided there is a considerable disparity in the age and circumstances of the parties.

Rape is also a name given to a division of a county, and sometimes means the same as a hundred, and at other times signifies a division consisting of several hundreds; thus Saxe is divided into six rapes, every one of which, besides its hundreds, has a castle, a river, and a forest, belonging to it. The like parts in other counties are called titheings, lathes, or rententakes.

Raphanus, radish, a genus of the silique order, in the tetradymana class of plants; and in the natural method ranking under the 39th order, siliqueous. The calyx is close: the silique torose, or swelling out in knots, subarticulated, and round. There are two melfillicel glandules between the shorter stamina and the pistil, and two between the longer stamina and the calyx. There are six species; the saline, or common garden-radish, is best known, and of these there are several varieties. They are annual plants, which being sown in the spring, attain perfection in two or three months, and shoot up soon after into stink, for flower and seed, which, ripening in autumn, the whole plant, root and top, perishes; so that a fresh supply must be raised annually from seed in the spring, performing the sowings at several different times, from about Christmas to May, in order to continue a regular succession of young tender radishes throughout the season, allowing only a fortnight or three weeks interval between the sowings; for one crop will not continue good longer than that space of time, before they will either run to seed, or become tough, sticky, and too hot to eat.

Raphidia, a genus of insects of the order neuroptera. The generic character is, mouth with two teeth; head depressed, humpy; feeders four; stemmata three; wings deltex; antennae the length of thorax, which is cylindrical, and elongated in front; tail of the female furnished with a recurved lase bristle. This genus contains but few species, the most remarkable of which is the raphidia ophthalmus of Linnaeus; a smallish fly, with rather large transparent wings, and a narrow thorax, stretching forwards in a remarkable manner. It is found on trees, &c. in summer, but is rather a rare insect; the pupa, according to Linnaeus, resembles the complete insect, but is destitute of wings.

Raphidota coronta is a large species, equal in size to one of the larger dragon-flies, and is distinguished by its very long homelike jaws, which extend far beyond the thorax, and are terminated by a bind lip; the wings are large, reticulated, and semitransparent. It is a native of North America.

Raphidota mautspa is a small species, but little superior is size to the R. ophthalmus, and is a native of some of the warmer parts of Europe. It has the habit of the genus mauspa, and it is even doubtful whether it should not more properly be referred to that genus.

Raphidota, in physics, the act whereby a body is brought to possess more room, or appear under a larger bulk, without the accession of any new matter. This is commonly the effect of caloric, as has long been universally allowed. In many cases, however, philosophers have attributed it to the action of a repulsive principle. However, from the many discoveries concerning the nature and properties of the electric fluid and caloric, there is the greatest reason to believe that this repulsive principle is no other than other caloric or hire.

Rasent, or Razant, in fortification, Rasant flank, or line, is that part of the curtin or flank whence the shot exploded rase, or glance along, the surface of the opposite bastion.

Rash, in medicine, an eruption upon the skin, thrown out in fevers or surfeits. See Medicine.
RAT

RAT, or Marlinpike, in clock-work, a sort of wheel having twelve fangs, which serve to lift up the detents every hour, and make the clock strike hourly.

RATCHETS, in a watch, are the small teeth at the bottom of the fusee, or barrel, which stops it in winding up.

RATES, in the navy, the orders or classes into which the seamen are divided, according to their force and magnitude. The regulation which limits the rates of men of war to the smallest number possible, seems to have been determined by considerations of political economy; or, the simplicity of the service in the royal dock-yards.

The British fleet is accordingly distributed into six rates, exclusive of the inferior vessels that usually attend the ships of war, armed ships, bomb-ketches, fire-ships and cutters, or schooners commanded by lieutenants. Ships of the first rate mount 100 cannon, having 42-pounders on the lower deck, 24-pounders on the middle deck, 12-pounders on the upper deck, and 9-pounders on the quarter-deck and forecastle. They are manned with 850 men, including their officers, seamen, marines, and armed sloops.

In general, the duties of every rate, besides the captains, have the master, the boatswain, the gunner, the chaplain, the purser, the surgeon, and the carpenter; all of whom, except the captain, have their mates or assistant, in which are comprehended the sailmaker, the master at arms, the armourer, the captain's clerk, the gunsmith, &c. The number of other officers is always in proportion to the rate of the ship. Thus a first-rate has six lieutenants, six master's mates, twenty-four midshipmen, and five Surgeon's mates, who are considered as gentlemen; besides the following petty officers; quarter-masters, and their mates; boatswain's mates and yeomen, eight; gunner's mates and assistants, six; quarter-gunnery twenty-five; carpenter's mates, two, besides fourteen assistants; with one steward, and steward's mate to the purser.

If the dimensions of all ships of the same rate were equal, it would be the simplest and most perspicuous method to collect them into the span of view in a table; but as there is no invariable rule for the general dimensions, we must content ourselves with but a few remarks on ships of each rate, so as to give a general idea of the difference between them.

The Victory, one of the last-built of our first-rates, and ever memorable for being commanded by Lord Nelson in the glorious battle of Trafalgar, is 222 feet 6 inches in length, from the head to the stern; the length of her keel, 154 feet 3 inches; that of her gun-deck, or lower deck, 180 feet; her extreme breadth is 51 feet 10 inches; her depth in the hold, 21 feet 6 inches; her burthen 2162 tons; and her poop reaches 6 feet before the mainmast.

Ships of the second rate carry 90 guns upon three decks, of which those on the lower battery are 32-pounders; those on the middle, 18-pounders; on the upper deck, 12-pounders; and those on the quarter-deck, mates, six 6-pounders, and yeomen, six gunner's mates and yeomen, with 22 quarter-gunnery, two carpenter's-mates with ten assistants, and one steward and steward's mate.

Ships of the third rate carry from 64 to 80 cannon; the largest have six-pounders; and the smallest, viz. those of 8 or 10 guns, four-pounders. Their officers are generally the same as in the 6th rate, with little variation; and their complement of great delays is to keep the officers to the force or magnitude. Bomb-vessels are on the same establishment as sloops; but fire-ships and hospital ships are on that of fifth rates.

Noolding the second rate excellently manifests the great improvement of the marine art, and the degree of perfection to which it has arrived in Britain, than the facility of managing our first rates; which were formerly extremely unmanageable. The crew of their upper deck being the same as those on the quarter-deck and forecastle of the latter, which are 9-pounders. The complement in a 74 is 155, and in a 64, 500 men; having, in peace, four lieutenants, but in war, five; and when an admiral is aboard, six. They have three master's-mates, 16 midshipmen, three surgeon's-mates, 10 quarter-masters and their guns, 30 9-pounders, 6 guns, 14 gunner's-mates and yeomen, with 18 quarter-gunnery, one carpenter's-mate with eight assistants, and one steward and steward's mate under the purser.

Ships of the fourth rate mount from 60 to 70 guns, upon two decks, and the quarter-deck. The lower tier is composed of 24-pounders, the upper tier of 12-pounders, and the cannon on the quarter-deck and forecastle are 6-pounders. The complement of a 50-gun ship is 320 men, in which there are three lieutenants, two master's-mates, 10 midshipmen, two surgeon's-mates, eight quarter-masters and their mates, four boat-swind's mates and yeomen, one gunner's mate and one yeoman, with 12 quarter-gunners, one carpenter's-mate and six assistants, and a steward and steward's-mate.

Vessels of war under the fourth rate, and above the sixth, have generally comprehended under the general name of frigates, and never appear in the line of battle. They are divided into the fifth and sixth rates: the former mounting from 50 to 52 guns, and the latter from 28 to 30. The largest of the fifth rate have two decks of cannon, the lower battery being of 18-pounders, and that of the upper-deck of 9-pounders; but those of 30 and 32 guns have one complete deck, mounting 12-pounders, besides the quarter-deck and forecastle, which carry 6-pounders. The complement of a ship of 44 guns is 250 men; and that of a frigate of 36 guns, 240 men. The first has three, and the second two lieutenants; and both have two master's-mates, six midshipmen, two surgeon's-mates, six quarter-masters and their mates, two boatswain's-mates and one yeoman, one gunner's mate and one yeoman, with 10 or 11 quarter-gunners, and one purser's steward.

Frigates of the 6th rate carry 9-pounders, those of 28 guns having 3-pounders on their quarter-deck, with 200 men in attendance; and those of 24, 100 men: the former have two lieutenants, the latter one; and both have two master's-mates, four midshipmen, one surgeon's-mate, four quarter-masters and their mates, one gunner's-mate, one yeoman, one gunner's-mate and one yeoman, with six or seven quarter-gunnery, and one purser's steward.

The sloops of war carry from 18 to 8 cannon; the largest have six-pounders; and the smallest, viz. those of 8 or 10 guns, four-pounders. Their officers are generally the same as in the 6th rate, with little variation; and their complement of great delays is to keep the officers to the force or magnitude. Bomb-vessels are on the same establishment as sloops; but fire-ships and hospital ships are on that of fifth rates.

The first rates, which have two tiers, are fit for the line of battle, to lead the convoys and squadrons of ships of war in action, and in general to suit the different exigencies of the naval service. The fourth rates may be employed on the same occasions as the third-rates, and may be also destined amongst the foreign colonies, or on expeditions of great delay; for these ships are excellently useful for keeping and sustaining the sea. Vessels of the fifth rate are too weak to suffer the shock of a line of battle; but they may be designed to lead the convoys of merchant-ships, to protect the commerce in the colonies, to cruise in different stations, to accompany squadrons, or be sent express with necessary intelligence and orders. The same may be observed of the sixth-rates. The frigates, which mount from 28 to 33 guns upon one deck, with the quarter-deck, are extremely proper for cruising against privateers, or for short expeditions, being light, long, and usually excellent sailers.

RATEEN, in commerce, a thick woollen stuff, quilted, woven on a loom with four threads, like serge, and other stuffs, that have the scale or quilted appearance. There are some rateens dressed and prepared like cloths; others left simply in the hair, and others where the hair or knap is fried.

RATIO, in mathematics and geometry, is that relation of homogeneous things which determines the quantity of one from the quantity of another, without the intervention of a third.

Two numbers, lines, or quantities, A and
B, being proposed, their relation one to another may be considered under one of these heads: 1. How much A exceeds B, or B exceeds A; and this is found by taking A from B or B from A, and is called arithmetical reason, or ratio. 2. Or how many times, and parts of a time, A contains B, or B contains A; and this is called geometric reason or ratio; or, as Euclid defines it, it is the mutual habit, or respect, of two magnitudes of the same kind, according to quantity; that is, as to how often the one contains, or is contained in, the other; and is found by dividing A by B, or B by A; and here note, that ratio which quantity is referred to another quantity, is called the antecedent of the ratio; and that to which the other is referred, is called the consequent of the ratio; as, in the ratio of A to B, A is the antecedent, and B the consequent. Therefore any quantity as antecedent, divided by any quantity as a consequent, gives the ratio of that antecedent to the consequent.

Thus the ratio of A to B is \( \frac{a}{b} \), but the ratio of B to A is \( \frac{b}{a} \); and, in numbers, the ratio of 12 to 4 is \( \frac{12}{4} = 3 \), or triple; but the ratio of 4 to 12 is \( \frac{4}{12} = \frac{1}{3} \), or subtriple.

The quantities thus compared must be of the same kind; that is, such which, by multiplication, may be made to exceed one the other; or as these quantities expressed to have a ratio between them, which, being multiplied, may be made to exceed one another. Thus a line, how short soever, may be multiplied, that is, produced so long as to exceed in length any given right line; and consequently these may be compared together, and the ratio expressed; but as a line cannot, by any multiplication whatever, be made to have breadth, that is, to be made equal to a superficies, how small soever; these cannot therefore be compared together, and consequently have no ratio or respect one another, according to quantity; that is, as to how often the one contains, or is contained in, the other. See PROPORTION.

RATIO, a certain allowance which is given in bread, &c., or forage, when troops are reliefed. See an officer or soldier.

Complete ratio of the small species.

<table>
<thead>
<tr>
<th>Flour, or bread</th>
<th>14 lbs.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Beef</td>
<td>1 lb.</td>
</tr>
<tr>
<td>Pork</td>
<td>1 lb.</td>
</tr>
<tr>
<td>Peas</td>
<td>1 lb.</td>
</tr>
<tr>
<td>Butter, or cheese</td>
<td>1 oz.</td>
</tr>
<tr>
<td>Rice</td>
<td>1 oz.</td>
</tr>
</tbody>
</table>

When the small species are not issued, 1½ lbs. of flour or bread, with 1½ lbs. of beef, or 10 oz. of pork, forms a complete ratio; or 3 lbs. of beef, or 2 lbs. of cheese, or half a pound of rice, forms a complete ratio.

The deductions to be taken for provisions from the pay of officers, non-commissioned officers, or men, are the same for all ranks, and in all corps, and—like the circumstances of service, when serving out of Great Britain, or stations where provisions are supplied by the public; also, when embarked in transports or other vessels, (except when serving as marines;) also when prisoners of war, maintained at the expense of Great Britain; also when in general hospitals, whether at home or abroad, a deduction of sixpence per day.

A deduction of threepence halfpenny from the pay of every non-commissioned officer and private in Jamaica, in New South Wales, or Gibraltar.

Non-commissioned officers and soldiers serving as marines shall not be liable to any deduction from their full pay on account of their war service.

Ration for a horse on home service in 1795, 14 lbs. of hay, 10 lbs. of oats, 4 lbs. of straw, for which a stoppage is made of sixpence.

The French use the same term, viz. ration de foin, a ration of hay; double ration, double ration; demi-ration, a half ration.

RATIONAL is applied to integral, fractional, and mixt numbers; thus we say, rational fraction, rational integer, and rational mixt number.

Rational is applied to the true horizon, in opposition to the sensible or apparent one. RATIONALS, a solution, or account of the principles of some opinion, action, hypothesis, plan, or the like.

RATLINES, or, as the seamen call them, Ratlines, those lines which make the ladder-steps to go up the shrouds and futtocks, hence called the ratlines of the shrouds.

RATTLE-SNAKE. See Crotalops.

RAVEN, in fortification, was a flat bastion, placed in the middle of a curtin; but now a detached work composed only of two faces, which make a salient angle, without any flanks, and raised before the curtin on the common face of the place. A ravelin is a triangular work resembling the point of a bastion with the flanks cut off. See FORTIFICATION.

In use before a curtin is, to cover the opposite flanks of the two next bastions. It is used also to cover a bridge, or a gate, and is always placed without the moat. There are also double ravelins that serve to cover each other; they are said to be double when they are joined by a curtin.

RAVEN. See Corvus.

RAUWOLFIA, a genus of the pentandria monogynia class of plants, the corolla of which consists of a single funnel-shaped petal, with a large limb, divided into five inclosed segments; the fruit is a succulent berry, with five seeds. There are four species, trees of South America.

RAY, a beam of light emitted from a radiant or luminous body. See OPTICS.

RAYS OF LIGHT, colour and heat of. Dr. Herschel had been employed in making observations on the sun by means of telescopes. To prevent the inconvenience arising from the heat, he used coloured glasses; but these glasses, though deep enough, colored to intercept the light, very soon cracked and broke in pieces. This circumstance induced him to examine the heating power of the different coloured rays. He made each of them turn upon the bulb of a thermometer, near which two other thermometers were placed to serve as a standard. The number of degrees which the thermometer exposed to the coloured ray rose above the other, which were kept under the heating power of that ray. He found that the most refrangible rays have the least heating power; and that the heating power gradually increases as the refrangibility decreases.

The violet ray therefore has the smallest heating power, and the red ray the greatest. Dr. Herschel found that the heating power of the violet, green, and red rays, are to each other as the following numbers: Violet = 1, Green = 22.4, Red = 55.

It struck Dr. Herschel as remarkable, that the illuminating power and the heating power of the rays follow different laws. The first is in greatest perfection in the middle of the spectrum, and diminishes as we approach either extremity; but the second increases constantly from the violet end, and is greatest at the red end. This led him to suspect that perhaps the heating power does not stop at the end of the visible spectrum, but is continued beyond it. He placed the thermometer completely beyond the boundary of the red ray, but still in the line of the spectrum, and found it still higher than it had done when exposed to the red ray. On shifting the thermometer still farther, it continued to rise; and the rate did not reach its maximum till the thermometer was half an inch or more beyond the situation of the red ray. When shifted still farther, it sank a little; but the power of heating was sensible at the distance of 1½ inch from the red ray.

These important experiments have been lately repeated and fully corroborated by Sir Henry Englefield, in the presence of some very good judges. The apparatus was very different from that of Dr. Herschel, and confided on purpose to obviate certain objections which had been made to the conclusions drawn by that illustrious philosopher. The bulbs of the thermometers used were mostly blackened. The following table exhibits the result obtained in one of these experiments:

<table>
<thead>
<tr>
<th>Thermometer in the blue ray rose in</th>
<th>3' from 55° to 50°</th>
</tr>
</thead>
<tbody>
<tr>
<td>green</td>
<td>3°</td>
</tr>
<tr>
<td>yellow</td>
<td>3°</td>
</tr>
<tr>
<td>full red</td>
<td>2°</td>
</tr>
<tr>
<td>confine of red</td>
<td>2°</td>
</tr>
<tr>
<td>beyond the visible light</td>
<td>2°</td>
</tr>
</tbody>
</table>

The thermometer with its bulb blackened, rose much more when placed in the same circumstances, than the thermometer whose bulb was either naked or whitened with paint. This will be apparent from the following table:

<table>
<thead>
<tr>
<th>Red ray</th>
<th>Black therm</th>
<th>White therm</th>
</tr>
</thead>
<tbody>
<tr>
<td>59°</td>
<td>55°</td>
<td>58°</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Dark</th>
<th>Black therm</th>
<th>White therm</th>
</tr>
</thead>
<tbody>
<tr>
<td>69°</td>
<td>69°</td>
<td>69°</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Confines of red</th>
<th>Black therm</th>
<th>White therm</th>
</tr>
</thead>
<tbody>
<tr>
<td>76°</td>
<td>71°</td>
<td>71°</td>
</tr>
</tbody>
</table>

Both Dr. Herschel and Sir Henry Englefield take notice of a faint blush of red at a semi-oval form, visible when the rays beyond the red end of the spectrum were collected by a lens.

From these experiments it seems to follow, that there are rays emitted from the sun, which produce heat, but have not the power of illuminating; and that these are the rays which produce the greatest quantity of heat. Consequently color is emitted from the sun.
in rays, and the rays of caloric are not the same as the rays of light. 1. On examining the other extremity of the spectrum, Dr. Herschel ascertained that no rays of colored heat and of violet ray. He had found, however, as Sen- nebier had done before him, that all the coloured rays of the spectrum have the power of heating; it may be questioned therefore whether there are any rays which do not warm. The coloured rays must either have the property of exciting heat as rays of light, or they must derive that property from a mixture of rays of caloric. If the first of these suppositions was true, light ought to excite heat in all cases; but it has been long known to philo-

sophers that the light of the moon does not produce the least sensible heat, even when concentrated so strongly as to surpass, in point of illumination, the brightest candles or lamps, and yet these produce a very sensible heat. Here then are rays of light which do not produce heat; rays, too, composed of all the seven prismatic coloured rays. We must conclude, therefore, that the well-known fact, that rays of light do not excite heat; and consequently that the coloured rays from the sun and combustible bodies, since they excite heat, must consist of a mixture of rays of light and caloric. This case was demonstrated long ago by Dr. Hooke, and afterwards by Scheele, who separated the two species from each other by a very simple method. If a glass mirror is held before a glowing fire, the heat, but not the rays of caloric; a metallic mirror, on the other hand, reflects both. The glass mirror becomes hot; the metallic mirror does not alter its temperature. If a plate of glass is suddenly interposed between a glowing fire and the face, it intercepts completely the warming power of the fire, without causing any sensible diminution of its brilliancy; consequently it intercepts the rays of caloric, but allows the rays of light to pass. If the glass is allowed to remain in its station till its temperature has reached its maximum, in that situation it ceases to intercept the rays of caloric, but allows them to pass as freely as the rays of light. This case was demonstrated by Dr. Robison, professor of natural philosophy in the university of Edinburgh. The fact consists in this, viz., that the rays of light and of caloric are different, and that the coloured rays derive their heating power from the rays of caloric which they contain. Thus it appears that solar light is composed of three sets of rays, the colorless, the caloric, and the de-

oxidizing.

The rays of caloric are refracted by trans-
parent bodies just as the rays of light. We see, too, that, like the rays of light, they differ in their refrangibility: that some of them are as refrangible as the violet rays, but that the greater number of them are less refrangible than the red rays. Whether they are trans-
mitted through all transparent bodies has not been ascertained, but there is no difference of their refraction in different mediums been examined. We are certain, however, that they are transmitted and refracted by all transparent bodies which have been employed as birefringent substances, and have been proved, by experiment, that it is not only the
colorable emitted by the sun which is refrang-

ible, but likewise the rays emitted by common fires, by candles, by hot iron, and even by water.

The rays of caloric are reflected by polished surfaces in the same manner as the rays of light. This was lately proved by Herschel; but it had been demonstrated long before by Scheele, who had even ascertained that the angle of their reflection is equal to the angle of their incidence. Mr. Pictet also had made a set of very ingenious experiments on this subject, about the year 1790, which led to the same conclusion. He placed two convex mirrors of tin, of nine inches focus, at the distance of twelve feet two inches from one another. In the focus of one of them he placed a ball of iron two inches in diameter, heated so as not to be visible in the dark; in the other was placed the bulb of a thermometer. In six minutes the ther-
mometer rose 22°. A lighted candle, which was substituted for the ball of iron, produced nearly the same effect. In this case both the rays had to pass in order to separate them; he interposed between the two mirrors a plate of clear glass. The ther-
mometer sunk in nine minutes 14°; and when the glass was again removed, it rose in seven minutes 11°. This effect fell on the thermometer did not seem at all dimin-

ished by the glass. Mr. Pictet therefore concluded, that the caloric had been reflected by the mirror, and that it had been the cause of the temperature, and that a third experiment, a glass matrasst was substituted for the iron ball, nearly of the same diameter with it, and containing 2043 grains of boiling water. Two minutes after a thick screen of silk, which had been interposed between the two mirrors, was removed, the thermometer rose from 47° to 50°, and descendent again the moment the matrasst was removed from the focus.

The mirrors of tin were now placed at the distance of 93 inches from each other; the matrasst with the boiling water in one of the, and a very sensible air thermometer in the other, every degree of which was equal to half a degree Fahrenheit. Exact-

ly in the middle space between the two mirrors there was placed a very thin common glass mirror, suspended in such a manner that either side could be turned towards the matrasst. In the mean time of this mirror was turned to the matrasst, the thermometer rose to 3.5°. In another experiment, when the polished side of the mirror was turned to the matrasst, the thermometer rose 3°, when the other side the same. On rubbing off the tin foil, and repea-
ting the experiment, the thermometer rose 0.5°. On substituting for the glass mirror a piece of thin white pasteboard of the same dimensions with it, the thermometer rose 10°. As the rays of light and of caloric emitted the sun accompany each other, it cannot be doubted that they move with the same velocity. The rays of caloric, therefore, move at the rate of almost 500,000 miles in a second. This is confirmed by an experiment of Mr. Pictet, which he performed in the following manner: He took a glass globe three inches in diameter, with a short neck, and weighing 451 grains; poured into it 1700 grains of water from the New River, London, and then sealed it hermetically. The whole weighed 2150.5 grains at the temperature of 32°. It was put for twenty minutes into a freezing mixture of snow and salt, till some of it was frozen; it was then, after being wiped first with a dry linen cloth, next with clean washed dry leather, immediately weighed, and found to be 22° below the weight of a grain heavier than before. This was repeated exactly in the same manner five different times; at each, more of the water was frozen, and more weight gained. When the whole water was frozen, it was 30° of a grain heavier than it had been when fluid. A thermometer applied to the glass showed at 10° the temperature of the air; when the thermometer was put into a glass globe in the same manner, the same column of the thermometer rose to 32°; it weighed 30° of a grain more than it did at the same temperature when fluid. It will be seen afterwards, that ice contains less caloric than water of the same temperature with it. The balance used was nice enough to mark 1° with part of a grain.

This subject had attracted the attention of Lavoisier, a philosopher distinguished by the uncommon accuracy of his researches. His experiments, which were published in the Memoirs of the French Academy for 1783, led him to conclude that the phenomena of water, when placed on the face of the tin mirror there was placed a thick screen, which was removed as soon as the bullet reached the focus. The thermometer rose the instant the screen was removed, and remained without. Any heat, consequently the time which caloric takes in moving 60 feet is too minute to be measured. We see at once that this must be the case when we recollect that caloric moves at the rate of 500,000 miles in a second.

The velocity of caloric being equal to that of light, its particles must move in an equally minute. Therefore neither the addition of caloric nor its abstraction can sensibly affect the weight of bodies. As this follows necessarily as a consequence from Dr. Herschel's experiments, it was possible to prove by experiment that caloric affects the weight of bodies, the theory founded on Dr. Herschel's discoveries would be overturned: but such ded-

uctions have been drawn from the experiments of De Luc, Fordyce, Moreau, and Chauvier. According to this view, the bodies become absolutely lighter by being heated. The experiment of Fordyce, which seems to have been made with the greatest care, was conducted in the following manner:

He took a glass globe three inches in diameter, with a short neck, and weighing 451 grains; poured into it 1700 grains of water from the New River, London, and then sealed it hermetically. The whole weighed 2150.5 grains at the temperature of 32°. It was put for twenty minutes into a freezing mixture of snow and salt, till some of it was frozen; it was then, after being wiped first with a dry linen cloth, next with clean washed dry leather, immediately weighed, and found to be 22° below the weight of a grain heavier than before. This was repeated exactly in the same manner five different times; at each, more of the water was frozen, and more weight gained. When the whole water was frozen, it was 30° of a grain heavier than it had been when fluid. A thermometer applied to the glass showed at 10° the temperature of the air; when the thermometer was put into a glass globe in the same manner, the same column of the thermometer rose to 32°; it weighed 30° of a grain more than it did at the same temperature when fluid. It will be seen afterwards, that ice contains less caloric than water of the same temperature with it. The balance used was nice enough to mark 1° with part of a grain.

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Caloric not only possesses the velocity of light, but agrees with it also in another property no less peculiar. Its particles are not exactly the same size, but are colloidal in mass; and whenever they are forcibly accumulated, they fly off in all directions, and separate from each other with inconceivable rapidity. This property necessarily suppose the existence of a mutual repulsion between the particles of caloric.

Thus it appears that caloric and light resemble each other in a great number of properties. Both are emitted from the sun in rays, with the velocity of 200,000 miles in a second; both of them are refracted by transparent bodies, and reflected by polished surfaces; both of them consist of particles which mutually repel each other, and which produce no sensible effect upon the weight of other bodies. They differ, however, in this particular, light produces in us the sensation of vision; caloric, on the contrary, the sensation of heat.

Upon the whole, we are authorized by the above statement of facts, to conclude that the solar heat is composed of three distinct substances, in some measure separable by the prism on account of the difference of their refrangibility. The caloric rays are the least refrangible, the deoxidizing rays are most refrangible, and the caloric rays possess a mean degree of refrangibility. Hence the rays in the middle of the spectrum have the greatest illuminating power, those beyond the red end the greatest heating power, and those beyond the violet end the greatest deoxidizing power: and the heating power on the one hand, and the deoxidizing power on the other, gradually increase as we approach that end of the spectrum where the maximum of each is concentrated. These different bodies resemble each other in so many particulars, that the same reasoning respecting refrangibility, reflectibility, &c. may be applied to all of them. They produce different effects upon those bodies on which they act. Little progress has yet been made in the investigation of these effects; but we may look forward to this subject as likely to correct many vague and unmeaning opinions which are at present in vogue among philosophers.

**REALGAR.**

Reach, in the sea language, signifies the distance between any two points of land, lying nearly in a right line.

Re-action, in physiology, the resistance made by all bodies to the action or impulse of others, that endeavour to change its state whether of motion or rest. See MOTION.

**REALGAR.**

Realgar, a mineral found in Sicily and various parts of Germany. It is either massive or crystallized. The primitive form of the crystals of iron with scalenohedrals, and it commonly appears in 4, 6, 8, 10, or 12 sided prisms, terminated by four-sided pyramids. Colour red. Streak yellowish-red. Specific gravity 3.355. It is electric on anode, and becomes incandescent electric by rubbing. Before the blowing of the wind, it easily burns with a blue flame, and soon evaporates. It is also the old name for a sublimate of arsenic, found native in different parts of Europe. It has a scarlet colour, and is usually found in transparent prisms. Its specific gravity is 3.5. It is composed of 50 parts of arsenic, and 20 of sulphur, and it is sometimes used as a part.

Rea, a term frequently used in composition, to denote something behind, or back of, another; thus, the back of a chair or sofa, in opposition to its front; thus, neo-classical, if used for the back part of a building, in opposition to the front, for the rear-guard, rear half-sheets, rear-line, rear-rank, and rear-admiral.

**REALM OF THE PROVINCE OF THE BADGERS.**

This is a second attack of a bear that was formerly attacked and dismissed the court without day, as by the not coming of the justices, or some such cause.

**REALMURIA.**

A genus of the class order polyandria pentagonia. The calyx is six-leafed; petals five; caps one-celled, five-valved, many-seeded. There is one species, an annual of Egypt.

**REAL-REBUTTER.**

In commerce, a term much used at Amsterdam, for an abatement in the price of several commodities, when the buyer, instead of taking time, advances ready money.

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**REBUTTER.**

Is the answer of the defendant to the plaintiff's sur-rejoinder.

**RECAPITULATION.**

In oratory, _&c._ is a summary, or a concise and rapid enumeration, of the principal things insisted on in the preceding discourse, whereby the force of the whole is collected into one view.

**RECAPITULATION.**

Where one has deprived another of property, the owner may lawfully claim and retake it wherever he happens to find it, so that it shall not be in a riotous manner, or attended with any breach of the peace.

RECEIPTS, are acknowledgments in writing of having received a sum of money or other value. A receipt is either a voucher for an obligation discharged or one incurred. Receipts for money above 40s. must be stamped; but on the back of a bill of exchange or promissory note which has already stamp'd, is good without a farther duty. Writing a receipt on a stamp of greater value than the value requires, inures no penalty, and the receipt is taken off on a stamp of a lower value, or on unstamped paper, then a receipt is no discharge, and incurs a penalty. See STAMP.

**RECEIVER.**

In Pneumatics, a glass vessel for containing the thing on which an experiment in the air-pump is to be made.

**RECEIVER.**

In chemistry, a vessel of earth, glass, &c. for receiving any distill'd liquor.

**RECEIVER.**

Receiving stolen goods, know'n to be stolen, is a high misdemeanor at the common law; and by several statutes is made felony and transportation; and in some particular instances, felony without benefit of clergy.

**RECEIVER.**

Also signifies an officer, of which there are several kinds, denominated from the particular matters they receive, the places where, or the persons from whom, &c.

**RECEIVER.**

Is an officer appointed to receive the money of such persons as are in compend with the king, upon original writs sued out of ohanancy. 2. Receiver-general of the duchy of Lancaster is an officer belonging to the duchy-court, who collects the revenues, fines, forfeitures, and assessment s, within that duchy. 3. Receiver-general of the public revenue, is an officer appointed in every county, to receive the taxes granted by parliament, and remit the money to the treasury.

**RECIPE.**

In medicine, a prescription or remedy, to be taken by a patient; so called because it is written with the word recipi, i.e. take; which is generally denoted by the abbreviation _R._

**RECIPIENT, or RECIPIENT.**

A mathematical in-trument, serving to measure re-entering and salient angles, especially in fortifications.

It usually consists of two arms, or rulers, AC, and BC (Plate Misc. fig. 197) riveted together at C, and capable of being opened and closed, like a sector. To take an angle with it, they lay the centre of a protractor over the joint C, and apply its diameter to one of the rulers; then the degrees cut by the edge of the other ruler, show the quantity of the angle.

There are other forms of this instrument: the _M._ (figured 198), has a graduated circle, by which may be readily measured by its index; and fig. 199. is another kind composed of four equal rulers of brass, riveted together by their ends, so as to form a parallelogram; and on one of the rulers, which is a graduated semicircle, which measures the opposite angle of the parallelogram, by means of one of the rulers produced so as to serve instead of an index.

**RECIPROCAL TERMS, among logicians, are those figures which have the antecedents and consequents of the same ratio, in both figures.**

Thus, (Plate Misc. fig. 200.) A:B::C:D or 12:4::3:9; that is, as much as the side A, in the first rectangle, is longer than B, so much deeper is the side C, in the second rectangle, than the side D in the first; and, consequently, the greater length of the one is compensated by the greater breadth or depth of the other; for the side A is 3 longer than C, so B is 4 longer than D, and the two are equal, so that A + D = B + C, or 12 3 = 4 9 = 36.

This is the foundation of that capital theorem, viz., that the rectangle of the extremes is always equal to that of the means; and, consequently, the reason of the rule of three.

Hence it follows, that if any two triangles, parallelograms, prisms, parallelepipeds, pyramids, cones, or cylinders, have their bases and altitudes reciprocally proportional, those two figures are equal to each other; and, vice versa, if they are equal, then their bases and altitudes are reciprocally proportional. See TRIANGLE, PARALLELOGRAM, &c.

**RECIPROCAL PROPORTION, in arithmetic, is when, in four numbers, the fourth is less than the second, by so much as the third is greater than the first; and vice versa.

This is the foundation of the inverse, or indirect, rule, which is fixed a graduated semicircle, 4: 10 = 8: 5. It is applied also to quantities which, being multiplied together, produce unity. Thus 1 and x, y and 1, are reciprocal quantities, be-
RECOGNISANCE, or RECOGNIZANCE, is an obligation of bond, which a man enters into before some court or record, or magistrate duly authorized, with consent given to some particular act; to appear at the assize or quarter sessions, to keep the peace, &c.

RECOIL, or REBOUND, the starting backward of a firearm, after an explosion. Merriam tells us, that a cannon 18 feet in length, weighing 8400 lb. gives a ball of 24 lb. an uniform velocity of 640 feet per second. Parting, therefore, \( w = 8400 \), \( w = 24 \), \( v = 640 \), and \( \omega = \frac{v}{w} = \frac{24 \times 64}{8400} = 0.24 \); that is, it could recoil at the rate of 2.2 feet per second free to move.

RECORD, An act committed to writing in any of the king's courts, during the term wherein it is written, is alterable, being no bond; but that term, the contrary, it is a record, and of that which consists of no alteration or proof of the contrary.

RECORDARE FACIAS, a writ directed to the sheriff, to remove a cause out of an inferior court, into the king's bench or common pleas.

RECORER, a person whom the mayor or other magistrates of a city or corporation nominate to them, for their better direction in matters of justice, and proceedings in law; and which account this person is generally a learned, or well skilled in the law. The recorder of London is chosen by the lord-mayor and aldermen; and, as he is led to be the mouth of the city, he delivers judgment of the courts, and records judgments.

RECOVERY, in law, is obtaining anything by judgment or trial at law. A recovery resembles a fine so far as being action red or fictitious, and in that land are recovered against the tenant of the freehold, and an absolute fee-simple is vested in the recoveror; but it is carried through every stage of proceeding, instead of being compromised like a fine. See Fine.

This invention we owe to the ingenuity of the ecclesiastics, to evade the statute of mortmain, which prohibited, without licence, any giving or receiving, under pretence of a free gift, or any lands or tenements whatsoever; and as judgment was given for religious houses, they were presumed to have recovered the lands by sentence of law on a supposed prior title, and were held not to recover in the statute.

The convenience of these recoveries was soon discovered, and made use of by lay persons as a common mode of transferring lands; but the want of moderation on the part of the ecclesiastics, in their frequent recourse to feigned recoveries, was such as to call for parliamentary interference, and gave rise to the act in the reign of Edward the First, called the statute of Westminster; which enacted, that in all cases where any recoveries were made to lay persons, the lands so recovered by default, a jury should try the right; and if the defendants were found to have no title, the land should be forfeited to the lord of the fee, according to the statute of mortmain.

This act threw the recoveries into disuse, till they were resumed as a mode of evading the strictness of the statute de donis conditionibus, which lays a general restraint on alienations, but allows many at-tempts to procure a release of this statute; but in vain: but as the inconveniences were manifest, the judges always endeavoured to construe means of evading it; and it was decided in a case in the reign of Edward IV., that a common recovery suffered by a tenant in tail, should operate as an effetual bar to his estate tail, and to all remainders and reversioners depending thereon; by which means tenants in tail are now enabled to dispose of their estates, or convert them into estates in fee-simple; and it may be suffered of all things, whereof a writ of covenant may be brought for the purpose of levying a fine.

There are three persons required to form a recovery: the demandant, tenant, and vouchee. The demandant is he who brings the writ of entry; the tenant is he against whom the writ is brought; and the vouchee is he whom the tenant vouches and calls to warranty; but this may be better understood by supposing John Jacobs to be tenant of the freehold, and desires of recovering a recovery to cut off all entail and reversions, and to convey the estate in fee-simple to James Jenkins. Jenkins sets out a writ of recovery, and, by him, as in the case of a fine, and charges that the defendant has no title, but came into possession after Hugh Hunt had turned the plaintiff out of it. The proceedings are made up on the recovery-roll, in which the writ and complaint of the defendant are recited; the tenant then apprises and calls upon one Charles Browning, who is supposed at the original purchase to have warranted the title to the tenant, and who is supposed to vouch; the vouchee then appears, is impleaded, and defends the title. Jenkins, the defendant, craves leave to impri, which is granted; the plaintiff then returns into court, but the vouchee is arraigned, and makes default; judgment is of course given for Jenkins, and Jacobs is to recover the value of Charles Browning, as he lost them through his default. But on enquiry, it is always found that Browning (who is merely an officer of the court, and denominated the common vouchee, from being impri, at whatever, has no lands, so that Jacobs, now vouching the recoveror, has but a nominal recompense; and the plaintiff, who is now recoveror, has the lands vested in him by judgment of the court, and again delivered by the sheriff. A recovery is sometimes with double or treble voucher, or even more if necessary. And, indeed, a double voucher is the most common, by first conveying an estate to any third person, against whom the writ is issued, he then vouches the tenant in tail, who vouches over the common vouchee; for if the recovery is had immediately against the tenant in tail, it bars only such estate in the premises of which he is then actually seized; but the act of error must be brought during his minority.

Sometimes, though but seldom, the court permits the infant to appear by guardian, where the recovery is made in manor advantage to the infant; and when this has been allowed by the judges, the infant cannot set it aside; but if it is to the prejudice of the infant, he has a remedy by action against the guardian. This appeared in several cases. If the infant appears by attorney, he may recover the recovery after he is of age, because it may be here discovered by trial whether the warrant of attorney was made by him while an infant. A married woman joining with her husband in recovering a recovery, will bar her remainder; because as she is examined privately as to her consent, it takes away the presumption in law that it is done by the consent of her husband. All persons have power to sue a recovery except the king, and for his use, or where the plaintiff must count against him, which the law does not allow, infants, persons non compos, and women who are personal dower; who are prohibited by the statute of Henry VII. c. 20, which enacts that a recovery suffered by any woman of lands settled by her on her husband, or settled on her husband and her by any of his ancestors, shall be void.

The effect of common recoveries may appear to be an absolute bar of all estates, if, but of remainders and reversions expectant on the determination of such estates. Sol that a tenant in tail may convey lands in tail to the recoveror, free and discharged of all conditions and appointments in tail, and of all remainders and reversions. But as before mentioned, a woman possessed of dower is prevented by the statute; and by the statute of Eliz. c. 8, no tenant for life of any sort can suffer a recovery, so as to bind the remainders or reversion. For which reason, if there is a tenant for life with remainder in tail, and other remainders in tail, and the tenant for life is desirous to suffer a valid recovery, either he or the tenant to the precise should vouch the remainder-man in tail. It is an essential part of a recovery, that the tenant to the precise should be actually
seized of the freehold; but by 14 Geo. II. though the legal freehold should be vested in lessees, yet those who are intitled to the next freehold estate in remainder or reversion may make a good tenant to the precise; and though the deed or fine which creates such tenant should be subsequent to the judgment of recovery, if it is in the same term, the recovery is valid; and that though the recovery itself does not appear to be entered, or not regularly entered on record; yet she dued to make a tenant to the precise and declare the uses of the recovery, with twenty years possession, shall be sufficient evidence of the recovery. If a recovery is levied without good title, the good title is determined, and the uses declared, they only oure to the uss of him who levies them; and if there is a consideration, yet as the most usual use, sur cognizance de droit, and c. c. conveys an absolute estate without limitations, these conveyances could not be made to answer the purposes of family, settlements (wherein a variety of uses and designations is often necessary), unless their force and effect were made subject to the direction of more complicated deeds. These deeds, if made previous to the judgment, are called deeds to lead the uses; if subsequent, to declare them.

RECTANGLE, in geometry, the same with a right-angled parallelogram.

RECTANGLED, RECTANGULAR, or RIGHT-ANGLED, appellation given to figures and solids which have one or more right angles: thus a triangle with one right angle, is termed a rectangular triangle; also parallelograms with right angles, squares, cubes, &c. are rectangular. Solids, as cones, cylinders, &c. are also said to be rectangular with respect to their axes, when their axes are perpendicular to the plane of the horizon.

RECTIFICATION, in geometry, is the finding a right line, equal in length to a curve. See the article CURVE.

The rectification of curves is a branch of the higher geometry, where the use of the inverse method of fluxions is very conspicuous.

Case I. Let AC, (Plate Six, fig. 201) be any kind of curve, whose ordinates are parallel to themselves, and perpendicular to the axis AQ. Then if the fluxion of the absciss AM be denoted by Ma, or by Ca (equal and parallel to Ma), and a", equal and parallel to Ca, is the representation of the corresponding fluxion of the ordinate MC; then will the diagonal CS, touching the curve in C, be the line which the generating point p would describe, was its motion to become uniform at C; which line, therefore, truly expresses the fluxion of the space AC, gone over. See the article Fluxions.

Hence, putting AM = a, CM = y, and AC = a'; we have a = dy = \sqrt{Ca^2 + Sa^2} = \sqrt{a^2 + y^2}, from which, and the equation of the curve, the value of y may be determined. Thus, let the curve be represented by a parallelogram of any kind, the general equation for which is 

\[ a \times y = 0 \]

and hence \( a = \frac{n - 1}{y} \), and therefore

\[ \frac{n}{a^2} \]

and the result is

\[ \frac{\sqrt{1 + \frac{n}{a^2}^2}}{a^2} = \sqrt{\frac{\frac{n}{a^2} + \frac{2n - 2}{a^2}}{2}} \]

which lies for a woman who has received part of her dower, and purposes to demand the remainder in the same term, against the heir, or his guardian.

RECTO D OE DOTE UNDE NIEL HARTE, a writ of right which lies in a case, where the husband having divers lands or tenements, has assured no dower to his wife, and she thereby is driven to sue for her thirds, against the heir or his guardian.

RECTO QUANDO DOMINUS REMISET, a writ of right, which lies in cases, where lands or tenements in the seignory of any lord are in demand by the right of the tenant.

RECTOR, a term applied to several persons whose offices are very different; as 1. The rector of a parish is a clergyman who has the charge and cure of a parish, and possesses all the tithes, &c. 2. The same name is also given to the chief elective officer in several foreign universities, particularly in that of Paris. 3. Rector is also used in several convents for the superior officer who governs the house; and the Jesuits give this name to their superiors of such houses as for other seminaries or colleges.

RECTORY, a parish church, parsonage, or spiritual living, with all its rights, tithes, and glebes.

RECTUM, in anatomy, the last and third part of the large intestines. See Anatomy.

RECURVIROSTRA, in ornithology, a genus belonging to the order of grallae. The bill is long, subulate, bent back, sharp and narrow; the legs are webbed, and furnished with three toes forwards, and one short behind. Mr. Latham notes of this genus three species, viz. the avocet, or the one commonly known, the American, and the alba. This last, it is probable, has some affinity to the American. The recurvirostra avocetta is about the size of a lapping body, but has very long legs. The substance of the bill is soft, and almost membranous at its tip, it is thin, weak, slender, compressed horizontally, and incapable of defence or effort. These birds are variegated with black and white, and during the winter are frequent on the eastern shores of Great Britain. They visit the Severn, and sometimes the pools of Shropshire. They feed on worms and insects, which they scoop out of the sand with their bills. They lay two eggs, white, with greenish lustre, and large spots of black, about the size of a pigeon's. They are found also in various parts of the continent of Europe in Russia, Denmark, and Sweden, but they are not numerous. They are also found in Siberia, but offenier about the salt lakes of the Tartar desert, and about the Caspian sea; likewise on the coasts of Picardy, France, in April and November, and at Orleans, but rarely. In breeding-time they are very plentiful on the coasts of Bas Poison. They do not appear to wander further south in Europe than Italy. Whether from tempest or address, the avocet shuns shores, and is not easily taken. The American avocet is rather larger and longer than the last. The bill is similar, but thicker; the fore head dusky white; the head, neck, and upper part of the breast, are of a deep cream-colour; the lower parts of the neck behind white; the back is black; and the under parts from the pure wings are purplish black, rarely white, and partly ash-coloured. These birds inhabit North America; and were...
RED

found by Dampier in Shaks' bay, on the coast of New Holland. See Plate Nat, Hist. fig. 345.
The recrivostra, or sectopela alta, is about 14 inches and a quarter long, its colour white, with a patch of crimson on its keys duckish, its bill orange, its legs brown. Edwards remarks that the bill of this bird is bent upwards, as in the avost: its bill black at the tip, and orange at the rest of its length; all the plumage is white, except a tine of yellowish on the great quills of the wing and of the tail. Edwards supposes that the whiteness is produced by the cold climate of Hudson's-bay, from which he received it, and that they remain their brown for whatever during the summer. It appears that several species of this bird have spread further into America, and have even reached the southern provinces.

A bird of this kind, Mr. Latham says, was sent from Hudson's-bay, and from the figure, has any appearance of an avost. In Edwards's plate, however, the toes appear cluen to the bottom: a circumstance seeming to overturn the supposition, an I only to be authenticated when other specimens shall have come under the eye of the well-informed naturalist.

RECURSANT, a person who refuses to go to church, and worship God after the manner of the church of England, as by law established; to which is annexed the penalty of 20 l. a month for nonconformity. 32 Eliz. c. 1.

RED, in dyeing, is one of the five sines or other colours. See Dyeing.

RED-LEAD. See Lead, oxide of.

RED-book of the exchequer, an antient record or manuscript containing the publick accounts of the king's remembrancer, containing divers miscellaneous treatises relating to the times before the Conquest.

REDDENDUM, in our law, is used substantively for the cause in a lease wherein the rest is reserved to the lessor. The provisions for it is next after the limitation of estate.

REDEMPTION, in law, a faculty or right of reentering upon lands, &c. that have been sold and assigned, upon reimbursing the purchaser the purchase money with all legal costs. Bargains whereby the faculty, or, as some call it, the equity, of redemption is reserved, are only a kind of pignorative contracts. A certain time is limited within which the faculty of redemption shall be exerciséd, and beyond which it shall not extend.

REDENS, REDANS, or REDANT, in fortification, a kind of work indented in form of the teeth of a saw, with rampart and receding angles, to the end that one part may flank or defend another. It is called saw-work, and indented work. Redens are frequently used in the fortifying of walls, where it is not necessary to be at the expense of building stairs; as when they stand on the side of a river, a marsh, the sea, &c.

REDOUBT, or REDOUTE, in fortification, a small square fort, without any defence but in front, used in trenches, lines of circumvallation, and approach, as also for the lodgings of corps de garde, and to defend passages. In marshy grounds, redoubts are frequently made of stone-works, for the security of the neighbouring road; their face consists of 10 to 15 fathoms, the ditch round them from 8 to 9 feet broad and deep, and their parapets have the same thickness.

REDUCE, or REDUCE, a military term signifying an advantageous piece of ground, entrenched and separated from the rest of the place, camp, &c. for an army, garrison, &c. to retire in case of a surprize.

REDUCTION, that rule by which numbers or different denominations are brought into one denomination. See ARITHMETIC.

REDEMPTION, or Draught, or Draught, is the making a copy of it either larger or smaller than the original, still preserving the form and proportion. The great use of the proportional compasses is the reduction of figures, &c. whence they are called compasses of reduction.

There are various methods of reducing figures, &c. The most easy is by means of the pentagraph, or parallelogram; but this has its defects. See PENTAGRAPH.

The best and most usual methods of reductions are as follows: 1. To reduce a figure, as ABCDE (fig. 204). About the middle of the figure, as z, pitch a point, and from this point draw lines to its several angles A, B, C, &c. then drawing the line ab parallel to BC, be parallel to DC, &c. you will have the figure abcede similar to ABCDE.

If the figure abede had been required to be enlarged, there needed nothing but to produce the lines from the point beyond the angles, as zD, ZC, &c. and reduce the sides, viz. DC, CB, &c. parallel to the sides de, eb, &c.

2. To reduce a figure by the angle of proportion, suppose the figure ABCDE (fig. 204) required to be diminished in the proportion of the line AB to cb, (fig. 205). Draw the indefinite line GH (fig. 206) and from G to H set off the line AB. On G describe the arch HI. Set off the line ab as a chord on HI, and draw GJ. Then with the angle JGH, you have all the measures of the figure to be drawn. Thus, to lay down the point c, take the interval BC, and upon the point G, describe the arch KL. Also on the point G, describe MN: and upon A, with the distance MN, describe an arch cutting the one in c, which produce to the side bc. And after the same manner are the other sides and angles to be described. The same process will also serve to enlarge the figure.

3. To reduce a figure by a scale. Measure all the sides of the figure, as ABCDE, fig. 204, by a scale, and lay down the same measures respectively from a smaller scale in the proportion required.

4. To reduce a map, design, or figure, by squares. Divide the original into little squares; and divide a fresh paper of the dimensions required into the same number of squares, which are to be larger or less than the former, as the map is to be enlarged or diminished. This done, in every square of the second figure draw what you find in its correspondent one in the first.

REDUCTION, in metallurgy, is the bringing back metallic substances which have been vitiated or deformed, into their natural and original state of metals again. See CHEMISTRY.

Reduction, in surgery, denotes an operation by which a dislocated, luxated, or fractured bone, is restored to its former state or place.

REED, See Arundo.

REEF, a term in navigation. When there is a great gale of wind, they commonly roll up part of the sail below, that by this means it may become the narrower, and not draw so much wind; which contracting or taking up the sail they call a reef, or reeling the sail; so also when a top-mast is sprung, as they call it, that is, when it is cracked, or almost in the cap, they cut off the lower piece that was nearly broken off, and setting the other part, now much shorter, in the step again, they call it a reefed topmast.

REEL, in the manufactories. There are various kinds of reels, some very simple, others very complex. Of the former kinds those most in use are: 1. A little reel held in the hand, consisting of three pieces of wood, the biggest and longest wherein (which does not exceed a foot and a half in length, and a quarter of an inch in diameter) is traversed by two other pieces disposed differently. 2. The common reel, or windlass, which turns upon a pivot, and has four flights traversed by long pins or sticks, wherein the skin to be reeled is put, and which are drawn closer or opened wider according to the skin. A representation of the common reel may be seen in Plate Mixed, fig. 207, where A is the bench or seat of the reel, B the two uprights; C the arms of the reel, its anchor turning, and hitching its little lantern of four notches in the teeth of the wheel; D two handles, the upper one to make the lower by means of a pinion; E a hammer, the handle wherein is lowered by a peg at the bottom of the lower wheel; F a cord which is rolled round the axle of the lower wheel and supports a weight which stops after a certain number of turns, to regulate the work-woman.

REELING, in the manufactories, the winding of thread, silk, cotton, or the like, into a skin, or upon a bottom, to prevent its entangling. It is used for the charging or discharging of bobbins or quills, to use them in the manufacture of different stuffs, as thread, silks, cotton, &c.

RE-ENTRY, in law, signifies the resuming or retaining that possession which any one had before he was dispossessed; as where a person makes a lease of lands to another, the lessor thereby quits the possession, and the leasee covenants that upon non-payment of the rent reserved, the lessor may lawfully re-enter.

REEVING, in the sea language, the putting a rope through a block called a rope, or a piece of a block, is called unreeling.

REFINING, in general, is the art of purifying a thing: including not only the assaying or refining of metals, but likewise the de-
Refract, in astronomy, is the inclination of the rays of light proceeding from the heavenly bodies, in passing through the atmosphere, by which their apparent altitudes are increased. See Astronomy, Vol. I. page 171.

Reflection in a crystal,
REG

According to the establishment of the present French army, the term of regiment is confined to the space of thirty years, and the name of half-brigade is given to the infantry; so that chief de brigade, chief of brigade, corresponds with our colonel of a regiment of infantry. The denomination of colonel is still retained in the French cavalry.

With respect to the derivation of the word, it appears that the best etymology is from the French word regie, management, which comes from the Latin regere, to govern. Hence a regiment is said to be governed by a colonel. M. Lenentout, a celebrated French etymologist, differs from this explanation. He traces it from the French regime, which signifies system, regimen, administration, and which is again derived from the Latin regimen, bearing the same import. In a physical acceptance of the term, regimen (under regimen) is used to express any body that is composed of several others. But this is mere conjecture of his part.

REGISTER, a public book, in which are entered and recorded memos, acts, and minutes, to be had recourse to occasionally, for knowing and proving matters of fact.

Of these are two kinds; as 1. Registers of deeds in Yorkshire, and other ancient deeds, in which are registered all deeds, conveyances, wills, &c., that affect any lands or tenements in those counties, which are otherwise void against the subsequent purchasers, or mortgagees, &c., but this does not extend to any copyhold estate, nor to leases at a rack-rent, or where they do not extend beyond 150 years. The registered memorials must be registered under the seal of some of the grantees or grantees, attested by witnesses who are to prove the signing or sealing of them, and the execution of the deed.

But these registers which are confined to two counties, are in Scotland, general, by which the laws of North Britain are rendered very easy and regular. Of these there are two kinds; the one general, fixed at Edinburgh, under the superintendence of the law-register; and the other particular, in the several shires, warraceys, and regiments, the clerks of which are obliged to transmit the registers of their respective courts to the general register. No man in England can have a right to any estate, but it must be registered by the registrar thereof, day of his being seiz'd thereof, by which means all secret conveyances are cut off. 2. Parish registers, are books in which are registered the baptisms, marriages, and burials, of each parish. The dissenters of all denominations register the births of their children at Dr. Williams's Library in Red Cross street, Cripplegate.

REGISTER is also used for the clerk or keeper of a register. Of these we have several, denominated from the registers they keep; as register of the high court of delates; register of the arches court of Canterbury; register of the court of admiralty; register of the prerogative court; register of the garter, &c.

REGISTER SHIPS, in commerce, are vessels which obtain a permission either from the king of Spain, or the council of the Indies, to traffic in the Spanish and West Indies, which are thus called from their being registered before they set sail from Cadiz for Buenos Ayres. Each of these permissions costs 30,000 pieces of eight; and by the tenor of the edict, or permit, they are not to exceed 300 tons; but there is such a good understanding between the merchants and the council of the Indies, that ships of 5 or 60 tons frequently pass unnoticed; and though the quantity and quality of the merchandise on board are always expressed, yet by means of presents, the officers both in Spain and the Indies allow them to load and unload vastly more than the permission expresses.

REGISTER, in printing, is disposing the forms on the press, so that the lines and pages printed on one side of the sheet fall exactly on those of the other.

REGISTER, among letter-founders, is one of the inner parts of the mould in which the printing-types are cast. Its use is to direct the joining the mould justly together again, before it is opened to take out the new-cast letter.

REGLETS, or RIGLETS, in printing, are thin slips of wood, exactly planed to the size of the body of the letter. The smaller sorts are placed between the lines of poetry; and those that are used in filling up short pages, in forming the spaces or distances between the lines of titles, and in adjusting the distances of the pages in the chase so as to form register.

REGIMATOR, or REGIMATR, in law, formerly signified one who bought wholesale, or by the great, and sold again by retail; but the term is now used for one who buys any wares or victuals, and sells them again in the same market or fair, or within five miles round it. See FORESTALLING.

REGISTRAR, is also used for one who furnishes up old moveables to make them pass for new. And missus, who take off the outward surface of hewn stone, in order to whiten it, or make it look fresh again, are said to register.

REGULAR, denotes any thing that is agreeable to the rules of art: thus we say a regular building, verb, &c.

A regular figure in geometry is one whose sides, and consequently angles, are equal; and a regular figure with three or four sides, is commonly termed an equilateral triangle or square, as all others with more sides are called regular polygons.

All regular figures may be inscribed in a circle. A regular solid, called also a Platonic body, is that terminated on all sides by regular and equal planes, and whose solid angles are all equal.

The regular bodies are the five following: 1. The tetrahedron, which is a pyramid comprehended under four equal and equilateral triangles. 2. The hexahedron, or cube, whose surface is composed of the equilateral squares. 3. The octahedron, which is bounded by eight equal and equilateral triangles. 4. The dodecahedron, which is contained under twelve equal and equilateral pentagons. 5. The icosahedron, which is composed of twenty equal and equilateral triangles. These five are all the regular bodies in nature. See TETRAHEDRON, &c.

Proportion of the five regular bodies inscribed in the same (sphere) from Peter Hor- rigen. Cursus Math. vol. i. p. 773, and Bur- row's Euclid, lib. xiii.:

REG

The diameter of the sphere being 2, the circumference of the greatest circle is 6.28318
Superficies of the greatest circle 3.14159
Superficies of the sphere 12.56637
Solidity of the sphere 4.18859
Side of the tetrahedron 1.02909
Superficies of a tetrahedron 4.6188
Solidity of a tetrahedron 0.15132
Side of a cube or hexahedron 1.1547
Superficies of the hexahedron 8
Solidity of the hexahedron 1.5306
Side of an octahedron 1.4142
Superficies of the octahedron 6.9282
Solidity of the octahedron 1.33333
Side of the dodecahedron 2.73816
Superficies of the dodecahedron 10.31462
Solidity of the dodecahedron 2.85316
Side of the icosahedron 1.05146
Superficies of the icosahedron 9.95734
Solidity of the icosahedron 2.33613

If one of these five regular bodies was required to be cut out of the sphere of any other diameter, it will be, As the diameter of the sphere (2), is to the side of any one solid inscribed in the same (suppose the cube, 1, 1347), so is the diameter of any one sphere (suppose 8), to 9.2376, the side of the cube inscribed in this latter sphere.

Let d be (Plate Miscel. fig. 358.) be the diameter of any sphere, and de of it =a1b2=b3.
Erect the perpendiculars up, and draw the line, de, ef, fr, and fis, then will:
1. re be the side of the tetrahedron.
2. df be the side of the hexahedron.
3. de be the side of the octahedron.
4. Cut de in extreme and mean proportion in b, and ef will be the side of the dodecahedron.
5. Set the diameter dr up, perpendicularly at r; and from the centre c, to its top, draw the line ec, cutting the circle in g.
Let fall the perpendicular gh, then is br the side of the icosahedron.

REGULAR curves, such as proceed gradually in the same geometrical manner with regard to the curvatures. See CURVE.

REGULATOR, in chemistry, an imperfect metallic substance that falls to the bottom of the crucible in the melting of ores, or impure metallic substances. The regular is now understood to be the pure metal.

REGULUS, in astronomy, a star of the first magnitude in the constellation Leo; called also from its situation, cor leonis, or the lion's heart. See ASTRONOMY.

REINDEER. See cervus.

REJOINER, in law, is the defendant's answer to the plaintiff's replication or reply. Thus, in the court of chancery, the defendant puts in an answer to the plaintiff's bill, which is sometimes also called an exception; the plaintiff's answer to this is called a replication, and the defendant's answer to that a rejoinder.

REJOINING, in architecture, filling up the joints of the stones in buildings. This ought to be performed with the best mortar, as that of lime and cement; and sometimes with plaster, as in the joints of vaults.
RELATIVE TERMS, in logic, are words which imply a relation; such are master and servant, husband and wife, &c.

In grammatical terms are those which answer to some other word foregoing, called the antecedent; such are the relative pronouns, who, whom, and, &c.

RELIEF, in law, is an instrument in writing, by which estates, rights, titles, entries, actions, and other things, are extinguished and discharged; and sometimes transferred, abridged, or enlarged; and in general, it signifies one person's giving up or discharging the right or action he has, or claims to have, against another, or his lands, &c.

A release may be either in fact or in law; a release in fact is where it is expressly declared, by the very words, as the act and deed of the party; and a release in law is that which acquits by way of consequence, as when a false creditor takes the debtor to be his own

RELIANIA, a genus of the class and order Syngenesia Polyma superfus. The calyx is imbricate, scarious; corollas of the ray many; pappus membranaceous; receptacle, chaffy. There are 16 species, herbs of the Gour

RELIEF, in law, a certain sum of money which the tenant holding by knight's service, grand seigniery, or other tenure (for which homage, or legal service, is due), and being at full age, and without the aid of his ancestor, paid by his father at his entrance.

RELIEVE, in a military sense, is to send off those men that are upon duty, and to bring others to take their place; thus, to relieve the guard, the trenches, &c. is to bring fresh men upon duty, and to discharge those who were upon duty before.

RELIBV, and RELIEF, are terms applied to that mode of working in sculpture by which figures are made to project from the ground or body on which they are formed, and to which they may be attached. The same term is used, whether the figure is cut with the chisel, modelled in clay, or cut in metal or plaster.

There are three kinds of reliefs:

1. Alto-relievo, or high relief, when the figures are so prominent from the ground, that merely a small part of them remains attached to it.

2. Mezzo-relievo, or half-relief, when one half of the figures rise from the ground, in such a manner that the figure appears divided by it.

3. Baso-relievo, or bas-relief (low relief), when the work is raised but little from the ground, in small medals, and generally in fresco, and other ornamental parts of buildings.

These reliefs are the comprehensive term by which all works in relief are denominated indiscriminately. See SCULPTURE.

RELIEVE, or RELIEF, in painting, is the detached manner in which the figures seem, at a due distance, to stand out from the ground of the painting. See PAINTING.

RELIGION, Seditious words in derogation of the established religion are punishable as treason to a breach of the peace. 1 H. 17.

REMAINDER, in law, is an estate limited in lands, tenements, or rents, to be enjoyed after the expiration of another particular estate.

An estate in remainder is an estate limited to take effect and be enjoyed after another estate is determined. As if a man seized in fee simple grants lands to one for 20 years, and after the determination of the said term, then to another and his heirs for ever; here the former is tenant for years, remainder to the latter in fee. In the first place, an estate for years is created or carved out of the fee, and given to the former, and the residue and remainder is left to the latter. But there are estates in remainder which are in fact only one estate; the present term of years, and the remainder afterwards, when added together, being equal only to one estate in fee. 2 Black. c. 11.

The word remainder is no term of art, nor is it necessary to create a remainder. So that any words sufficient to show the intent of the party, will create a remainder; because such estates take their denomination of remainder, whether natural and manner and manner of their existence after they are limited, than from any previous quality inherent in the word. See Fcarne on Remainders.

There is this difference between a remainder and a reversion, in case of a reversion, the estate granted, after the limited time, reverts to the grantor or his heirs; but by a remainder it goes to some third person, or a stranger.

REMEMBRANCCS, antiently called either of the remembrance, certain offices in the exchequer, whereby three are distinguished by the names of the king's remembrancer, the lord treasurer's remembrancer, and the remembrancer of the first-fruits. The king's remembrancer enters in his office all recognizances taken before the barons, for any of the king's debts, for appearances, or observing of orders; he also takes all bonds for the king's debts, &c; and makes out processes thereon. He likewise issues process against the collectors of the customs, excise, and others, for their accounts; and informations upon penal statutes are entered and sued in his office, where all proceeding in matters upon his book, and in his hand, remain. His duty further is to make out the bills of compositions upon penal laws, to state the statements of debts; and into his office are delivered all kinds of indentures and other documents, which concern the surveying of any lands to the crown. He yearly, in crastino Annuarum, reads in open court the statute for election of sheriffs; and likewise openly reads in court, the oaths of all the officers, when they are admitted.

The lord treasurer's remembrancer is charged to make out process against all sheriffs, escheators, receivers, and bailiffs, for their accounts. He also makes out warrants of fictitious, and for debts due to the king, either in the pipe or with the auditors; and process for all such revenue as is due to the king, on account of his tenures. He takes the account of sheriffs; and also keeps a record book, in which are registered all debts of sheriffs or other accountants pay their proctors due at Easter and Michaelmas; and at the same time he makes a record, whereby the sheriffs or other accountants keep their prescribed days, and pay their accounts to that officer. He keeps account of this office all the accounts of customers, comptrollers, and accountants, in order to make entry thereof on record; also all extants and transfers are certified here, &c.

The remembrancer of the first-fruits takes all compositions and bonds for the payment of first-fruits and tenth; and makes out process against such as do not pay the same.

REMITTING, to send, or to remit a sum of money, bill, or the like, is to send the sum of money, &c.

REMITTER, in law, is where one that has a right to lands, but is out of possession, has afterwards the freehold cast upon him by some subsequent defective title, and enters in virtue of that title; in this case the law remits him to his antient and more certain right, and by an equitable fiction supposes him to have gained possession in consequence and by virtue thereof; and this, because he cannot possibly obtain judgment at law, to be restored to his prior right, since he is hims the tenant of the land. 3 Black. 190.

RENOMA, the sucking-fish. See Eels.

REMOVER, in law, is where a suit is removed or taken out of one court into another; and is the opposite of remanding a cause, or sending it back into the same court whence it was removed.

RENDER, in law, is used in levy a fine; which is either single, whereby nothing is granted or rendered back again by the cognizor to the cognizor; or double, which contains a grant or render back again of some real common, or other thing, out of the land itself to the cognizor.

RENDEZVOUS, or BRENDEVOYS, a place appointed to meet in, at a certain day and place.

RENEALMIA, in botany, a genus of the monogynia order, belonging to the monandria class of plants. The corolla is tubular; the nectarium oblong; the calyx monophyllous; the anthera sessile, opposite to the nectarium; the berry is fleshy. There is only one species, a native of Surinam.

RENT, is a certain profit issuing yearly, out of lands and tenement corporeal.

There are at common law three kinds of rents; rent in service, rent charge, and rent seek, or rack rent.

Rent service is where the tenant holds his land of his lord by fealty and certain rent; or by homage, fealty, and certain rent; or by other service and certain rent; and it is called a rent service, because it has some corporeal service incident to it, which is chiefly the service. Rent charge is so called because the land for payment of it is charged with a distress. Rent seek, or rack rent, is where the land is granted without any clause of distress for the same. 1 Tost. 141.

The time for payment of rent, and consequently for a demur, is such a convenient time before the setting of the last day, as will be sufficient to have the money counted; but if the tenant meets the lessor on the land at any time of the last day of payment, and tenders the rent, that is sufficient; but the money is to be paid indifferently on that day, and therefore a tender on that day is sufficient. See DISTRESS.

RENTERS, in the manufactories, the name for line-drawers. It consists in sewing two pieces of cloth edge to edge, without doubling them, so that the seam scarcely ap-
and hence it is denominated fine-drawing. The French word meaning the same thing, and is derived from the Latin retrahere, or re, in, and trahere, because the scene is drawn in or covered. It is said that in the East Indies, if a piece of fine muslin is torn, and the threads of the fine-drawers, it will be impossible to discover where the rent was. In this country the dexterity of the fine-drawers is not so great as that of those in the East; but it is still such as to enable them to defend the revenue, by sewing a head or slip of English cloth on a piece of Dutch, Spanish, or other foreign cloth; or a slip of foreign cloth on a piece of English, so far as to pass the whole as a piece, and by that means avoid the duties, penalties, &c. The trick was first discovered in France by M. Savary.

RESTERING, in tapestry, is the working new warp into a piece of damaged tapestry, whether eaten by the rats or otherwise destroyed, and on this warp to restore the ancient pattern or design. The warp is to be of woollen, not linen. Among the titles of the French tapestry-makers is included that of resterers.

REVERSE, inverted. See Heraldry.

REPARATION FACIENDA, a writ which lies in divers cases, one of which is, where three are tenants in common, or joint tenants, as in a mortgage, of a mill or horse which is fallen into decay, and the one being willing to repair it, the other two will not; in this case, the party willing shall have this writ against the other two. P. N. B. 172.

REPARATION. A tenant for life or years, may cut down timber trees to make reparations, although he is not compelled thereto; as where a house is ruinous at the time of the lease made, and the lessee sells it to fall, he is not bound to rebuild it, and yet if he sells timber for reparations he may justify the same. Co. Litt. 54.

REPEAT, in music, a character shewing that what was last played or sung must be repeated or gone over again.

REP E LMENTS, medicines supposed to have the power of bringing back into the mass of the blood such morbid humours as had been secreted from it. The term is now lost out of the materia medica.

REP E RCU SION, in mechanics. See Reflection.

REFLECTION. Reflection, in music, a frequent repetition of the same sound.

REPERTORY, a place in which things are orderly disposed, so as to be easily found when wanted. The indexes of books are repertories, shewing where the matters sought for are contained. Common-place books are also kinds of repertories.

REP E TEND, in arithmetic, denotes that part of an infinite decimal fraction, which is continually repeated. Thus 2, 131, 131, the figures 13 are the repetend. These repetends chiefly arise in the reduction of vulgar fractions to decimals, as \( \frac{1}{7} = 0.142857 \) 142857 0.142857, and so on, for ever. A single repetend is that in which only one figure repeats itself, as \( \frac{1}{7} \) is a single repetend. A compound repetend is that in which two or more figures are repeated, as \( \frac{1}{11} = 0.131313 \). To find the value of any repetend, or to reduce it to a vulgar fraction, "taken the given repeating figure or figures for a numerator: and for the denominator, take as many 9s as there are figures in the repetend: this is the fraction answering to 123123, &c., is \( \frac{13}{99} \).

REPETITION, in music, denotes a repetition of a term or figure, or an entire composition, or even a whole strain, part of a strain, or double strain, &c. The repetition is denoted by a character called a repeat, which is varied so as to express the various circumstances of a repeat. Repeat means a figure which gracefully and emphatically repeats either the same word, or the same sense in different words.

REPLEADER. Whenever a repleader is granted, the pleadings must begin de novo at that stage of them, whether it is the plea, replication, rejoinder, or whatever else, wherein there appears to have been the first default, or deviation from the regular course. When a repleader is awarded, it must be without costs. 3 Black. 395.

REPLETION. See Medicine.

REPLEVIN, is the writ called replication figure. If any goods distrained by another, for any cause, and putting in surety to the sheriff, that upon delivery of the thing distrained, he will prosecute the action against the distrainer. Co. Litt. 12.

That the avowant is in the nature of a plaintiff, appears, 1st. from his being called an actor, which is a term in the civil law, and signifies plaintiff; 2dly, from being entitled to have judgment de novo habilato; 3dly, and as plaintiff or defendant to have a return of the goods distrained, 4th.

That the avowant is in the nature of a plaintiff, appears, 1st. from his being called an actor, which is a term in the civil law, and signifies plaintiff; 2dly, from being entitled to have judgment de novo habilato; and 3dly, from this, that the plaintiff might plead in abatement of the avowry, and consequently such avowry must be in the nature of an action. Cartl. 112.

Replevins by writ, issue properly out of chancery, returnable into the courts of K. B. and C. B. at Westminster. In order to obtain a reprieve, the application must be made to the plaintiff, or any of his deputies, and security given that the party replying will pursue his action against the distrainer; for which purpose, by the ancient law, he is required to put in pledges to protect the county, and if the right is determined against him, he will return the distress again, for which purpose he is to find pledges to make return. These pledges are discretionary, and at the peril of the sheriff. 3 Black. 147.

After the goods are delivered back to the party replying, he is then bound to bring his action of reprieve against the distrainer, which may be prosecuted in the county court where the distress of which he was the party, or in any other court or in any other place, which court or place the distrainer may be. If the court or place to which the distress of which the plaintiff was the party shall not be suitable to the court in which the action is brought, the plaintiff to be tried, he may remove it to the superior courts of king's-bench or common- pleas, the plaintiff at pleasure, and the defendant upon reasonable cause.

If the sheriff is shown a stranger's goods, and he takes them, an action of trespass lies against him, for otherwise he could have no remedy; for being a stranger he cannot have the writ of proprietary procedans; and was he not intituled to this remedy, it would be in the power of the sheriff to strip a man's house of all his goods. 2 Rol. Abr. 352.

If it is determined for the plaintiff, namely, that the distress was wrongfully taken, he has already got his goods back into his own possession, and shall keep them, and moreover recover damages. But if the defendant prevents by the decretal or nonsuit of the plaintiff, this be his de novo habilato, hendo, by which the goods or chattels which were distrained and then reprieved, are removed into his custody, to be sold, or otherwise disposed of as if a privation had been made. If the distress was for damage feasant, the distrainer may keep the goods so returned, until tender shall be made of sufficient amends. Rol. Abr. 146.

On a return being had to the same, the party desiring to have the cattle or goods restored, must shew them to the sheriff, for otherwise the sheriff may not know them.

REPLICATION, in logic, the assuming one's meaning the same term twice in the same proposition.

REPLICATION, an exception or answer of the plaintiff in a suit to the defendant's plea; and is also that which the complainant replies to the defendant's answer in chancery. The replication is to contain certainly, and not to vary from the declaration, but must pursue and maintain the cause of the plaintiff's action; otherwise it will be a depreciation in pleading, and going to another matter. 1 Inst. 304.

REPORT, in law, is a public relation of cases judicially argued, debated, resolved, or adjudged, in any of the king's courts, with the causes and reasons of the same, as delivered by the judges. Also when the court of chancery, or any other court, refers the stating of a case, or the comparing of an account, to a master, or any other, it certifies thereon is called a report.

REPOSE, in painting, certain masses or large assemblages of light and shade, which being well conducted, prevent the confusion of objects and figures, by engaging and fixing the eye so that it cannot attend to the other parts of the painting for some time; and thus leading it to consider the several groups gradually proceeding from stage to stage.

R E P R E S E N T A T I O N. There is an heir by representation, where the father dies, in the life of the grandfather, leaving a son, who shall inherit the grandfather's estate before the father's brother, &c.

REPRIEVE, to suspend a prisoner from the execution and proceeding of the law at that time. Every judge who has power to order any execution, has power to reprieve.

REPRISALS. See LETTERS OF MARQUE.

REPRISE, or Reprieve, at sea, is a merchant-ship, which, after its being taken by a corsair, privateer, or other enemy, is retaken by the opposite party. If a vessel thus retaken has been 24 hours in the possession of the enemy, it is deemed a lawful prize; but if it is retaken within that time, it is to be restored to the party in lawful possession. If the vessel thus retaken has been 24 hours in the possession of the enemy, it is deemed a lawful prize; but if it is retaken within that time, it is to be restored to the party in lawful possession, and if it has been led into any port, it is to be restored to the proprietor.

REPRODUCTION, is usually understood to mean the restoration of a thing before existing, and since destroyed. It is very well known that trees and plants may be
REPRODUCTION.

This particular. If a piece of stick, or any other substance, is brought near them, they do not stay for its touching them, but begin to leap and frisk about as soon as it comes towards them. There want, however, some further experiments to ascertain whether this is really by the sense of sight, for though we can discover no distinct organs of sight in these creatures, yet they seem affected by the light of the sun or a candle, and always frisk about in some manner at the approach of either; and even the moonlight has some effect upon them.

A twig of willow, poplar, or many other trees, being planted in the earth, takes root, and becomes a most perfect piece of wood which will in the same manner produce other trees. The case is the same with these worms; they are cut to pieces, and these several pieces have perfect animals; and each of these may be again cut into a number of pieces, each of which will in the same manner produce an animal. It has been supposed by some that these worms were oviparous; but Mr. Bonett, by cutting one of them to pieces, having observed the fragment, resemblance a small filament, to move at the end of one of the pieces, separated it; and on examining it with his glasses, found it to be a perfect worm in some form with its parent, which lived and grew larger in a vessel of water into which he put it. These small bodies are easily divided, and very readily complete themselves again, a day usually serving for the production of a head to the part that wants one; and, in general, the smaller and more slender the worms are, the sooner they complete themselves after this operation. When the bodies of the large worms are examined by the microscope, it is very easy to see the appearance of the young worms alive, and moving about within them; but it requires great precision and exactness to be certain of this; since the ramifications of the great artery have very much the appearance of young worms, and they are kept in a sort of continual motion by the systole and dilatation of the several portions of the artery, which is the source of many hearts. It is very certain, that what we force in regard to these animals by our operations, is done also naturally every day in the brooks and ditches where the earthworms abound; the virtuoso observer will find in these places many of them without heads or tails, and some without either; as also other fragments of various kinds, all which are then in the act of completing themselves; but whether accidents have reduced them to this state, or they thus purposely throw off parts of their own body for the reproduction of more animals, it is not easy to determine. These are plainly liable to many accidents, by which they lose the several parts of their body, and must perish very early if they had not a power of reproducing what was lost; they often are broken into two pieces, by the residence of some hard piece of mud which they enter and they are subject to a disease, a kind of gangrene, rotting off the several parts of their bodies, and must inevitably perish by it, had they not this power.

This worm was a second instance, after the polype, of the surprising power in an animal of recovering its most essential parts when lost. But nature does not seem to have limited her beneficence in this respect to these two creatures. Mr. Bonett tried the same experiments on another species of water-crawls, discovered in being much thicker. This kind of worm, when divided in the summer season, very often shows the same property; for if it is cut into three or four pieces, the pieces will lie dead for a long time; but afterwards will move about again; and will be found in this state of rest to have recovered a head, or a tail, or both. After recovering their parts, they move very little; and according to this gentleman's experiments, seldom live more than a month.

It should seem, that the more difficult success of this last kind of worm, after cutting, and the long time it took to observe, that in the last parts, if it does recover them at all, are owing to its thickness; since we always find in that species of worms which succeeds best of all, that those which are thinnest recover their parts much sooner than the others.

The water-insects also are not the only creatures which have this power of recovering the lost parts. The earth abundes us some examples, which, when cut in such manner from their cuttings, are less deserving our admiration than those of the water: the common earth-worms are of this kind. Some of these worms have been divided into three or four pieces; and some of these pieces after having passed two or three months without any appearance of life or motion, have then been able to reproduce a head or tail, or both. The reproduction of a worm, after such a state of rest, is no long work; a few days do it; but it is otherwise with the head, that does not seem to perform its functions in the divided pieces till about seven months after the separation. If in all these operations, both on earth and water-worms, the hinder part suffers greatly more than the fore part in the cutting; for it always tends itself about a long time, as if actuated by strong convulsions; whereas the head usually crawls away without the appearance of any great uneasiness.

The reproduction of several parts of lobsters, crabs, &c. makes those great curiosities in natural history. That, in lieu of an organic part of an animal broken off, another shall rise perfectly like it, may seem inconsistent with the modern system of generation, where the animal is supposed to be wholly formed in the egg. Yet has the matter of fact been well attested by the fishermen, and even by several virtuosi who have taken the point into examination, particularly M. de Recamier and M. Perron, whose skill and exactness in things of this nature will hardly be questioned. The legs of lobsters, &c. consist each of five articulations: now, when any legs happen to break, by any accident, as in walking, &c. which frequently happens, the fracture is always found to be in a part near the fourth articulation, and what that loss is precisely reproduced some time afterwards; that is, a part of a leg shoots out, consisting of four articulations, the first of which has two claws as before, so that the loss is entirely repaired. The virtuoso's leg is cured by design at the fourth or fifth articulation, and is thus broken off always comes again; but it is not so if the fracture is made in the first, second, or third articulation. In those cases, the re-
production is very rare if things continue as they are. For, as is exceedingly surprising, it is that they do not; for, upon visiting the lobster mained in these barren and unhappy articulations, at the end of two or three days, all the other articulations are found broken off; and it is asserted they have performed the operation on themselves, to make the reproduction of a leg certain.

The part reproduced is not only perfect, like that retracted, but also, in a certain space of time, grows equal to it. Hence it is that we frequently see lobsters which have their two large legs unequal, and that in all proportions. This shows the smaller leg to be a new one.

A part thus reproduced being broken, there is a second reproduction. The summer, which is the only season of the year when the lobsters eat, is the most favourable time for the reproduction. It is then performed in four or five weeks; whereas it takes up eight or nine months in any other season. The small legs are sometimes reproduced, but more rarely of them than the great ones; the horns do the same. The experiment is most easily tried on the common crab.

REPTILES, in natural history, are a order of amphibia, the character of which is, that they breathe through the mouth; have feet, and flat naked ears, without auricles. There are five genera of reptiles, viz.

Toad
Draco
Lucerta
Rana
Siren.

REPUISION, in physics, that property in bodies, by which, if they are placed just beyond the sphere of each other's attraction of cohesion, they mutually fly from each other.

That there is a force which opposes the approach of bodies towards each other, and which tends to separate them farther from each other, is obvious from the slightest view of the phenomena of chemistry. Thus, when we represent the north pole of a magnet A to the south pole of another magnet B, suspended on a pivot, and at liberty to move, the magnet B recedes as the other approaches; and by following it with A, at a proper distance, it may be made to turn round on its pivot with considerable velocity. In this case there is evidently some force which opposes the approach of the north poles of A and B, and which causes the movable magnet to retire before the other. There is then a repulsion between the two magnets; a repulsion which increases with the power of the magnets; and this power has been made so great, by a proper combination of magnets, that all the force of a strong man is insufficient to make the two north poles touch each other. The same repulsion is equally obvious on electrical bodies; and indeed it is by means of it alone that the quantity of electricity is measured by philosophers. If two cork balls are suspended from a body with silk threads, so as to touch each other; we charge the body with electricity, the cork balls separate from each other, and stand at a distance proportional to the quantity of electricity with which the body is charged; the balls of course repel each other. See Electricity.

But it is not in electric and magnetic bodies only that repulsion is perceived. Newton has shown that it exists also between two glasses. He found that when a convex lens is put upon a flat glass, it remains at the distance of the 1/4 th part of an inch, and a very considerable pressure is required to diminish this distance; nor does any force which may be applied bring them into actual mathematical contact; a force may indeed be applied sufficient to break the glasses in pieces; but it may be demonstrated that it does not diminish their distance much beyond the 1/5 th part of an inch. There is, therefore, a force of repulsion which prevents the two glasses from touching each other.

That the particles of air repel each other is evident; for a considerable force is required to keep them, as near each other as we find them at the surface of the earth; and when this force is removed, they separate from each other, that is to say, the air expands. Nor is it known how far this expansion extends; it is artificially expanded to 3000 times its usual bulk, and is doubtless at great heights in the atmosphere its expansion is still much greater than that.

On the other hand, air may be forcibly condensed, so that it may be made to approach nearer each other; but a considerable force is required to produce this effect; and this force increases nearly as the density: if it is removed, the particles again separate, and the atmosphere assumes its former bulk.

What are the limits of this condensation is not known; but air has been forcibly compressed to 1000th part of its natural bulk. Thus we see that the air may be made to approach 16 times nearer each other. The elasticity of air, or the effort which it makes when compressed to resume its former bulk, is evidently the consequence of a repulsive force which its particles exert. All gaseous fluids possess the same repulsive force, and are indebted to it for their elasticity.

The particles of solid elastic bodies likewise repel each other; for they also, when forcibly compressed, resume their former size, and of course their particles repel each other. It has been demonstrated by philosophers, that all liquids are capable of a certain degree of compression, and that when the compressing force is removed they resume their former bulk; consequently the particles of these bodies also repel each other.

All bodies then possess a repulsive force, which exerts itself at sensible distances or at insensible distances; of course the repulsions may be divided into two classes.

The only sensible repulsions with which we are acquainted, take place at small distances. They may be reduced to two kinds, namely, electricity and magnetism.

It has been ascertained, that bodies possessed of the same kind of electricity repel each other; and likewise that the same magnetic poles of bodies repel each other; while, on the other hand, differently electrified bodies, and the different magnetic poles of magnetic bodies attract each other.

Repulsion increases, as far as has been ascertained, inversely as the square of the distance; consequently, at the point of contact it is infinite.

In sensible repulsion is most conspicuous in elastic fluids, as air and the gases; but it is exhibited also by elastic bodies in general. In these, if a judgment can be formed from the experiments on air, the repulsion increases nearly at the rate of 1/2.

Inensible repulsion may either be a force inherent in the particles of bodies, or it may belong exclusively to some particular body combined with these particles. The first of these hypotheses seems to have been adopted by Newton.

Other philosophers have supposed that repulsion is not a property inherent in all matter, but confined to a peculiar substance which has been generally considered as calcareous. According to this hypothesis, there are two kinds of matter, one whose particles attract, another whose particles repel. Let us call the first cohesive matter, and the other calcareous; and let us suppose also, what must be the case, that cohesive matter and calcareous matter attract each other with a certain force, in certain circumstances. This will explain the expansive power of calcareous, which combining with other particles of other matter, destroys the cohesion of those particles, and acts upon the body as a repulsive force; and this appears at least to explain the repulsion which exists in elastic, and, perhaps, other fluids.

Before we quit this subject, it will be worth while to shew, by an example, that the repulsion between the particles of calcareous matter acts as a present chemical force, and that it affords a key to explain several phenomena which at first sight appear nearly contradictory.

Why do bodies require different temperature in order to unite? and why does the presence of calcareous in many cases favour, or rather produce, union, while it prevents or destroys it in others?

Some substances, phosphorus for instance, combine with oxygen at the common temperature of the atmosphere; others, as carbon, combine with oxygen at a higher temperature. To what are these differences owing?

It is evident, that what diminishes the cohesion which exists between the particles of any body, must tend to facilitate their chemical union with the particles of other bodies. This is the reason that bodies combine more easily when heated by friction, than, or when they have been previously reduced to a fine powder. Now calcareous possesses the property of diminishing cohesion; and it is evident why some bodies require a high temperature to cause them to combine, is that at a low temperature the attraction of cohesion is in them superior to that of affinity; accordingly, it becomes necessary to weaken that attraction by calcareous till it becomes inferior to that of affinity.

The quantity of calcareous necessary for this purpose must vary according to the strength of the cohesion and of the affinity; it must be inversely as the affinity, and directly as the cohesion. When we see precisely the force of the cohesion between the particles of any body, and of the affinity between the particles of that body and with any other, we can easily reduce the temperature necessary to calculation.

That calcareous or temperature acts in this manner, cannot be doubted, if we consider that other methods of diminishing the attrac-
tion of cohesion may be substituted for it with success. A large lump of charcoal, for instance, will not unite with oxygen at so low a temperature as the same charcoal will do when re-covered to a very fine powder; and charcoal will combine with oxygen at a still lower temperature, if it is reduced to its integral particles, by precipitating it from alcohol, as Dr. Hutton has shewn by the alcohol through red-hot copper. And to shew that there is nothing in the nature of oxygen and carbon which renders a high temperature necessary for their union, if they are presented to each other in different circumstances, they combine at the common temperature of the atmosphere; for if nitric acid, at the temperature of 6°, is poured upon charcoal-powder, well dried in a clay oven, and which charcoal takes fire, owing to its combining with the oxygen of the acid. And in some other situations, carbon is so completely divided that it is capable of combining with the oxygen of the atmosphere, or, to be in the same thing, of catching fire at the common temperature: this seems to be the case with those p.rophori that are formed by distilling to dryness several of the neutral salts with a certain acid. The observations are sufficient to show, that carbonic is in many cases necessary in order to diminish the attraction of cohesion.

But there is a difficulty still remaining. Hence it is certain that in those instances in which the bodies combine with oxygen without the assistance of any foreign heat, the combination is once begun, though a quantity of carbonic is necessary to begin the combination of carbonic and oxygen, it is not necessary to be surrounded by a great quantity of carbonic during the whole time of their combining with oxygen? Alcohol, for instance, if once kindled, burns till it is quite consumed; and this is the case with oils also, provided they are furnished with a wick.

We err very much, were we to suppose that a high temperature is not as necessary to these substances during the whole of their combustion as at the commencement of it: for Mr. Monge found, in making the trial, that a candle would not burn after the temperature of the air around it was reduced below a certain point.

All substances which continue to burn after being once kindled are volatile, and they burn the easier in proportion to that volatility. The application of a certain quantity of carbonic to alcohol volatilizes part of it, that is, diminishes the attraction of its cohesion, so much that it combines with oxygen. The oxygen which enters into this combination gives out as much heat as volatilizes another portion of the alcohol, which combines with oxygen in its turn, more heat is given out; and thus the process goes on. Oils and tallow exhibit the same phenomena; only the amount of carbonic to alcohol volatilizes part of it, that is, diminishes the attraction of its cohesion, so much that it combines with oxygen. The oxygen which enters into this combination gives out as much heat as volatilizes another portion of the alcohol, which combines with oxygen in its turn, more heat is given out; and thus the process goes on. Oils and tallow exhibit the same phenomena; only the amount of carbonic to alcohol volatilizes part of it, that is, diminishes the attraction of its cohesion, so much that it combines with oxygen. The oxygen which enters into this combination gives out as much heat as volatilizes another portion of the alcohol, which combines with oxygen in its turn, more heat is given out; and thus the process goes on. Oils and tallow exhibit the same phenomena; only the amount of carbonic to alcohol volatilizes part of it, that is, diminishes the attraction of its cohesion, so much that it combines with oxygen. The oxygen which enters into this combination gives out as much heat as volatilizes another portion of the alcohol, which combines with oxygen in its turn, more heat is given out; and thus the process goes on. Oils and tallow exhibit the same phenomena; only the amount of carbonic to alcohol volatilizes part of it, that is, diminishes the attraction of its cohesion, so much that it combines with oxygen. The oxygen which enters into this combination gives out as much heat as volatilizes another portion of the alcohol, which combines with oxygen in its turn, more heat is given out; and thus the process goes on. Oils and tallow exhibit the same phenomena; only the amount of carbonic to alcohol volatilizes part of it, that is, diminishes the attraction of its cohesion, so much that it combines with oxygen. The oxygen which enters into this combination gives out as much heat as volatilizes another portion of the alcohol, which combines with oxygen in its turn, more heat is given out; and thus the process goes on. Oils and tallow exhibit the same phenomena; only the amount of carbonic to alcohol volatilizes part of it, that is, diminishes the attraction of its cohesion, so much that it combines with oxygen. The oxygen which enters into this combination gives out as much heat as volatilizes another portion of the alcohol, which combines with oxygen in its turn, more heat is given out; and thus the process goes on. Oils and tallow exhibit the same phenomena; only the amount of carbonic to alcohol volatilizes part of it, that is, diminishes the attraction of its cohesion, so much that it combines with oxygen. The oxygen which enters into this combination gives out as much heat as volatilizes another portion of the alcohol, which combines with oxygen in its turn, more heat is given out; and thus the process goes on. Oils and tallow exhibit the same phenomena; only the amount of carbonic to alcohol volatilizes part of it, that is, diminishes the attraction of its cohesion, so much that it combines with oxygen. The oxygen which enters into this combination gives out as much heat as volatilizes another portion of the alcohol, which combines with oxygen in its turn, more heat is given out; and thus the process goes on. Oils and tallow exhibit the same phenomena; only the amount of carbonic to alcohol volatilizes part of it, that is, diminishes the attraction of its cohesion, so much that it combines with oxygen. The oxygen which enters into this combination gives out as much heat as volatilizes another portion of the alcohol, which combines with oxygen in its turn, more heat is given out; and thus the process goes on. Oils and tallow exhibit the same phenomena; only the amount of carbonic to alcohol volatilizes part of it, that is, diminishes the attraction of its cohesion, so much that it combines with oxygen.

The affinity of hydrogen is greater for oxygen than for the other gases which either of these gases. The oxygen is the other gases, and there is an attraction of cohesion between the particles of the oxygen and hydrogen; the same attraction subsists between those of nitrogen and oxygen; the affinity of all these affinities (namely, the affinity between hydrogen and carbon, the affinity between oxygen and carbon, the cohesion of the particles of the hydrogen, and the cohesion of the particles of oxygen) is greater than the affinity between the hydrogen and oxygen; and therefore no decomposition can take place. Let the affinity between

\[\text{Oxygen and carbon} \quad 50\]
\[\text{Hydrogen and carbon} \quad 50\]
\[\text{Cohesion of oxygen for hydrogen} \quad 4\]
\[\text{Cohesion of hydrogen} \quad 2\]

Sum of quiescent affinities \quad 108

The affinity of oxygen and hydrogen 105

The quiescent affinities being greater than the dissoluble affinities, no decomposition can take place.

Let now a quantity of caloric be added to the oxygen and hydrogen gas, it has the property of expanding them, of course of diminishing their cohesion; while its affinity for them is so small, that it may be neglected. Let us suppose that it diminishes the cohesion of the oxygen 1, and of the hydrogen 1; then the combination will now be 3 and 1; and the quiescent affinities being 104, while the divalent are 105, decomposition would of course take place, and a quantity of caloric would thus be set at liberty to produce the same effects upon the neighbouring particles.

Thus, then, caloric acts only by diminishing cohesion; and the reason that it is required so much in gaseous substances, and in those combinations into which oxygen enters, is the strong affinity of oxygen and the other bases of the gases for caloric; for owing to the repulsion which exists between the molecules of that substance, an effect is produced by adding large doses of it, contrary to what happens in other cases. The more it is accumulated, the stronger is the repulsion between its particles, and therefore the more powerful is its tendency to fly off; and as this tendency is opposed by its affinity for the body and the cohesion of its particles, it must diminish both these attractions.

REPUTATION, or FAME. The security of reputation, or good name, from the arts of detraction and slander, is a right to which every man is entitled, by reason and natural justice; since, without this, it is impossible to have the perfect enjoyment of any other advantage or right. 1 Bl. 134.

Reputation is properly under the protection of the law, as all persons have an interest in their good name, and scandal and defamation are criminal, though defamatory words are not actionable, otherwise than as they are a damage to the estate of the person injured. Wood's inst. 37.

REQUESTS, Court of, an ancient court which flourished in the nineteenth year of Henry VII. See Court.
gument, in the court of common pleas, that the court of request was then no court of equity.

**RES**

RESCRIPT, an answer delivered by an emperor, or a pope, when consulted by particular persons on difficult questions or points of law, to serve as a decision thereof.

**RESCUE,** or **Rescous,** is the taking away and setting at liberty against law, any distressed or confined person, of any case, or things, from damage or harm; but the more general notion of rescue is, the forcibly freeing another from an arrest or some legal commitment; which being a high offence, subjects the offender not only to an action is the suit of, or common injured, but likewise to fine and imprisonment at the suit of the king. Co. Lit. 160.

It goods are distrained without cause, or contrary to law, the owner may make rescue; but if there are odious-imposed fines, or though taken without any cause, the owner may not break the pound and take them out, for then they are in custody of the law. 1 Black. Comm. 116.

**RESEARCH,** in medicine, is a kind of prelude or voluntary played on the organ, &c. wherein the performer seems to search or look out for the strains and touches of harmony, which are belied in the regular piece to be played afterwards.

**RESEDA,** dyer's-seed: yellow-seed, suite; or wild-seed, a genus of the order of trigna, in the dodecaenra class of plants; and in the nature of vegetable stains, it is a species of the order, miscellaneous. The calyx is monophyllous and pinnate; the petals laminated; the capsule unilocular, and opening at the mouth. There are 13 species of which the most remarkable is, wild-seed, the plant is cultivated and much used for dyeing silk and wool of a yellow colour. The great recommendation of the plant is, that it will grow with very little trouble, without dung, and on the very worst soils. For this reason it is commonly sown with, or immediately after, barley or oats, without any additional care except drawing a bush over it to narrow it in; the reaping of the corn does it little or no hurt, as it grows but little the first year; and the next summer it is pulled and dried like flax. Much care and nicety, however, is requisite, so as not to injure either the seed or stalk; or, which sometimes happens, damaging both, by letting it stand too long, or pulling it too green. To avoid these inconveniences, a better method of culture has been devised. This new method is, to plough and harrow the ground very fine, without dung, as equally as possible; and then sowing a gallon of seed, which is very small, upon an acre, some time in the month of August. In about two months, it will be high enough to hoe, which must be carefully done, and the plants left about six inches asunder. In March it is to be hoed again, and this labour is to be repeated a third time in May. About the close of June, when the flower is in full vigour, and the stalk is become of a greenish yellow, it should be pulled; a sufficient quantity of stems being left growing for seed till September.

**RESERVE,** body of, or corps de reserve, in military affairs, the third or last line of an army, drawn up for battle; so called because they are reserved to sustain the rest, as occasion requires; and not to engage, but in case of necessity.

**RESIDENCE,** is the continuance of a person or vicar on his benefice. By Statute 43dGeo. III. chap. 84, it is enacted that the statute 13th Eliz. c. 39, and its continuating statutes, are repealed; and that the penal- or forfeiture, under the 21st Hen. VIII. are repealed; and that every spiritual person possessed of any archdeaconry, or other dignity, benefice, curacy, or chapel, who shall, without exemption, or sufficient cause, be absent from his benefice, or place where he has other dignity or benefice, and less than six months of the annual value (deducting all out-goings, except curate's pay); when eight months, two-thirds; and when the whole year, three-fourths. The penalty to go to the informer; but the penalty for non-residence cannot be recovered, if the person has resided a whole year without absence before the action is brought.

Besides the exemptions contained in the above-mentioned acts, the following persons are exempt: clerk, or deputy clerk, of the king's chapel; chaplain of the house of commons; chaplain-general of the forces; brigade-chaplain on foreign service; chaplain of the garrisons, or of the corps of artillery, during the time of attending such offices; chaplain to any British factory, or in the household of any British subject resident abroad; chaplain of a royal, or in his absence, the surrogate, or official, in an ecclesiastical court; minor canon, vicar, choral, or other officer, in any cathedral or collegiate church; deans, subdeans, priests, or scholar, in the king's private chapels; chaplain of the military asylum, of the hospitals of Chelsea, Greenwich, St. Mary, &c. and Plymouth, while attending their duty; preacher or reader at the inns of court; the three future or at present vice-presidents; public tutors, or chaplain, or such other public officers, in the universities, or at Eton, or Winchester, or schoolmasters or usher in the same, or at Westminster; and persons entitled by the last of the above-mentioned statutes to the privilege of non-residence, till after forty years of age, shall not be entitled to it after thirty. The bishops may, if they think fit, grant licences for non-residence in certain cases, the fee for which shall not be more than ten shillings, independent of stamp-duty; and if the bishop requires to grant the licence, the party who thinks himself aggrieved may appeal to the archbishop, on giving security for paying the expenses of the appeal: the reasons for granting the licences shall be transmitted to the archbishop, for his examination and allowance; and although in the absence of any sec., the vicar-general may grant them, and they shall not be void on the death or removal of the grantor, unless revoked by his successor.

A person, although he may reside on the living, is liable to the penalties of non-residence, if he resides in any other house than that appointed for his residence, except by such licence from the diocese as has been stated, or while the tenant to whom the house of residence has been let continues in possession.

**RESIDUAL FIGURE,** in geometry, the figure remaining after subtracting a lesser from a greater.

**RESIDUAL ROOT,** in algebra, a root composed of two parts or members, connected together by the sign + . Thus a + y is a residual root, so called because its value is no more than the difference between its parts x and y.

**RESIGNATION,** in the canon law, the surrendering a benefice into the hands of the collator, or bishop.

**RESIGNEE,** in law, the person to whom a thing is resigned.

**RESIN,** in natural history, a viscid juice oozing either spontaneously, or by incision, from several trees, as the pine, fir, &c.

**RESINS.** It is at present the opinion of chemists, that resins stand in the same relation to the volatile oils that wax does to the fixed. Wax is considered as a fixed oil saturated with oxygen, whereas resins, as volatile oils saturated with the same principle.

The resins are very numerous; and in account of the various purposes to which they are applied, and the peculiarity of their properties, constitute one of the most important classes of natural substances. Till lately they have been very much overlooked by chemists, who satisfied themselves with gleaning doubtful information from artists and manufacturers, who, from the erroneous opinions concerning them have of course been admitted into every system of chemistry. The subject has lately engaged the attention of Mr. Hatchett, whose consummate skill and happy talent for observation peculiarly fitted him for the task.

Resins often exude spontaneously from trees; they often flow from artificial wounds; and not uncommonly are combined at first with volatile oil, from which they are separated by distillation. The reader can be at no loss to form a notion of what is meant by resin, when he is informed that common resin furnishes a very perfect example of a resin, and that it is from this substance that the whole genus derived their name: for resin is very frequently denominated resin.

Resins may be distinguished by the following properties:

- They are solid substances, naturally brittle; have a certain degree of transparency, and a colour most commonly inclining to yellow.
- Their taste is more or less acrid, and hot like that of volatile oils; but they have no smell unless they happen to contain some foreign body. They are all heavier than water.
- Their specific gravity varies from 1.0180 to 1.2829. They are all non-conductors of electricity; and when excited by friction, their electricity is negative.

When exposed to heat, they melt; and if the heat be increased, they take fire; and burn with a strong yellow flame, emitting at the same time a vast quantity of smoke.

They are all insoluble in water, whether cold or hot; but when they are melted along with water, or mixed with volatile oil and then distilled with water, they seem to unite
with a portion of that liquid; for they become opaque, and lose much of their brittleness. This at least is the case with common resin. They are all, with few exceptions, soluble in warm, doubly when boiled with heat. The solution is usually transparent, and when the alcohol is evaporated, the resin is obtained unaltered in its properties. When the solution is mixed with water, it becomes milky, and the resin falls in the state of white powder. They are soluble also in sulphuric ether. Many of them are soluble in several of the fixed oils, especially in the drying oils. The greater number are soluble in the volatile oils; at least in oil of turpentine, the one commonly employed.

Hitherto it has been affirmed by all chemists, both ancient and modern, that the alkaloids do not exert action on the resins. Fournier, for instance, in his last work, affirms this in the most positive manner; but the experiments of Mr. Hatchett have demonstrated this opinion to be completely erroneous. He reduced a quantity of common resin to powder, and gradually added it to a boiling lixivium of carbonat of potass; a perfect solution was obtained of a clear yellow colour, and this change continued permanent after long exposure to the air. The experiments succeeded equally well with carbonat of soda, and with solutions of pure potass or soda. Every other resin tried was dissolved as well as rosins, and the discovery led to very important consequences. The well-known fact, that the soap-makers in this country constantly mix resin with their soap; that it imparts its yellow colour, its odour, and its easy solution in water, to this addition, ought to have led chemists to suspect the solubility of resins in alkalies. No such consequence, however, was drawn from this notorious fact.

It has been supposed also that the acids are incapable of acting upon the resins. Fournier is equally positive with regard to this, and Gren speaks of it in such a manner, that every reader must conclude that he had tried the effect of nitric acid upon resins. Yet Mr. Hatchett has ascertained this opinion likewise to be erroneous, at least as far as nitric acid is concerned. He found that resins were subjected to the actions of nitric acid in alkalies in the state of a curdy precipitate; but when nitric acid is added in excess, the whole of the precipitate is resolved in a boiling heat. This remarkable fact, which did not hold when sulphuric or muriatic acids were used, led him to try whether the resins were soluble in nitric acid. He poured nitric acid, of the specific gravity 1.38, on powdered resin in a tubulated retort; and by repeated distillation formed a complete solution of a brownish yellow colour. The solution took place much sooner in an open man than in a solution close vessels. The solution contains permanent, though the liquid exposed to the air. It becomes turbid when water is added; but when the mixture is boiled, the whole is redissolved. When Mr. Hatchett collected the liquid thus thrown down by water filtration, he found that it still possessed the properties of resin. The resin is thrown down from nitric acid by potass, soda, and ammonia; but an excess of these alkalies redissolves the precipitate formed. This reasoning, extended to muriatic or orange colourd liquids. When Mr. Hatchett dissolved resin in boiling nitric acid, the solution was attended with a copious discharge of nitrous gas; and when the powdered resin was thrown into cold nitric acid, a considerable effervescence soon took place, and a porous mass was formed, commonly of a deep orange colour.

When resins are subjected to destructive distillation, we obtain, according to Gen. carbetuted hydrogen and carbonic acid gas, a very small portion of accludios water, and much empyreumatic oil. The charred is light and brilliant, and contains no alkali.

When volatile oils are exposed for some time to the action of the atmosphere, they acquire consistency, and assume the properties of resins. During this change they absorb a quantity of oxygen from the air. Westrum put 30 grains of oil of turpentine into 40 cubic inches of oxymercic acid gas. Heat was evolved; the oil gradually evaporated, and assumed the form of yellow resin. Mr. Proust observed, that when volatile oil is exposed to the air, it is partly converted into a resin, and partly into a crystallized acid; usually the benzoic or the caphoric. Hence we see that volatile oil is converted into two distinct substances. During this change oxygen is absorbed; and Fournier has observed that a portion of water is also formed. It is probable, from these facts, that resin is volatile oil deprived of a portion of its hydrogen, and combined with oxygen.

Hermstadt affirms, that to know whether any vegetable substance contains resin, we have only to pour some sulphuric ether upon it in powder, and expose the infusion to the light. If any resin is present, the ether will assume a brown colour.

Having now described the general properties of resins, it will be proper to take a more particular view of those of them which are of the most importance, that we may ascertain how far each possesses the general characters of resins, and by what peculiarities it is distinguished from the rest. The most distinguished of the resins are the following:

1. Rosin. This substance is obtained from different species of fir; as the pinus abies, sylvestris, larix, balsamifera. It is well known, that some of the exudation from the pinus sylvestris, or common Scotch fir, which hardens into tears. The same exudation appears in the pinus abies, or spruce fir. These tears constitute the substance called turpentine, or tar, and are employed when bark is stripped off these trees, a liquid juice flows out, which gradually hardens. This juice has obtained different names according to the plant from which it comes. The pinus sylvestris yields common turpentine; the larix, turbine venetica; the balsamia, balsam of Canada, &c. All these juices, which are commonly distinguished by the name of turpentine, are composed of the same ingredient, namely, oil of turpentine, and resin. When the turpentine is distilled, the oil comes over, and the resin remains behind. When the distillation is continued to dryness, the residue is kept by the name of common rosin, or colophonium; but when the water is mixed with it while yet fluid, and incorporated by violent agitation, the mass is called yellow resin. During winter the wounds made in the fir-trees become incrusted with a white brittle substance called barras or galipot, consisting of resin united to a small portion of oil. The yellow resin made by mixing and agitating this substance in water, is preferred for most purposes; because it is more ductile, owing probably to its still containing some oil. The properties of turpentine are those which have been detailed in the former part of this article. Its uses are numerous and well known.

2. Mastich. This resin is obtained from the Pistacia lentis, or Mastich tree, in the Levant, particularly in the island of Chios. When transverse incisions are made into this tree, a fluid exudes, which soon concretizes into yellowish semitransparent brittle grains. In this state it is sold under the name of mastich. It softens when kept in the mouth, but imparts very little taste. This has induced surgeons to employ it to fill up cavities, which it does tolerably well. When heated, it melts, and exudes a fragrant liquid. It contains a little volatile oil. It dissolves readily in fixed oils and in alcohol; but is too fusible and opaque for insertion as a varnish. It is found soluble in alkalies and nitric acid with the phenomena described in the former part of this article. Its specific gravity is 1.074.

3. Sandarach. This resin is obtained from the Semecarpus orientalis, or common reaper. It exudes spontaneously, and is usually in the state of small round tears of a brown colour, and semitransparent, not unlike mastich; but rather more transparent and brittle. Besides the resinous part, it contains alkalies of principle. Mr. Hatchett found the resin of juniper soluble in alkalies and nitric acid. Its specific gravity is 1.992.

4. Elemi. This resin is obtained from the Anisyris elemifera; a tree which grows in Canada and Spanish America. Incisions are made in the bark during dry weather, and the resinous juice which exudes is left to harden in the sun. It comes to this country in long roundish cakes wrapped in flag-leaves. It is of a pale yellow colour, semitransparent; at first softish, but it hardens by keeping. Its smell is at first strong and fragrant, but it gradually diminishes. When distilled, it yields a portion of volatile oil. The residuum is a pure resin. Its specific gravity is 1.018.

5. Tacamahac. This resin is obtained from the Fagura octandra, and likewise it is supposed from the populus balsamifera. It comes from America in large oblong masses wrap in flag-leaves. It is of a light-brown, very brittle, and easily melted when heated. Mr. Hatchett found it soluble in alkalies and nitric acid with the usual phenomena. Its specific gravity is 1.086.

6. Auric. This resin is obtained from the hymezae courbaril or lecust tree, which grows to the North of Brazil. This resembles copal very much in its appearance; but is readily soluble in alcohol, which copal is not; this readily distinguishes them. It is so very frequently employed in the making of varnishes. Its specific gravity, according to Birsön, is 1.028.

7. Ladanum, or lobadaum. This resin is obtained from the cystus creticus, a shrub which grows in Syria and the Grecian islands.

8. Opopulaenum, or balm of Gilced. This resin is obtained from the amyris Gi-
11. Guaiacum. This resin is obtained from the guaiacum officinale, a tree which is a native of the West Indies. The resin exudes spontaneously, and is driven out melted by heating one end of the wood in billets previously bored longitudinally; the melted resin runs out at the extremity farthest from the fire. The resin is of a green colour, has some transparency, and is brittle. Its fracture is vitreous. When heated, it melts. It has no smell, and scarcely any taste. Alcohol dissolves it; but water has no effect upon it. When thrown on burning coals, it diffuses a fragrant odour. When swallowed in powder, it causes a burning sensation in the throat.

12. Botany Bay resin. This resin is said to be the produce of the sarcos resinera; a tree which grows abundantly in New Holland, especially in Botany Bay. Specimens of it were brought to London about the year 1799, when it was tried as a medicine. Some account was given of it in governor Philip's Voyage, and in White's Journal of a Voyage to New South Wales; but it is to be noted that it is of no account as an article of commerce.

13. Copaiva, or balson of copaiva. This resin is obtained from the copaiva officinale; a tree which grows in South America, and some of the West Indian islands. The resin juvenile exudes in water, which is made in the trunk of the tree. The juice thus obtained is transparent, of a yellowish colour, an agreeable smell, a pungent taste, at first of the consistence of oil, but it gradually becomes thick and dark. It is a combination of volatile oil and resin; the oil is easily obtained by distillation with water. It is employed in medicine.

14. Viny. This resin is obtained from the viny tree, Fracture solens, and the viny of Brazil. The resin exudes spontaneously from the trunk of the singular tree which yields it, especially if the bark is wounded. It is but first fluid, but becomes gradually cold when dried in the sun. According to governor Philips, it is collected usually in the soil which surrounds the tree, having doublet run down spontaneously to pieces of it, and to the various sizes of a yellow colour unless when covered with a greenish-grey crust. It is firm, yet brittle; and when pounded, does not stick to the mortar nor cake. In the mouth it is easily reduced to powder without sticking to the teeth. It communicates merely a slight sweetish astrignent taste. When moderately heated, it melts; on hot coals it burns to a sour, emitting a white smoke which has a fragrant odour something like storax. When thrown into the fire, it increases the flame like pitch. It communicates to water the flavour of storax, but is insoluble in that liquid. When digested, the proportions of two-thirds dissolve: the remaining third consists of one part of extractive matter, soluble in water, and having an astrigent taste; and two parts of woody fibre and other impurities, perfect tasteless and water; the solution has a brown colour, and exhibits the appearance and the smell of a solution of benzoin. Water throws it down unaltered. When heated, it produces an empyreumatic oil, and charcoal; but it gives no traces of any acid, alkali, or salt, even when distilled with water.

Twelve parts were boiled in a solution of soda in water; the resin was dissolved; the remaining ten parts were floating on the solution, cohering together in clots. No crystals were obtained by evaporation part of the solution; and when sulphuric acid was dropped into the solution, resin separated unaltered. When mixed with twice its weight of nitric acid, the resin swells unaltered on the surface; but when heat is applied, the insoluble portion takes place. The digestion was continued till the effervescence stopped, and the resin swam on the surface of the liquid, collected together in clots. It was then separated by filtration. It had the bulk of 1/4 of the resin that treated had acquired a bitter taste, was not so easily melted as before, and alcohol was capable of dissolving only one-half of it. The solution was brown, tasted like bitter almonds; and when mixed with water, let fall a yellow resinous precipitate of a very bitter taste. The insoluble portion mixed with water, but formed a turbid liquid, which passed through the filter. The nitric acid solution separated from the resin by filtration, was transparent; its colour was yellow; its taste bitter; and it tinged substances dipped into it of a yellow colour. By evaporation it yielded oxalic acid, and produced a yellowish powder. This last substance was insoluble in water, and scarcely soluble in alcohol. Its taste was exquisitely bitter, like quassia. It mixed with the saliva, and resisted the skin and unchanged yellow. The resin deposited continued bitter and yellow, but yielded no precipitate with potash and nitrat of lime. The bitter substance, into which this resin was thus converted by nitric acid, was considered as one of the theories that it is capable of producing the same changes on all the resin: but this conjecture has been verified only with regard to colophonium, which he found to yield equally a yellow bitter substance.

The green resin which constitutes the colouring matter of the leaves of trees, and almost all vegetables, is insoluble in water, and soluble in alcohol. From the experiments of Provost, we learn, that when treated with oxymuriatic acid it assumes the colour of a withered leaf, and acquires the resinous properties in greater perfection.

15. Copal. This substance, which deserves particular attention from its importance as a varnish, and which at first sight seems to belong to a distinct class from the resin, is obtained from the rhiz copalimum, a tree which is a native of North America; but the best sort of copal is said to come from Spanish America. Copal is a beautiful transparent resinous-like substance, with a slight tinge of brown. When heated it melts like other resins; but it differs from them in not being soluble in alcohol, nor in oil of turpentine without peculiar medicinal properties: but it does dissolve in the fixed oils with the same ease as the other resins. It resembles gum annie exactly in appearance; but is easily distinguished by the solubility of this last in alcohol. The specific gravity of copal varies.

RESISTANCE, or resisting-force, in philosophy, denotes, in general, any power which acts in an opposite direction to another, so as to stop or diminish its effect.

There are various kinds of resistance arising from the various natures and properties of the resisting bodies, and governed by various laws; as, the resistance of solids, the resistance of fluids, the resistance of the air, &c.

Resistence of solids, in mechanics, is the force with which the quiescent parts of solid bodies oppose the motion of other parts contiguous to them. Of these there are two kinds: The first where the resisting and the resisted parts, i.e. the moving and quiescent bodies, are only contiguous, and do not cohere; constituting separate and distinct bodies or substances, as, the friction of what Leibnitz calls resistance of the surface, but which is more properly called friction; for the laws of which, see the article Friction.

The second case of resistance, is where the resisting and resisted parts are not only contiguous, but cohere, being parts of the same continuous body or mass. This resistance was first considered by Galileo, and may properly be called cohesion.

Theory of the resistance of the fibres of solid bodies. To conceive an idea of this resistance, or cohesion of the parts, suppose a cylindrical body suspended vertically by one end. Here all its parts, being heavy, tend downwards, and endeavour to separate the two contiguous planes or surfaces where the body is the weakest; but all the parts of them resist this separation by the force which they cohere, or are bound together. Here then are two opposite powers, viz. the weight of the cylinder, which tends to break it; and the force of cohesion of the parts, which resists this force.

If now the base of the cylinder is increased without increasing its length, it is evident...
Then \( I' \times x = \frac{c}{I} \times x \), the weight of the prism; and \( x = \frac{c}{I} \times x \) is its momentum; also, \( \frac{d}{y} = \) the momentum of the prism \( x \) and \( x \) is its added weight. In like manner \( \frac{d}{y} + \frac{d}{y} = \) the momentum of the prism \( x \) and \( x \) is its added weight, which that broke it; consequently \( \frac{d}{y} + \frac{d}{y} = \frac{d}{y} + \frac{d}{y} = \frac{d}{y} \), the length sought, that just breaks with the weight \( g \) at the distance \( x \). If this weight \( g \) is nothing, then \( x = \sqrt{\frac{d}{y}} + \frac{d}{y} \times x \) is the length of the prism that just breaks with its own weight.

If two prisms of the same matter, having their bases and lengths in the same proportion, are suspended horizontally; it is evident that the greater has more weight than the lesser, both of equal lengths, and of its base; but it has less momentum on account of its length, considered as a longer arm of a lever, and has only more resistance on account of its base; therefore it exceeds the lesser in momentum more than it does in its resistance, and consequently it breaks more easily.

Hence appears the reason why, in making small machines and models, people are apt to consider the resistance be much less than the strength of certain horizontal pieces, when they come to execute their designs in large, by observing the same proportions as in the small.

When the prism, fixed vertically, is just about to break, there is an equilibrium between its positive and relative weight; and consequently those two opposite powers are to each other reciprocally as the areas of the lever to which they are applied, that is, as half the diameter to half the axis of the prism. On the other hand, the resistance of a body is always equal to the greatest weight which it will just sustain in a vertical position, that is, to its absolute weight. Therefore, substituting the absolute weight for the resistance, it appears, that the absolute weight of a body, suspended horizontally, is to its relative weight, as the distance of its centre of gravity from the fixed point or axis of motion, is to the distance of the centre of gravity of its base from the same.

The discovery of this important truth, at least as an equivalent to, and to which this is reducible, we owe to Galileo. On this system of resistance of that author, Maritot made an ingenious remark, which gave birth to a new system. Galileo supposes that where the body breaks, all the fibres break at once; so that the body always resists with its whole absolute force, or the whole force that it can possibly exert at any instant, and never breaks till entirely bent. Hence those nearest the fulcrum of the lever, or lowest point of the fracture, are stretched less than those farther off, and consequently employ less part of their force, and break later.

This consideration only takes place in the horizontal situation of the body; in the vertical, the fibres of the base all break at once; so that the body will at once resist the whole weight of itself, and never exceed the united resistance of all its fibres; a greater weight is therefore required here than in the horizontal situation; that is, a greater weight is required to overcome their several resistances one after another. See 'Timber, strength of.'
of a ball of lead, descending in water, is equal to that which a heavy body acquires by falling through a space of 14 feet; or, 

$$\sqrt{\frac{g_\text{water}}{g_\text{air}}} = \sqrt{\frac{1/4}{1/4}} = 1$$

nearly, or 8 times the root of the same space.

Hence it appears, how soon small bodies come to their greatest or uniform velocity in descending in a fluid, as water, and how very small that velocity is; which explains the reason of the slow precipitation of mud, and small particles, in water; as also why, in precipitations, the larger and gross particles descend sooner, and the lowest.

Further, where \( N = n \), or the density of the fluid is equal to that of the body, then \( N = n \), so that the velocity and distance descended are each nothing, and the body will just float in any part of the fluid.

Moreover, when the body is lighter than the fluid, then \( N < n \), and \( N - n \) becomes a negative quantity, or the force and motion tend the contrary way, that is, the ball will ascend up to the top of the fluid by a motrice force, which is as if it were a body, the body ascending by the action of the fluid, is moved exactly by the same laws as a heavier body falling in the fluid. Wherever the body is placed, it is carried up with a force equal to the difference of the weight of a fluid of the same bulk as the body, from the weight of the body, that is, a body heavier than the ball continually acts equally upon the body; by which not only the action of gravity of the body is counteracted, so as that it is not to be considered in this case, but the body is also carried upwards by a motion equally accelerated, in the same manner as a body heavier than a fluid descends by its spheric gravity; but the equality of acceleration is destroyed in the same manner by the resistance, in the ascent of a body lighter than the fluid, as it is destroyed in the descent of a body that is heavier.

For the circumstances of the correspondent velocity, space, time, &c. of a body moving in a fluid in which it is projected with a given velocity, or descending by gravity, see Dr. Hutton's Select Exercises, prop. 29, 30, 31, and 32, page 221, &c.

Resistance of the Air, is the force with which the resistance of fluids, or the air, is retarded by the opposition of the air or atmosphere. See GUNSMITh, PROJECTILES, &c.

The air being a fluid, the general laws of the resistance of fluids obey the same rules except only to some variations and irregularities from the different degrees of density in the different stations or regions of the atmosphere. The resistance of the air is chiefly of use in military projectiles, in order to allow for the differences caused in their flight and range by it. Before the time of Mr. Robins, however, I thought that this resistance to the motion of such heavy bodies as iron balls and shells, was too incomparable to be regarded, for the rules and conclusions derived from the common parabolic theory, were sufficiently exact for the common practice of gunnery. But that gentleman showed, in his New Principles of Gunnery, that, so far from being incomparable, it is in reality enormously great, and by no means to be rejected without incurring the greatest errors; so much so, that the range, at the most, in the air, to the distance of two or three miles, would in a vacuum range twice as far.

The quantity of this resistance, in the case of different velocities, Mr. Robins discharged musket-balls, with various degrees of known velocity, against his ballistic pendulums, placed at several
RESISTANCE.

and gradual, continually from the smallest to the highest velocities; and that the increased real resistance no where rises higher than to about double of that which Newton's theory gives it.

The subject of the resistance of the air, as begun by Robins, has been prosecuted by Dr. Hutton, to a very great extent and variety, both with the whirling-machine, and with cannon-balls of all sizes, from 1 lb. to 6 lb. weight, as well as with figures of many other different shapes, both on the fore part and hind part of them, and with planes set at all varieties of angles of inclination to the path or motion of the same; from all which we obtain the real resistance to bodies, for all velocities, from 1 up to 2000 feet per second; together with the law of the resistance to the same body for all different velocities, and for different sizes with the same velocity, and also for all angles of inclination.

RESISTANCES OF DIFFERENT BODIES.

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<th>Velocity per second.</th>
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In this table are contained the resistances to several forms of bodies, when moved with several degrees of velocity, from three feet per second to 80 feet. The columns of the bodies are at the tops of the columns, as also which end went foremost through the air; the different velocities are in the first column, and the resistances on the same line, in their several columns are avoirdupois ounces and the decimal parts. So on the first line are contained the resistances when the bodies move with a velocity of three feet in a second, viz. in the second column, for the small hemisphere, of 42 inches diameter, its resistance 0.08 ounces when the flat side went foremost; in the third and fourth columns the resistances to a larger hemisphere, first with the flat side, and next the round side foremost; the diameter of this, as well as all the following figures, being 66 inches, and therefore the area of the great circle being 32 square inches, or 7/6 of a square foot; then in the fifth and sixth columns are the resistances to a cone, first its vertex, and then its base foremost; the altitude of the cone being 26 inches, as the same diameter of its base; in the seventh column the resistance to the end of the cylinder, and in the eighth, that against the whole globe or sphere. All the numbers show the real weights which are equal to the resistances; and at the bottom of the columns are placed proportional numbers, which shew the mean proportions of the resistances of all the figures to one another, with any velocity. Lastly, in the ninth column are placed the exponents of the power of the velocity which the resistances in the second and third columns bear to each other, viz. that of the tenth-foot velocity bears to each of the following ones, the medium of all of them being as the 2.04 power of the velocity, that is, very little above the square or second power of the velocity, so far as the velocities in this table extend.

From this table the following inferences are easily deduced:

1. That the resistance is nearly in the same proportion as the surfaces; a small increase only taking place in the greater surfaces, and for the greater velocities. Thus, by comparing together the numbers in the second and third columns, for the bases of the two hemispheres, the areas of which bases are in the proportion of 173 to 32, or 5 to 9 very nearly, it appears that the numbers in those two columns, expressing the resistances, are nearly as 1 to 2 or 5 to 10, as far as the velocity of 12 feet; but after that, the resistances on the greater surface increase gradually more and more above that proportion.

2. The resistance to the same surface with different velocities, is, in these slow motions, nearly as the square of the velocity; but gradually increases more and more above that proportion as the velocity increases.

This is manifest from all the columns; and the index of the power of the velocity is set down in the ninth column, for the resistances 3
in the eighth, the medium being 2.04; by which it appears that the resistance to the same body is, in these slow motions, as the 2.04 power of the velocity, or nearly as the square of it.

3. The round ends, and sharp ends, of solids, suffer less resistance than the flat or plane ends, of the same diameter; but the sharper end has not always the less resistance. Thus, the hinderer, and the flat ends of the hemisphere and cone, have more resistance, than the round or sharp ends of the same; but the round side of the hemisphere has less resistance than the sharper end of the cone.

4. The resistance on the base of the hemisphere, is to that on the round, or whole sphere, as 25 to 1, instead of 2 to 1, as the theory gives that relation. Also the experimented resistance, on each of these, is nearly 1/4 more than the quantity assigned by the theory.

5. The resistance on the base of the cone, is to that on the vertex, nearly as 2 1/2 to 1; and in the same ratio is radius to the sine of the angle of inclination of the side of the cone to its base. In the first case, therefore, the resistance is directly as the sine of the angle of incidence, the transverse section being the same.

6. When the hinder parts of bodies are of different figures, as far as resistance is concerned, though the fore-parts are exactly alike and equal; owing probably to the different pressures of the air on the hinder parts. Thus, the resistance to the fore-part of the cylinder, is less than on the equal flat surface of the cone, or of the hemisphere; because the hinder part of the cylinder is more pressed or pushed by the following air than those of the other two figures; also, for the same reason, the base of the hemisphere suffers less resistance than that of the cone, and the round side of the hemisphere less than the whole sphere.

Resistance of the fibres of solid bodies is more properly called cohesion.

Resolution in chemistry, &c. the reduction of a mixed body into its component parts, or first principles, by a proper analysis.

Resolution in music is when a consonant or interval figure is not written on a line, or in one part, but all the voices that are to follow the guide or first voice are written separately either in score, that is in separate lines, or in separate parts, with the pauses each to observe, and in the proper tone to each.

Respiration consists in drawing a certain quantity of air into the lungs, and throwing it out again alternately. Whenever this function is suspended, even for a very short time, the animal dies.

The fluid respired by animals is common atmospheric air; and it has been ascertained by experiment, that no other gaseous body with which we are acquainted, can be substituted for it. All the known gases have been tried; but they all prove fatal to the animal which is made to breathe them. Care has been taken that no air containing carbonic acid is concerned, may be divided into two classes: 1. Unrespirable gases; 2. Respirable gases. See Air.

1. The gases belonging to the first class are of such a nature that they cannot be drawn into the lungs of an animal at all; the episiotis closing spasmodically whenever they are applied to it. To this class belong carbonic acid, and probably all the other acid gases, as has been ascertained by the experiments of Pierre-Duphresne. Ammoniacal gas belongs to the same class; for the lungs of animals suffocated by it were found by Pluot not to give a green colour to vegetable blue.

II. The gases belonging to the second class may be drawn into the lungs, and thrown out again, without any opposition from the respiratory organs; of course the animal is capable of breathing them. They may be divided into four subordinate classes: 1. The first set of gases occasion death immediately, but produce no visible change in the blood. They occasion the animal's death merely by depriving him of air, in the same way as he would be suffocated by being kept under water. The only gases which belong to this class are hydrogen and azote. 2. The second set of gases occasion death immediately, but at the same time produce certain changes in the blood, and therefore kill, not merely by depriving the animal of air, but by certain specific properties. The gases belonging to this class are carburetted hydrogen, carbonic oxide, and perhaps also nitrous gas. 3. The third set of gases may be breathed for some time without destroying the animal; but death ensues if the animal is kept long enough to blow up the lungs. To this class belong the nitrous oxide and oxygen gas. 4. The fourth set may be breathed any length of time without injuring the animal. Air is the only gaseous body belonging to this class.

It has been long known that an animal can only breathe a certain quantity of air for a limited time; after which it becomes the most deadly poison, and produces suffocation in about a minute. This has been confirmed from his experiments, in order to prove the fact. Dr. Priestley and Mr. Scheele demonstrated, that the quantity of oxygen gas in atmospheric air is diminished; and Lavoisier demonstrated, in 1773, that oxygen gas, which did not previously exist in it, was found in air after it had been for some time respired. It was afterwards proved by Lavoisier, and many other philosophers, who confirmed and extended his facts, that no animal can live in air totally destitute of oxygen. Even fish, which do not sensibly respire, die very soon if the water in which they live is deprived of oxygen gas. Frogs, which can suspend their respiration at pleasure, die in about forty minutes, if the water in which they have been confined is covered over with oil. Insects and worms, as Vaccinia, which die, do so by the same means. These phenomena require air as well as other animals, and die like them if they are deprived of it. They diminish the quantity of oxygen in the air in which they live, and give it out, by respiration, the very same products as other animals. Worms, which are more retentive of life than most other animals, or at least not so much affected by poisonous gases, absorb every particle of the oxygen contained in the air in which they are...
The opinion that it is the oxygen only, and that the azote remains the same after respiration as before it. These conclusions were the consequence of the experiments of Lavoisier, who announced the non-alteration of the azote of the atmosphere in their earliest period of his researches. This conclusion seems to have been the consequence of the opinion which he entertained, that air is merely a mechanical mixture of the two gases, oxygen and azote. When he first adopted it, his apparatus was not delicate enough to measure small changes; and he does not appear to have afterwards examined the azotic residue with much attention. Mr. Davey has rendered it possible to Mr. Lavoisier of the azote of the air as well as oxygen disappears during respiration.

According to Dr. Menzie's, at every respiration 2.1885 cubic inches of oxygen gas are consumed. Now 2.1885 cubic inches of that gas amount to 0.6869 grains troy. Supposing, with Hales, that a man makes 1200 respirations in an hour, the quantity of oxygen gas consumed in an hour will amount to 0.8240 grains troy, and in 24 hours to 19776.672 grains, or 412104 ounces troy. This quantity exceeds that found by other chemists considerably; but the allowance of oxygen for every respiration is rather too great. Indeed, from the nature of Dr. Menzie's apparatus, it was scarcely possible to measure it accurately. According to the last experiments of Lavoisier and Seguin, a man, at an ordinary and convenient rate of respiration, 32.48437 ounces troy of oxygen gas: that is to say, that a quantity of oxygen gas, equal to that weight, disappears from the air which he respires in 24 hours. Indeed, the average quantity of air which disappears during every respiration is 1.4 cubic inch; of which 0.2 are azote and 1.2 oxygen. This, allowing 20 respirations per minute, as was the case with Mr. Davey (the subject of the experiment), amounts in 24 hours to rather more than 38 ounces of air; or precisely to 4.68 ounces of azote, and 33.54 of oxygen. This does not differ far from the other estimates obtained by Lavoisier, excepting in the azote, which the French chemist neglected altogether. We may consider it therefore as approximating to the truth as nearly as can be expected in the present state of the science.

2. That the air thrown out of the lungs contains carbonic acid, may be easily ascertained by blowing it through a tube into lime-water, which immediately becomes milky; and the bulk of the gas may be estimated by putting a portion of air from the lungs into a graduated jar standing over mercury, introducing a little baryatic water, or pure soda, to absorb the carbonic acid, and observing the diminution of bulk in consequence of this absorption. According to Lavoisier, a man in 24 hours throws out from his lungs at an average about 15.73 ounces troy of carbonic acid gas, as much as the experiments of Mr. Davey, on the other hand, it follows, that at every expiration about 1.1 cubic inch of carbonic acid is emitted, which amounts in 24 hours to no less than 37 ounces. The difference between these two sets of experiments is enormous, and claims a more complete experimental investigation to determine, whether the proportion of this gas emitted by different individuals, or by the same individual at different times, does not differ essentially. This supposition is surely very probable, as it tallies with what we know to be the case in other excrections; and it proves true, would the respiration continue, which has hitherto been ascertained. In the mean time, let farther experiments decide the point, we may consider Mr. Davey's conclusions as nearly the medium of the two, because they correspond with the earlier experiments of Lavoisier, and remove a very striking anomaly which appears when we compare Lavoisier's experiments on the respiration of man, with those produced in a laboratory. He took a guinea-pig into 708.090 grains troy of oxygen; and after the animal had breathed the gas for an hour, he took it out. He found that the oxygen gas now amounted only to 592.853 gr. Consequently there had disappeared 116.736 gr.

The carbonic acid gas formed was 130.472 gr.

The guinea-pig consumed in 24 hours 5.8308 oz. troy of oxygen gas, and emitted 6.9230 oz. of carbonic acid gas. Man, on the other hand, consumes in the same time 22.48437 oz. of carbonic acid gas. The oxygen gas consumed by the pig is to the carbonic acid gas emitted as 1.001:1.12; whereas in man it is 1.000:0.48; which would depend upon the accuracy of each of these experiments, they would prove, beyond a doubt, that the changes produced by the respiration of the pig are different, at least in degree, from those produced in man; but it is probable that some mistake has happened in one or other of the experiments.

3. It is not so easy to determine the proportion of water emitted from the lungs mixed with the air expired, as it is that of the carbonic acid. According to the experiments of Dr. Hales, it amounts in a day to 20.4 oz.; but his method was not susceptible of great accuracy. Mr. Lavoisier, on the other hand, estimated it at 28.55 ounces; but this proportion seems rather to have been the result of calculation than of any direct measurement. It can only be considered therefore as an approximation to the truth, and most probably a very imperfect one.

III. Let us now endeavour to ascertain the changes produced on the blood by respiration. The whole of the blood is propelled from the heart to the lungs, circulates through the vessels of that organ, and during that circulation it is exposed to the influence of the air with which it is constantly coming into contact. The slow changes are produced upon it by this action, which has been partly traced by the experiments of Priestley, Cigna, Fourcroy, Hussonfrat, Bedschode, Watt, and others, and all by the slow changes, as far as we are acquainted with them, are the following: 1. The blood absorbs air. 2. It acquires a florid red colour, and the chyle disappears. 3. It emits carbonic acid, and 4. It emits water, and perhaps hydrogen.

As the azote which has separated from the air during respiration is not to be found in the products of respiration, we must conclude that it has been absorbed by the blood. The experiments of Mr. Davey have rendered it exceedingly probable that the air is absorbed by the blood, and that it is afterwards decomposed by that liquid; and that the portion of azote which is useless is given out again, and mixed with the air in the lungs. The following facts render this opinion probable: first, the expired air is no, nor are any positive changes produced on the blood. When the gaseous oxide of azote is respired, it changes in quantity, and its composition; at the same time carbonic acid is evolved as usual, and a quantity of azotic gas makes its appearance. Now, as this azotic gas did not exist separately in the air before respiration, it must have been produced in conjunction with the separation of the oxide of azote; but its quantity being much less than the azote contained in the oxide of azote, which has disappeared, it follows that at least one fourth of azote has been absorbed by the blood unaltered; and if a part is thus absorbed, why not the whole? In that case the azotic gas must have been separated from the blood, in consequence of the decomposition of the oxide of azote absorbed. Now, as air is composed of precisely the same ingredients with the oxide of azote, as well as of the oxygen, of the air respired, it is impossible to suppose that the air is absorbed by the blood, and that the azotic gas which is developed is thrown out of the blood in consequence of the decomposition of the air absorbed. But farther, if the air is absorbed by the blood during respiration while the azote remains unaltered, oxygen gas ought to answer the same purposes as air. This gas, however, cannot be resired without occasioning death at last; and when it is respirated, the proportion of oxygen which disappears in a given time is much smaller than when the air is resired. Thus when 182 cubic parts of oxygen gas were breathed by Mr. Davy for but a minute, 11.4 cubic inches of the oxygen gas disappeared, whereas 15.6 cubic inches disappear in the same time when common air is resired. This is a demonstration of the useful in respiration, and not merely its oxygen; and if so, the air must be absorbed.

2. It has been long known that the blood which flows in the veins is of a dark-redish purple colour, whereas the blood in the arteries is of a florid scarlet colour. Lower observed that the colour of venous blood was converted into that of arterial during its passage through the lungs. No chyle can be distinguished by its white colour in the blood after it has passed through the lungs. The changes, then, which take place upon the appearance of the blood, are two: 1. It acquires a florid red colour; 2. the chyle disappears. Priestley himself knew that the change was produced by the air, and Mayow attempted to prove that it was by absorbing a part of the air. But it was not till Dr. Priestley discovered that air acquired a scarlet colour when put in contact with oxygen gas, and arterial blood a red colour when put in contact with hydrogen gas; or, which is the same thing, oxygen gas instantly gives blood the colour of arterial, and hydrogen on the
RESPIRATION.

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contrary, gives arterial blood the colour of venous blood; it was not till then that philosophers began to attempt any thing like an explanation of the phenomena of respiration.

The blood is a fluid of very complex a nature, that it is not easy to ascertain the changes produced by the exposure to the atmosphere of the body, and even if that could be done, we have no method of proving that the effects of these gaseous bodies upon the coagulated blood are the same as would be on the blood in the motionless state, circulating in the vessels of a living animal. The facts which have been ascertained are the following:

1st. It appears from the experiments of Priestley, Girtanner, and Hassencrantz, that when venous blood is exposed to oxygen gas confined over it, the blood instantly assumes a scarlet colour, and the gas is diminished in bulk; therefore part of the gas has been absorbed. Mr. Davy indeed could not perceive any sensible diminution of the bulk of the gas.

2d. The same change of colour takes place when arterial blood is exposed to common air; and in that case the diminution of the bulk of the air is rather more sensible.

3d. Venous blood exposed to the action of azotic gas continues unaltered in colour; neither can any perceptible diminution of the gas ensue.

4th. Venous blood exposed to the action of nitrous gas becomes a deep purple, and about one-eighth of the gas is absorbed.

5th. The lungs along with the vessels, carbonic oxide becomes of a brighter purple, especially on the surface, and a considerable portion of the gas is absorbed.

6th. Venous blood exposed to carbonic acid gas becomes of a brownish-red colour, much darker than usual, and the gas is slightly diminished in bulk.

7th. Carburated hydrogen gas gives venous blood a fine red colour, a shade darker than oxygen gas does, as was first observed by Dr. Beddoes, and at the same time a small portion of the gas is absorbed. This gas has the property of preventing, or at least greatly retarding the combination of blood, as was first observed by Mr. Watt.

8th. When arterial blood is put in contact with azotic gas, or carbonic acid gas, it gradually assumes the dark colour of venous blood, as Dr. Priestley found. The same philosopher observed, that arterial blood acquired the colour of venous blood when placed in vacuo. Consequently this alteration of colour is owing to some change which takes place in the blood itself, independent of any external agent.

The arterial blood becomes much more rapidly and deeply dark-coloured when it is left in contact with hydrogen gas placed above it, what is the exact reason, therefore, the presence of this gas accelerates and increases the change, which would have taken place upon the blood without any external agent.

9th. If arterial blood is left in contact with oxygen gas, it gradually assumes the same dark colour which it would have acquired in vacuo, or in contact with hydrogen; and after this change oxygen can no longer restore its scarlet colour. It is therefore only upon a part of the blood that the oxygen acts; and after this part has undergone the change which occurs in the blood, the blood loses the power of being affected by oxygen.

10th. Mr. Hassencrantz poured into venous blood a quantity of oxymuriatic acid; the colour of the blood changed and assumed a deep and almost black colour. When he poured common muriatic acid into blood, the colour was not altered. Now oxymuriatic acid has the property of giving out its oxygen readily combined with the black colour was owing to the instant combination of a part of the blood with oxygen.

Such are the phenomena produced upon the blood by the different gases out of the body; but the science is not far enough advanced at present to be able to explain them in a satisfactory manner. The obvious changes produced on the blood in the lungs by respiration, are the florid red colour, and the disappearance of the dark red colour; a process which was explained as follows.

1. That carbonic acid is emitted from the lungs during expiration, has been fully ascertained; but whether it is formed in the lungs, according to the theory of Lavoisier, by the decomposition of the oxygen of the air with carbon emitted by the blood, or is emitted ready-formed from the blood at the same time that the air is absorbed, is not so obvious; but the latter opinion is more probable; and indeed follows from the supposition that air is absorbed without decomposition.

2. It is much more reasonable to conclude that the watery vapour which exalts from the lungs, has been diffused with oxygen, and carries it along with it through the blood-vessels. During the circulation the air is gradually decomposed by the blood, its oxygen, and part of its azote enter into combination, at the same time a portion of azote, of carbonic acid, and water, is evolved. When the blood returns to the lungs, it absorbs a new dose of air, and at the same time lets go the azote, carbonic acid, and watery vapour, which had been formed during the circulation. The same changes are again repeated, and the same substances emitted, every time the blood comes to the lungs.

It is probable that, during a considerable part of the day, there is a constant influx of chyle into the blood; and we are certain that lymph is constantly flowing into it. Now it appears, from the observations hitherto made, that neither chyle nor lymph contains fibrina, which forms a very conspicuous part of the blood. This fibrina is employed to supply the waste of the muscles, the work being from the body, and therefore, in all probability, requiring the most frequent supply. Nor can it be doubted that it is employed for other useful purposes. The quantity of fibrina in the blood, then, must be constantly diminishing, and therefore new fibrina must be constantly formed. But the only substances out of which it can be formed are the chyle and lymph, neither of which contains it. There must, therefore, be a continual decomposition of the chyle and lymph going on in the blood-vessels, and a continual new formation of fibrina. Other substances also may be formed; but it is certain that no fibrina can be formed, because it does not exist previously. Now, one great evil of respiration must undoubtedly be, to assist this decomposition of chyle, and complete formation of blood.

It follows, from the experiments of Fourcroy, that fibrina contains more azote, and less hydrogen and carbon, than any of the other ingredients of the blood, and consequently that of the chyle. In what manner the chyle, or a part of it, is converted into fibrina, it is impossible to say; we are not sufficiently acquainted with the subject to be able to explain the process. But we can see at least that carbon and hydrogen must be abstracted from that part of the chyle which is to be converted into fibrina; and we know, that these substances are actually thrown out by respiration. We may reasonably suppose, therefore, that the use of the air absorbed is to abstract a quantity of carbon and hydrogen from a part of the chyle by compound affinity, in such proportion that the remainder becomes insoluble; but the science of respiration is incomplete.

The complete formation of blood is not the only advantage gained by respiration; the temperature of all animals depends upon it. It has been long known, that those animals which breathe through the lungs, have a temperature much higher than the atmosphere; that of man is 98°. Birds, who breathe in proportion a still greater quantity of air than man, have a temperature equal to 103° or 104°. It has been proved, that the temperature of all animals is proportional to the quantity of air which they breathe in a given time.

These facts are sufficient to demonstrate, that the heat of animals depends upon respiration. But it is not to be doubted that Dr. Black's doctrine of latent heat became known to the world, that any explanation of the cause of the temperature of breathing animals was attempted. That illustrious philosopher, whose discoveries form the basis upon which all the scientific part of chemistry has been reared, saw at once the light which his doctrine of latent heat threw upon this part of physiography, and he applied it with so early to explain the temperature of animals.

According to him, part of the latent heat of the air inspired becomes sensible; and of course the temperature of the lungs, and the blood that passes through them, must be raised: and the blood, thus heated, communicates its heat to the whole body. This opinion was ingenious, but it was liable to an unanswerable objection; for if it was true, the temperature of the body ought to be greatest in the lungs, and to diminish gradually as the distance from the lungs in-
Crawford and Lavosiéer, who considered all the changes operated by respiration as taking place in the lungs, accounted for the origin of the heat almost perfectly; in the same manner with Dr. Black. According to them the oxygen gas of the air combines in the lungs with the hydrogen and carbon emitteed by the blood. During this combination the oxygen gives out a great quantity of caloric, with which it had been combined; and this caloric is not only sufficient to support the temperature of the body, but also to carry off the new-formed warmth, which thereby becomes exuded; and thus the temperature of the air inspired is raised. According to these philosophers, then, the whole of the caloric which supports the temperature of the body is evolved in the lungs. Their theory accordingly was liable to the same objection with Dr. Black's; but they obviated it in the following manner: Dr. Crawford found, that the specific caloric of arterial blood was 1.089; while that of venous blood was only 0.925. He hence concluded, that the instant venous blood is changed into arterial blood, its specific caloric increases; consequently it requires an additional quantity of caloric to keep its temperature as high as it had been while venous blood. This addition is so great, that the whole new caloric evolved is employed; the temperature of the lungs must necessarily remain the same as that of the rest of the body. During the circulation, arterial blood is gradually converted into venous; consequently its specific caloric diminishes, and must give out heat. This is the reason why the state of the veins, the extreme parts of the body do not diminish.

This explanation is certainly ingenious, but it is not quite satisfactory; for the difference in the specific caloric, granting it to be accurate, is too small to account for the great quantity of heat which must be evolved.

It is evident that it must fall to the ground altogether, provided, as we have reason to suppose, that the carbonic acid gas and water are not formed in the lungs, but during the circulation.

Since the air enters the blood, and combines with it in the state of gas, it is evident that it will only part at first with some of its caloric; and this portion is chiefly employed in carrying off the carbonic acid gas, the azotic gas, and the water. For the reason that the carbonic acid leaves the blood at the instant that the air enters it, seems to be this: The air combines with the blood, and part of its caloric units at the same instant, with the carbonic acid, and converts it into gas: another portion converts the water into vapour. The rest of the caloric is evolved during the circulation, when the oxygen of the air combines with hydrogen and carbon, and forms water and carbonic acid gas. The quantity of caloric evolved in the lungs seems not only sufficient to carry off the carbonic acid and water, which the diminution of the specific caloric must facilitate; but it seems also to raise the temperature of the blood a little higher than it was before. For Mr. John Hunter constantly found, that the heat of the heart in animals was a degree higher than any other part of the body, when it was examined. Now this could scarcely happen, unless the temperature of the blood was somewhat raised during respiration.

The heart has seen two uses which respiration seems to serve. The first is the completion of blood by the formation of fibrin; the second is the maintaining of the temperature of the body at a particular standard, notwithstanding which is continually giving out to the colder surrounding bodies. But there is a third purpose, which explains why the animal is killed so suddenly when respiration is stopped. The circulation of the blood is absolutely necessary for the continuance of life. Now the blood is circulated in a great measure by the alternate contractions of the heart. It is necessary that the heart should contract regularly, otherwise the blood would not go on: but the heart is stimulated to contract by the blood: and unless blood is made to undergo the change produced by respiration, it ceases almost instantaneously to stimulate. As the blood respiration is stopped, the heart ceases to be acted on, and therefore, is opposed to motion. See Motion.

Rest, in music, the same with pause.

RESTAURATION, in architecture, the art of repairing those parts of a building that are gone to decay, in such a manner as to give it its original strength and beauty. See Architecture.

RESTIO, a genus of the triandria order, in the diocese class of plants. The male calyx is an ovate scale of membranaceous scales; the corolla is proper, hexapetalous, and persistent. The female calyx and corolla are as in the male; the germen is roundish, and is sex-sucicled; there are three erect and persistent styles; the capsule is roundish, with six plats, and is rostrated and trilocular; seeds are angular and cylindrical. They are twenty-eight species, all natives of the Cape, some of them resembling rushes; and used for making brooms, thatching houses, &c.

RESTITUTION, of medals. See Medal.

RESTORATIVE. See Medicine, and Materia Medica.

RETAILER, in law, a servant who does not continually dwell in the house of his master, but only attends upon special occasions.

RETAINING FEES, the first fee given to a servant or counsel at law, in order to make him sure, and prevent his pleading on the contrary side.

RETARDATION, in physics, the act of diminishing the velocity of a moving body. See Resistance.

RETÉ MIRABILE, in anatomy, a small plexus, or net-work, of vessels in the brain, surrounding the pia mater. See Anatomy.

RETE MACULOSUM. See Cusps.

RETENTION, is defined, by Mr. Locke, to be a faculty of the mind, whereby it keeps or retains those simple ideas it has once received by sensation or reflection.

RETENTIO, also used as medicine, for the state of contraction in the solid or vascular parts of the body, which makes them hold fast their proper contents. In this sense retention is opposed to evacuation and conveyance.

RETICULA, or Reticule, in astronomy, a contrivance for the exact measuring the quantity of eclipses.

The reticule is a little frame, consisting of thirteen fine silken threads, equidistant from each other, and parallel, placed in the focus of object-glasses of telescopes; that is, in the place where the image of the luminaries is painted in its full extent; of consequence, when the sun or moon is seen divided into twelve equal parts or digits; so that to find the quantity of the eclipse, there is nothing to do but to number the luminous and the dark parts. As a square reticule is only proper for the diameter, not for the circumference, of the luminaries, it is sometimes made circular by drawing six concentric equidistant circles, which represents the phases of the eclipse perfectly.

RETINA, in anatomy, the expansion of the optic nerve on the internal surface of the eye, whereupon the images of objects being received, are impressed, and by that means conveyed to the common sensory in the brain, where the mind views and contemplates their ideas. See Optics.

RETO, or Retorite, in chemistry, a kind of hollow sphere of glass, used in brewing, and sometimes made circular by drawing six concentric equidistant circles, which represents the phases of the eclipse perfectly.

RETORT, in law, is where a plaintiff comes in person to the court where his action is brought, and declares he will not proceed in it, in which case the action is hanged or arrested. A retort differs from a non-suit in this, that it is always where the plaintiff or defendant is personally in court. See Nosuit.

RETRENCHMENT, in the act of war, any kind of work raised to cover a post, and fortify it against the enemy, such as fascines loaded with earth, gabions, barrels of earths, sandbags, and generally all things that can be thrown as a protection; and the general title. But retrenchment is more particularly applicable to a fosse bordered with a parapet; and a post fortified thus is called post retrenched, or strong post.

Retrenchments are either general or particular: general retrenchments are new fortifications made in a place besieged, to cover the besiegers when the enemy become masters of a lodgment on the fortification, that they may be in a condition of dispute the ground inch by inch, and putting a stop to the enemy's progress in expectation of relief.

RETROGRADATION, or Regression, the act or effect of a thing moving backwards.

The retrograde motion of the planets is an apparent motion, whereby they seem, to an observer upon earth, to move backwards, or contrary to the signs. See Astronomy.

RETURNS, return, or returns, in law, is used in divers senses: 1. Return of writ by sheriff and bailiff is a certificate, made by them to the court, of what they have done in relation to the execution of the writ di-
REVE, REVE, or GREVE, the bailiff of a franchise, or manor, thus called, especially in the west of England. Hence hire-reve, sheriff, port-greve, &c.

REVEL, a beat of drum about break of day, to give notice that it is time for the soldiers to arise, and that the sentries are to be on the alert.

REVELLS, entertainments of dancing, masked, acting comedies, farces, &c., and usually very frequent in the inns of court, and in noblemen's houses, but now disused. The officer who has the direction of the revels at court, is called the master of the revels.

REVENU, PUBLIC, the yearly income appropriated to the expenses of government. There are four different sources of public revenue: 1. The income derived from property vested in the public. 2. The emoluments of lucrative prerogatives annexed to the sovereignty. 3. Voluntary contributions from the people. 4. Taxes or imposts, not prodigiously and continuously exacted. From one or other of these great sources all public revenue must arise.

The revenue of the kings of England consisted formerly of various branches which were inherited from the crown. Of these, the rents and profits of the demesne lands of the crown might alone have furnished a very considerable income, as there are few estates in the country which have not been regarded as so much as the conquest been in the hands of the king. The custody of the lay revenues, lands, and tenements, of bishoprics during their vacancy, and of the temporalities of such abbeys as were of royal foundation, was made a productive source of revenue by some of the kings, who kept the sees a long time vacant to enjoy their income; Elizabeth kept the see of Ely vacant nineteen years for this purpose. First fruits and tenths of the livings of the clergy, were originally paid to the pope; but upon the destruction of his authority in England, were demanded by the crown as a legal and clerical supremacy. The other branches of the national revenue were, the profits of the military tenures; with the right of purveyance and pre-emption; and a claim to all property of which the king was surety, whether it be now in possession of others, such as treasure-trove or money-plate, or bullion found hidden in the earth; deadlands, and forfeitures of lands and goods for offences; walks, or goods stolen and thrown away by the thief in his flight; estrays, or valuable animals found wandering and the owner unknown; goods wrecked, if no proof could be made within a certain space of time who were the legal proprietors; the right to mines of silver and gold; and to certain fish, as whales and sturgeon, when either thrown on shore, or caught near the coast. These, with fines and forfeitures of various descriptions, not at one time, the ordinary revenue of the country, was made a productive source of revenue by some of the kings, who kept the sees a long time vacant to enjoy their income; Elizabeth kept the see of Ely vacant nineteen years for this purpose.

Sir John Sinclair, in his History of the Public Revenue, gives the following view of its amount at the commencement of each reign.

<table>
<thead>
<tr>
<th>Year</th>
<th>Annual income</th>
</tr>
</thead>
<tbody>
<tr>
<td>1660</td>
<td>400,000</td>
</tr>
<tr>
<td>1687</td>
<td>330,000</td>
</tr>
<tr>
<td>1681</td>
<td>300,000</td>
</tr>
<tr>
<td>1707</td>
<td>209,000</td>
</tr>
<tr>
<td>1722</td>
<td>139,000</td>
</tr>
<tr>
<td>1729</td>
<td>100,000</td>
</tr>
<tr>
<td>1748</td>
<td>80,063</td>
</tr>
<tr>
<td>1753</td>
<td>84,976</td>
</tr>
<tr>
<td>1769</td>
<td>134,139</td>
</tr>
<tr>
<td>1777</td>
<td>130,000</td>
</tr>
<tr>
<td>1789</td>
<td>100,000</td>
</tr>
<tr>
<td>1797</td>
<td>76,043</td>
</tr>
<tr>
<td>1804</td>
<td>64,976</td>
</tr>
<tr>
<td>1812</td>
<td>69,000</td>
</tr>
<tr>
<td>1820</td>
<td>80,000</td>
</tr>
<tr>
<td>1828</td>
<td>69,180</td>
</tr>
<tr>
<td>1836</td>
<td>43,000</td>
</tr>
<tr>
<td>1844</td>
<td>100,000</td>
</tr>
<tr>
<td>1852</td>
<td>400,000</td>
</tr>
<tr>
<td>1860</td>
<td>500,000</td>
</tr>
<tr>
<td>1868</td>
<td>600,000</td>
</tr>
<tr>
<td>1876</td>
<td>895,019</td>
</tr>
<tr>
<td>1884</td>
<td>1,577,247</td>
</tr>
</tbody>
</table>

The taxation of the commonwealth was 20.000,000.
It.2741.2253.3418. in addition to the permanent and temporary taxes, constuting the public revenue. there are always certain incidental receipts applicable to the public service; such as the profits of lotteries, fees of the regulated exchequer-office, moneys repay'd by public accounts, &c.

REVERBERATION, in physics, the act of a body repelling or reflecting another after its impinging on it.


REVERSE of a medal, coin, &c. denotes the second or back side, in opposition to the head or principal figure. See MEDALS.

REVERSION, in heraldry, a thing turned backwards, or upside-down.

REVERSION, in law, is defined to be the re-turning of land, &c. to the possession of the donor, or his heirs. Reversion, in the law of England, has two significations; the one of which is an estate left, which continues during a particular estate in being; and the other is the return of the land, &c. after the particular estate is ended; and it is further said to be an interest in lands, when the possession of it falls; or where the estate which was for a time parted with, returns to the grantors, or their heirs. But, according to the usual definition of a reversion, it is the residue of an estate left in the grantor, after a particular estate granted away ceases, continuing in the grantor of such an estate.

The difference between a remainder and a reversion, consists in this: that the remainder may belong to any man except the grantor; whereas the reversion returns to him who conveyed the land, &c.

In order to render the doctrine of reversions easy, we shall give the following table; which shews the present value of one pound, to be received at the end of any number of years not exceeding forty, discounting at the rate of five, four, and three per cent. compound interest. See INTEREST.

<table>
<thead>
<tr>
<th>Years</th>
<th>Value at 5 per cent</th>
<th>Value at 4 per cent</th>
<th>Value at 3 per cent</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>9204</td>
<td>9115</td>
<td>9020</td>
</tr>
<tr>
<td>2</td>
<td>9070</td>
<td>9043</td>
<td>9015</td>
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<tr>
<td>3</td>
<td>8949</td>
<td>8920</td>
<td>8893</td>
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<tr>
<td>4</td>
<td>8831</td>
<td>8802</td>
<td>8774</td>
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<tr>
<td>5</td>
<td>7762</td>
<td>7739</td>
<td>7714</td>
</tr>
<tr>
<td>6</td>
<td>7100</td>
<td>7069</td>
<td>7039</td>
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<td>7</td>
<td>6719</td>
<td>6684</td>
<td>6658</td>
</tr>
<tr>
<td>8</td>
<td>6368</td>
<td>6336</td>
<td>6312</td>
</tr>
<tr>
<td>9</td>
<td>6064</td>
<td>6086</td>
<td>6101</td>
</tr>
<tr>
<td>10</td>
<td>5869</td>
<td>5886</td>
<td>5910</td>
</tr>
<tr>
<td>11</td>
<td>5704</td>
<td>5733</td>
<td>5762</td>
</tr>
<tr>
<td>12</td>
<td>5568</td>
<td>5600</td>
<td>5632</td>
</tr>
<tr>
<td>13</td>
<td>5459</td>
<td>5493</td>
<td>5529</td>
</tr>
<tr>
<td>14</td>
<td>5368</td>
<td>5405</td>
<td>5443</td>
</tr>
<tr>
<td>15</td>
<td>5296</td>
<td>5333</td>
<td>5378</td>
</tr>
<tr>
<td>16</td>
<td>5241</td>
<td>5280</td>
<td>5327</td>
</tr>
</tbody>
</table>

The use of the preceding table.—To find the present value of any sum to be received at the end of a given number of years, discounting the sum of three, four, or five per cent. compound interest. Find by the above table the present value of one pound to be received at the end of the given term, which sum, by the number of pounds proposed (cutting off several figures from the product on account of the decimals), then the result will be the value sought. For example: the present value of 10,000/. to be received ten years hence, and the rate of interest five per cent. is equal to .6190 X 10,000 = 6190.00. Again, the present value of 10,000/. due in ten years, the rate of interest being three per cent. is 7.441 X 10,000 = 74411.

REVERSION of series, in algebra, a kind of reversed operation of an infinite series.

REVIEW, in chancery, is used for a bill where a cause has been heard, and a decree thereon signed; but some error in law appearing upon the decree, or new matter being discovered after it was made, this bill is given for a fresh examination into the merits of the case.

REVIEW, in war, is the appearance of an army, or part of an army, in order of battle, and their being viewed by the general, that he may know the condition of the troops.

REVIEW, is also the name of one kind of periodical publications, now too much prostituted (under the shelter of anonymous criticism) to the purposes of the malice of rival authors, and the petty artifice of interested booksellers.

REVISE, among printers, a second or third proof of a sheet to be printed; taken off in order to be compared with the last proof, to see whether all the mistakes marked in it are actually corrected.

REVIVOR, bill of, in chancery, is a bill for reviving a cause, where either of the parties dies after the bill and answer, and before the cause is heard; or if heard, before the decree is inviolate: in which case this bill must be brought, praying that the former proceeding may stand revived, and be put upon the same footing as at the time of the abatement.

REVOCATION, in law, signifies the recalling, or annulling, and making void, some power, grant, deed, &c. made before.

RHACHITIC. See Medicine.
Rhamnus, the buckthorn, a genus of the monogynia order, in the pantanida class of plants; and in the natural method ranking under the forty-third order, dimorne. The calyx is tubulous, with five minute scales along the rim of the stamina; there is no corolla; the fruit is a berry. There are forty-two species; of which the most remarkable are, 1. The catarticus, or common purging buckthorn, growing naturally in some parts of South America, it grows to the height of 12 or 14 feet, with many branches at the extremities. The leaves are oval-lanceolate, finely serrated on the edges, their nerves converging together. The flowers grow in clusters, not crooked foot-wide, and in this species divided into four segments; the fruit is a round black berry, containing four seeds. The juice of the berries is a strong purgative, and is made use of for making the common syrup of buckthorn kept in the shops. The bark is emetic; the juice of the unripe berries with alum dyes yellow; the rips ones a fine green; the bark dyes yellow. The green colour yielded by the berries, called in French the vert du ruisseau, is much esteemed by miniature-painters. Of this species there are two varieties, viz. the dwarf buckthorn, a shrub of about a yard high, columnar, but little show; and the long-leaved dwarf buckthorn, which is a larger shrub, with leaves somewhat larger, but in other respects very similar to the dwarf buckthorn. 2. The lotus has the trunk of the large-leaved or balsam-leaved, the zizyphus or judah; only with this difference: that the fruit is here round, smaller, and more lucious, and at the same time the branches, like those of the palmarum, are neither so stiff as the lotus, nor as the trunk of the Scriptures. This species is very common in the Jereedee and other parts of Bombay; and has been supposed by some to be the same species celebrated in the ancient poems, Homer for its enchanting property; though the latter is more generally supposed to have been a species of Diospyros. It is proper, however, to distinguish between both these shrubs, as a herb often mentioned by the ancients under the name of lotus. They are also different from the Egyptian lotus described by Herodotus; for which see Nymphaea. 3. The fragula, or berry-bearing alder, is a deciduous shrub, a native of England and most of the northern parts of Europe, and affords several varieties. 4. The alpine, rough-leaved fragula, or berry-bearing alder, is also a deciduous shrub, and native of the Alps. It differs in no respect from the common sort, except that it has no thorns, and that it will grow to be rather taller, with tough, large, and double laciniated leaves. The alpine fragula is a variety of this species, with smooth leaves and of a lower growth. 5. The paliurus, or thorn of Christ, a deciduous shrub or tree, a native of Palestine, Spain, Portugal, and Italy. It will grow to reach the height of 14 feet, and is armed with sharp thorns, two of which are situated at each joint, one is about half an inch long, straight, and upright; the other is scarcely half that length, and bent backward; and between them is the bud for the next years growth. This plant (says Houttyn) is undoubtedly the sort of which the crown of thorns for our blessed Saviour was composed. 6. The common alaternus is an evergreen tree, and native of the south of Europe. There are several varieties of this species; the most remarkable of which are the broad-leaved and the jagged-leaved alaternus, which have all been confounded with the phillyrea. 7. The insectivaler, or caperberry alaternus, is an evergreen shrub or tree, and native of Spain. It grows to the height of ten or twelve feet, and sends forth several branches from the base of the trunk. They are covered with a blackish or dark-coloured bark, and each of them is terminated by a long sharp thorn. The fruit continues on the trees all winter, making a beautiful appearance among the narrow clustered leaves at that season. 8. The oleoides, or olive-leaved buck horn, is an evergreen shrub, and native of Spain, and grows to the height of eight or ten feet. It sends forth numerous branches, each of which is the bed for a long sharp thorn. The flowers are small, of a whitish-green colour, and are succeeded by round black berries.

Rhapis, a genus of the monogynia order, in the pantanida class of plants; and under the fifth order, palmia. There are several varieties of this species; the most remarkable of which is the large-leaved and the jagged-leaved rhapis, of which there is a third variety, the palmia. The calyx is a monophyllous tritid spatha; the corolla monopetalous and tridual. There are two species, viz. 1. The large-leaved, or ground-natan, a native of China; 2. A rare variety, simple-leaved rhapis, a native of California.

Rhea Americana, the American ostrich, in size very little inferior to the common one; and is the bird for a long time illusory. This bird is flat on the top and rounded at the end; the eyes are black, and the lids furnished with hairs; the head is rounded, and covered with downy feathers; the neck is very long, and covered also; from the tip of one wing to that of the other extended, the length is eight feet; but from the want of continuity of the webs of these feathers, and their laxity of texture, the bird is not always able to incline from the ground; it is, however, capable of greatness, assisted itself by their motion in running, which it does very swiftly; the legs are stout, and bear feathers also; the hands, and furnished with three toes, all placed forwards, each having a straight and stout claw as in the casowary; on the heel is a callos knot, serving in place of a back toe; the general colour of the plumage is dull grey mixed with white, inclining to the latter on the under parts; the tail is very short, and not conspicuous, being entirely covered with long loose and floating feathers, having its origin from the lower part of the back and rump, and entirely covering it; the bill and legs are brown.

In respect to manners, it is said to be a very lordly bird; for instance, it flies, which it catches with great dexterity, and will also, like the common ostrich, swallow bits of iron and other trash offered to it. In common with the ostrich of the Old World, it lays its four eggs in the open air, in the same season, each of them holding a quart; but it differs from that bird in many particulars, especially in wanting the callousity of the sternum, and spurs on the wing. With these last the common ostrich is known to defend itself in defect of them, the bird here treated of trusts the feet with such boldness, as to become at once a furious and dangerous antagonist. The female calls its young ones together with a kind of whistling note somewhat similar to that of a man; when young it is very tame, frequently following the first creature it meets with. The flesh of this bird is said to be very unpalatable. It is found in various parts of South America, from Paraguay to Chili, and is known by the name of choique.

Rheidia, a genus of the monogynia order, in the pantanida class of plants; and in the natural method ranking with those of which the order is doubtful. The corolla is tetrapetalous; there is no calyx; and the fruit is a trispernum berry. There is one species, a tree.

HETORIC, in the most extensive sense of the word, denotes the art of composition, or that which enables us to apply language or speech to the best possible advantage. According to etymology, which often affords the most satisfactory explanation, the term signifies the art of pouring forth a stream of sentiment, and communicating with fluency our feelings and thoughts to others. It is derived from the Greek μέλος, to speak; and this again from μία, one, or μίχος, mixture. Another speech of the elocution of Nestor, says

Το και οι νυφινοι μεθοδοσίαν προσθήκατο. (Iliad. I. 49.)

"And out of his mouth flowed a harangue sweeter than honey."

Taken in this point of view, rhetoric will comprehend all polite literature, poetry perhaps excepted, the belles-lettres of the French, the pathetic and pleasant of every kind; compositions whose aim and end is not so much to inform or satisfy the understanding, as to move, incline, and persuade, by addressing the imagination, the affections, and, in some measure, sensation itself.

There cannot be a better rule for composing one more plain and practical, than what is laid down by Cicero, "to consider what is to be said; secondly, how; thirdly, in what words; and, lastly, how it is to be ornamented." We will venture to add, as a supplement even to Cicero, how far it ought to be ornamented.

The matter of any composition does not, properly speaking, fall under the cognizance of rhetoric; any farther than that there is an intimate connection between the subject and the style; and that the sentiments, whatever they are, naturally form, and raise or lower, swell or contract, the diction; on which we shall have occasion to make some observations when we speak of style.

But the second point in Cicero's rule, arrangement or order, is the most important, beyond all comparison, in every species of composition. It is laid down by Cicero, that the mind of the author is seen; the process of his thoughts; the connection of his ideas with one another, and with his main design.

In every composition it is required that there should be some plan or object; just as in every thing we do or say, there is some purpose or intention. All written compositions may be divided into discourse or reasoning, poetry, and history, including both

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narration and description. In all, unity of design is indispensable. In discourse or reasoning, the object is to prove and impress on the mind some truth or series of truths. Here the binding principle is causation; it explains the reason why such and such a thing must be so and so, and cannot be, or reasonably be supposed to be, otherwise. We believe certain things, it is true, on authority, or the testimony of others; but then it must be observed we judge of evidence by reason.

In respect to unity of design, there is a very near resemblance between epic poetry and history. The unity of design and action required in both differs not in kind but in degree. In epic or narrative poetry, the connection among the events related or described is more close and sensible. The narration is not carried on at a uniform rate for a long space of time; and the actors hasten to some remarkable period which satisfies the curiosity of the reader. This difference between the epic poem and history, depends on that particular situation of the imagination and the passions which is supposed in the former. The imagination of both writer and reader is more enlivened, and the passions more inflamed, than in history, civil, political, or literary, poetry. Any species of narration that confines itself to strict truth and reality. The same unity of design that runs through the epopeia, must also run through dramatic works, whether serious or tragic. Even in an ode, though the poet may be hurried from his plan for a time, or perhaps (as is sometimes the case, even with Horace) drop it altogether, there must appear some aim of design at least in the outset.

The connecting principle among the several events or circumstances which form the subject of a poem, may be very different according to the different designs of the poet. The design of a Poet is to produce some work that embraces every fabulous transformation produced by the power of the gods. Thus, his plan is formed upon the connecting principle of resemblance. The subject of poetry forms a distinct article in the present work; but as unity of design is a principle common to all kinds of composition, it saves repetition to glance at poetical as well as rhetorical or practical works, as far as this universal principle in all works of art is concerned.

As there may be different connecting principles in practical, so there may be in history and composition; and in every species of this composition, there must be some connecting principle, some bond of union among the different parts. Even in an epistle communicating or requiring information, there is a unity of design. In grave and serious letters, the subject is naturally and almost necessarily one; and even in the most light and familiar epistles there is this unity: that while they relate to a thousand particular inductions to all the world history, they all of them relate to the situation, circumstances, and feelings, either of the writer, or the friend to whom the letter is addressed. History, the design of which is both interesting and closely attended to, in the eye of the historian states-tered, even in proportion as the composition appears both uninteresting and detached to others. In memoirs and anecdotes too, we seek to know when and where certain materials for building an edifice, there is activity of design, in as much as they relate to some one person, or class of persons, some distinct time or period, or some place or country. Thus we have Memoirs of Frederick the Great of Prussia, Curious Collections relating to the State of Society in the Middle Ages, Court- and Empire of Russia. In biography, the unity of design is manifest. That there is an unity of design in natural history, consisting chiefly in classification as well as description, needs no illustration. But the grand province of history, and what is generally understood by the term, is

**History civil and political.** The state, progress, or vicissitude of society, in any particular period or country, in government, science, art, manners, and general civilization. The analyst, in his collections, or rather selections, (for it is not as absurd, nor as it is possible, to record of all things, guided by the connection of contingency in time or place, the philosophical, the true, and legitimate historian, by that of cause and effect. He traces the series of actions, accounted for by the order,复古至 their secret springs and principles, and delineates their most remote consequences. He chooses for his subject a certain portion of that great train of events which compose the history of mankind, in which link in this chain be endeavours to touch in his narration. Sometimes unavoidable ignorance renders all his attempts fruitless; sometimes he supplies at conjecture what is want of knowledge, and always he is sensible that the more broken the chain is, which he presents to his readers, the more perfect is his production. He sees that the knowledge of causes is not only the indispensable, (this relation or connection being the strongest of all); but also the most instructive: hence it is by this knowledge alone, that we are enabled to controvert events and govern the future." Hume’s Essay.

The matter of a composition being prepared, and the general design formed, the next thing to be considered is

**The order of arrangement of the parts of a composition.** And first of all, on this head, it may be observed that the authors of written compositions, usually, as is very natural and proper, set out with an introduction, whether in the form of a letter, or address to the reader, separate from the body of the work, or in the beginning of the work itself, without any distinction or separation. If the composition is addressed to the ear, the orator bespeaks the candid attention of his hearers by removing any prejudices they may be supposed to have conceived, and shewing the interest and importance of the subject of his discourse. He considers well what is the state or tone of mind of his hearers. To this he addresses himself in the first place; and endeavours to carry them along with him from one step to another, till through a train of reasoning he arrives at the conclusion. There is a familiar illustration of the nature and use of an introduction or exordium to be met with every day in our house of commons, where considerations often assure the house, when it begins to grow late, when or from any other cause, it betrays symptoms of impatience or inattention, that "they will not trespass on their time for more than a very few minutes;" the writer of a discourse or essay bespeaks the candid attention of his readers, by giving some general account of the nature of his design. It is a question in history or philosophy, that is, concerning either matter of fact, or relations of ideas, he follows up his introduction immediately with the history or the controversy. In some instances this statement and history are the only introduction; and, indeed, if the question is universally and highly interesting, there is no other introduction necessary: there can be none better. It is not only in doctrinal or didactic subjects that some introduction is required, but also in even in most poetical, especially the epic, and historical compositions. The poet announces and gives an outline of his subject and design at the outset of his work, in order to interest his reader in its farther development. He awakens curiosity by some of the most striking events in his narrative. Thus Homer tells you at once that he sings of the wrath of Achilles:

"That wrath which hurl'd to Pluto's dreary reign,
The souls of mighty chiefs, untimely slain."

Thus, in the Odyssey, he interests us in his design by a glimpse of the character of Ulysses, and his adventures after the redemption of Troy. Thus Virgil, having introduced us to the reader, by letting him know who he is, in the first book of the Aeneid gives a summary view of the hardships, sufferings, and designs of Aeneas. He introduces him first near the period when his designs were established; and so of the designs which could not fail to interest every Roman, and afterwards shews, as in perspective, the more distant events, circumstances, and causes, that led to their formation, and crowned them with success. Thus Milton interests the Christian reader by letting him know in the outset of Paradise Lost, that he sings

"Of man's first disobedience, and the fruit Of that forbidden tree whose mortal taste Brought death into the world, and all our woe, With loss of Eden, till one greater man Restore us, and regain the blissful seat."

Thus, also, Virgil announces his different designs in the exordium of his different books of Georgies; and thus also Thomson, in his Seasons.

In dramatic pieces there is no annunciation of a design, because suspension is kept up till the catastrophe. In tragedy, the design is, however, partly announced by the very name or names of the illustrious heroes or princes to whom it relates; and in comedy, the design is in some measure frequently expressed in the title; as In Love for Love; The Bussy-body; The Taming of the Shrew; The Careless Husband; the Jealous Wife; the School for Scandal. So there can be none better.

With regard to that most extensive and important branch of composition, civil and political history, here too an introduction or annunciation of the design is as natural as in the epopeia, and it may be added, it is precisely of the same kind. The general effect or impression, the most striking events, truth, inference, or moral, that remains uppermost in the mind, after reviewing any series of events, and which serves as a bond of union among the occurrences and transactions.
which the historian invades in the stream of his narrative, implies him, it is supposed, to communicate his views, sentiments, and emotions, to others. It is natural therefore, and as it is natural it is expected, that the historian, in most cases, should introduce his work by glancing at the importance and the nature of his main design or object. Thus Livy, in his much admired and truly admirable exercise of his design of inquiring into the cause by which the Roman empire was extended over the world, and reached to such a pitch of greatness that it seemed to tatter under its own weight. The design was noble and clear. There was no more distraction of it could not but draw attention. Thus Sallust chooses for a subject the Catilinarian conspiracy, because it was "in the highest degree memorable on account of the singularity, and the danger involved in the enormous crime." Thus also he writes an account of the Jugurthine war: "first, because it was great and terrible, and the success various; and secondly, because a check was then given, for the first time, to the pretensions of the nobility." In both cases he makes an apology for retiring from political life, and employing himself in the composition of history.

2. In didactic discourse, the speaker or writer, after an introduction, states the truth which he proposes to prove or illustrate, and also the chief propositions or points, by the establishment of which he forms his conclusion. This serves to keep up the attention of the hearer or reader to the main object, and the connection or dependance of this on the intermediate or subordinate propositions; but the heads must not be too many, for otherwise they would run into the embarrassment of multiplicity, and in fact cease to be heads.

3. As to the disposition of arguments, or order of placing them, it is proper, after proving your own position, to refute the arguments urged by gainsayers or adversaries.

Lastly, comes the conclusion of the discourse or treatise, or whatever it is called; which consists of two parts: a recapitulation of the principal arguments or circumstances, and an address to the passions.

In oratory too, it is observed by rhetoricians, besides the parts just mentioned, there is room for Digression, transition, and qualification. Where a subject is of itself but entertaining and dry, the orator is restored to the exertion of its powers by amusing digression; which, however, it is evident, should neither be too frequent nor too long, except, indeed, when the cause is very bad, and almost lost for this, in case, it is good economy to divert attention as much as possible from too nice a scrutiny into the subject.

Transitions are defined to be "forms in speech by which orators tell their hearers in a few words both what they have said already, and what they next design to say." When a discourse consists of a considerable number of parts, and especially when these are of considerable length, transitions are necessary; but sometimes, in passing from one thing to another, a very general hint is sufficient.

By amplification the orator enlarges and expatiates on a subject in such a manner as to represent it in the fullest and most comprehensive view, and as an enumeration of instances; he connects his position with a concurrence of various causes, and on the other hand, with a variety of effects; he places things in the light of consideration; he amplifies facts from the circumstances of time, place, and person in the like. To the order of historical composition, the general effect or impression of the whole of the materials, which serves as a bond of union among the events, and which historian weaves into his narrative, serves him also as a clue by which he winds back and unfolds the concatenation of circumstances which produced the grand event, or effect or effects, that first interested and induced him to transmit the whole to posterity. Every legitimate history, as well as epic poems, springs from some important truth or moral, as from its root; and shoots forth into various branches, twigs, leaves, and flowers, that, in the due time, it reproduces, in a manner, that fruitful which gave it birth; until by some issue or catastrophe, it impresses on the mind the doctrine, truth, or moral, which forms its principal object, and as the epic poet, after briefly announcing the subject that fires his soul, does not fly directly and rapidly to the end he has in view, but on the contrary, keeps long on the wing, and aims in his flight to warm the mind and to gratify its vast desires by frequent views of the grandeur, magnificence, and beauty of nature; so the historian diversifies and enriches his narrative with many incidents, circumstances, and episodes; various scenes are opened, various actors introduced, with various characters and manners.

As the historian is guided by his taste and judgment in the selection of his materials, so according to the measure of his taste and judgment he assigns them their place. To the order in which an infinite variety of materials may best be arranged under the eye that contemplates them, the rules or resources of rhetoric scarcely extend. If nothing more, yet certainly nothing better, can be said on the subject of order in general, than what has been said, in the two thousand years ago by Horace, and is still just

"Sit vicrum materiam, vestris qui scribitis, squam Viribus; et versate diu quid ferre recusat, Quid valeant humeri, cui lecta potuerit eres."

Nec facundia desert lacus, nec lucidus ordo.

De Arte Poetica, line 35—41.

"O ye writers! make choice of a subject suited to your powers; and ponder long on what your shoulders are able or not able to bear. Where there is a good choice, neither eloquence nor method will ever be wanting."

This is truth the question is, There is, however, as Horace immediately observes, room for taste or judgment, in the preferring of one order or arrangement of the particulars to another. The efficacy and grace of method consists in knowing when to say any thing, whether on the present, or whether, though pertinent enough to the present, it may not with advantage be reserved to some future occasion." The same just and accomplished critic says elsewhere, more generally.

Scribendi recte, supere principium et fimus.

De Arte Poetica, line 1289.

"The principle and spring of fine writing is good sense."

As good sense will prescribe just order in composition, so also it will suggest just and suitable sentiments.

Style: A style should correspond to the tone of mind of the author, and the tone and temper he wishes to communicate to others. The connection between the tone of mind and the diction is described by the same Roman poet, whose great master was Aristotle, in so just and connected a manner, that we shall content ourselves on the present point with quoting a small part of Horace, and referring our readers to the poet himself. Every subject need have a quintessence of itself. A comic subject does not admit of the pomp of a tragic strain; nor the bloody supple of Thyestes heard to be told in the simple numbers of comedy. Sometimes, however, comedy raises her voice, and Charies roused to anger and rage, gives vent to his sentiments in a high strain of indignation. Tragedians, on the contrary, lower their style to express their grief. It is natural for men to laugh with those that laugh, and weep with those that weep; the human countenance to vary with the sympathetic emotions of joy or sorrow. If you would have me shed tears, you must first shed them yourself. Plaintive words are most correspondent with a dejected look. Threats come well from a person in anger, mirth and pleasantry from a facetious temper, and grave remonstrances from a serious character." See De Arte Poetica, line 90—118.

Though these observations are made here with a reference to poetic, it is manifest that the spirit of them (namely, that language should be suited to the nature of the subject and is applicable to all composition; to common prose, to oratorical prose, to philosophical or didactic prose, and to historical prose; on each of which it is proposed to make a few observations.

But we premise a few remarks on the qualities that should prevail in style in general. They may be reduced to these: 1. purity; 2. elegance and dignity; 3. vigour; 4. harmony; 5. force and a beauty.

Purity consists in the choice of such words and phraseology as are agreeable to the most general and approved usage of the language in which we write. The offences against purity are accordingly divided into two, barbarisms and solecisms: the former respects single words, the latter their construction in sentences. The words and phrases that occur in writings, though in many re-
Spectators estimable, are not all of them pure, but only such as are agreeable to the usage of the approved writers; writers whose works descend from one generation and one age to another, without losing aught of their original interest and beauty. Thus, our English translation of Boccaccio, which is written in a popular style; so are the Spectators and other writings of Mr. Addison, and the letters and prefaces of Mr. Pope. "To purity of style it is necessary not only that it is formed according to the rules of philosophical or universal grammar, but according to the particular genius or idiom of the language in which we write. Thus, though "I see a voice" is allowable in Greek, and occurs in the twelfth verse of the Revelations, it would not be allowed in any original composition in English. Hence as it depends on the purity of a style whether a composition shall not become untranslatable and the away, or penetrate to posterity, and be transmitted to future ages, this, of all the qualities of style, may be considered as the most important. In the present day, in our country, there is a strong want of this, which consists not only of phrases degraded by common and trivial use, but of what may be called vulgar slang (if slang is not indeed an example itself of the abuse here noted), into the debates in pamphlets, and consequently no new or proper epistles, and a deluge of ephemeral histories. What reader of the next century will understand, "it is a hoax; meeting my idea; making up my mind; having the gift of thrift &c. &c. Even Mr. Hume, and other writers of note, especially among his countrymen the Scots, trespass greatly against purity, when they admit into their English style not only Scotchisms, but in many cases, are not generally on their guard, but so many Latin usages and Gallicisms. As to Latinity, this too has been used even immoderately by our great Dr. Johnson. Exegesis, like purity, consists partly in single words, and partly in their construction. As to single words, their force and propriety are to be judged of from the usage of the most generality of our times. The writer, at the period of our writing. For through length of time, words lose their original signification, and assume a new one, which then becomes their proper sense. Thus the word knave antiently signified a servant. In an old English version of the New Testament we find, "Paul, the knave of Jesus Christ." The proper and precise meaning of words, nearly synonymous, is to be distinguished with accuracy. For example; mercy and pity are sometimes confounded; though mercy is, properly speaking, exercised towards an offender, and pity towards one in distress. But though the meaning of all the words in a sentence, considered by themselves, may be very obvious, yet the sense of the whole may be obscured by a disorderly arrangement, of which a very apt and curious example is given by Quintilian. "A certain man, in his will left his heir should erect for him a statue holding a spear made of gold." A question here of great consequence to the heir arose; from the ambiguity of the expression; as it admitted of doubt whether the words, "made of gold," were to be applied to the statue, or to the spear. Care, therefore, must be taken to dispose both the words and parts of a sentence in such a manner as best agrees with their mutual connection and dependance on each other.

**Figure, or energy of style, depends chiefly on brevity and a judicious use of tropes and figures. Brevity consists in the use of general propositions and condensed terms, which are comprised, from a great number of particulars, the enumeration of which weakens a style, as in the material world bodies are weakened by dilatation. The use of figurative language, or tropes and figures, is of very great utility, and is a framework of dignity, and of beauty of style; but we embrace the first casion of making some remarks on its nature.

The ancient rhetoricians, who were fond of multiplying new comparisons, distinguished a trope from a figure; understanding by a trope a change in the usual meaning of words, and by a figure a change or division from the usual mode of constructing them in sentences, but they are generally confounded by the most accurate and purest writers. Both these kinds of changes, however, may be comprehended, even according to the rules of grammar, under the word trope, which occurs in the first book of Greek Ethics. As no language contains a sufficient number of proper words to express all the different conceptions of our minds, tropes were introduced to supply the deficiency; to express new ideas that could not occur naturally in our language. And these tropes contain a sufficient number of proper words to express all the different conceptions of our minds, tropes were introduced to supply the deficiency; to express new ideas that could not occur naturally in our language.

**Irony is a trope in which one thing is said, and the contrary intended. The subjects of irony are all manner of vices and follies, which are sometimes exposed in this way more pleasantly than by any other reason-ing. In irony, the author assumes the air of believing as others do; but by a development of the ground of belief, of the pro and the con, brings out the truth, and leaves the reader himself to draw the conclusion. We listen to the still voice of our own reason and conscience, and secretly condemn our own tenets or our own conduct, while pride and passion might raise a mist that might shade us from the light that should emanate from others. This figure of speech was used so much by Socrates, that he got the appellation of Eiron or Droll. The most perfect specimen of irony in the English language is Swift's Directions to Servants.

**Hyperbole, which exceeds the bounds of strict truth, and represents things as either greater or less than they really are, is the boldest of all tropes. The representation, however, is not made in such a manner as to impose on the hearer. It has always a very considerable effect, even when most extravagant; as it shows, at least, the opinion entertained by the speaker on any subject, in a very strong and striking manner. A hyperbole is a kind of embellishment. We meet with hyperboles even in the Scripture: "I hear you record," says St. Paul in his Epistle to the Galatians, chap. iv. "that if it had been possible ye would have plucked out your own eyes, and have given them to me," and the Evangelist John concludes his Gospel in these words. "There are also many things that Jesus did, which if they should be written every one, I suppose that even the world itself could not contain the books that should be written."

**Climax is a compound sentence in which the different parts or clauses are closely connected, and rise gradually in importance above one another. We have an admirable example of this trope in that passage of sacred writ, where it is said of the "joy of Heaven, that eye hath not seen, nor ear heard, neither hath it entered into the heart of man to conceive what things God hath prepared for them that love him."

**Metonymy is a trope which changes the names of things, either naturally though not essentially united, as the cause for the effect, or the effect for the cause; and. Thus, Mars put for war, Ceres for corn, and Bacchus for wine:

Impulant veteris Bacchi pinguesque farinae.
Virg.

Thus, in common discourse, it is usual to say, "this is such a person's hand, I know his hand," that is his writing.
Yet this was not burlesque; it was intended for a serious and heroic poem. In some instances it would appear as if writers were at pains to study the art of slinking. Mr. Lane Macgregor Buchanan meaning to do great honour, and to excel the isle of Skye, says, that "some of the vassals (of the great families there) are colonels, majors, captains, and lieutenants." Macgregor Buchanan's Defence of the Highlanders, page 86.

Dr. Swift observed the just order in composition when he made the tell the ladies who entertained him in a tavern:

"Had ye been coming stagers, Yourselves might have been treated by captains and by majors.

But it is not only in writers of the very lowest class that we find the antichrist. We have an example of this in Dr. Reid, where he says "the emotion raised by grand objects is awful, solemn, and serious." The order of these epithets should just have been inverted.

Inversion is a figure in speech in which the usual arrangement of words in a sentence, or in a sentence of a compound sentence or period, is inverted. For an example of the first kind, see Nisus in the Iliad, explaining:

"Me, me: adama quic feci; in me convertere ferrum."

"Me, me: here I am who have done the deed; on me turn your steel.

Under extreme agitation the usual process both of thought and speech is interrupted. The language of passion is bold and heretic. The impassioned mind rushes directly to the principal figure or object, from the action to the agent; from the attribute to the substance. Of the second kind, where the mind, though unruffled and composed, and thinking in a regular train, is animated to great conceptions, we have an instance in the first sentence of the Paradise Lost.

Antithesis is the illustration of one thing by another, and is, we presume, universally understood. If an explanation or illustration of it by an example is wanted, the reader is referred to the three last verses of the fourth chapter of St. Paul's Second Epistle to the Corinthians. There cannot be a happier example, and the reader is referred to it in every hand. Neither is it necessary to explain interregation or exclamation. The meaning of these figures is obvious from the very names given to them, and examples occur at every turn in all kinds of composition and discourse, written or spoken.

In an apostrophe, the speaker breaks off from the series of his discourse, and addresses himself to some particular person, present or absent, living or dead, or even to immaterial objects. A line example of apostrophe occurs in the second book of Paradise Lost, line 681-7:

"Whence, and what art thou, execrable shape?"

And a still finer in the fourth book, line 720—35: "Thus at their shady lodge arrived, both stood, Both turn'd, and under open sky ador'd The God that made both sky, and earth, and heaven,"

Which they behold; the moon's resplendent globe, And starry pole: 'Thou also mad'st the night, Maker omnipotent, and thou the day,' &c. See also the much admired apostrophe of Aeneas to his departed father Anchises: "Heu! genitori, omnis cura casisque levamen, Aemilius Anchises; hic me, pater, optime, fœsus Deseris, hest?" Aeneid, lib. iii. line 710.

"Here, alas! I lose my father Anchises, the soother of all my cares, my relief in every misfortune. Here, O thou best of parents! you me overcame with fatigue," &c.

Prosopopeia, or personification, either introduces an absent person as speaking, or one who is dead as if he were alive and present, and speech is attributed to some immaterial being. Ezr supposed that the prophet was writing of the celestial heaven, and could be eternally adored.

Inversion, and other similar figures, often break the usual order of thought, yet the effect is not as bad as it would seem. The sentence, "I found in the book of Job Job," on a review of his own actions, appears from the inaccessibility of men to the judgment of God. It could not be expected of a single poet that he should be possessed of the whirlwind and wind, &c., as in the Book of Job, chap. xxxvii—xlii.

There is not any figure better adapted to the purposes of the higher species of eloquence, that is, the pathetic and sublime, than the prosopopeia, by which the poet or orator may call all nature to his aid; but if it was introduced in any other than a highly impassioned strain, it would lose its effect, and even appear ridiculous. In all things the speaker is to consider well for what he has prepared the hearer.

Did our limits admit, most of our readers, and among these the most cultivated and intelligent, would excuse us from following the ancient rhetoricians, and those who tried in their footsteps, through all the tropes and figures to which the genius of true sublime language is given. A very ancient and highly admired instance of such a kind of nominal existence: sync Tempo, antonuma, litotes, euphemismus, catachresis, metaplexus, asyndeton, pleonasmus, poly- synvcton, antanaclasis, pioce, epizeuxis, &c.

On looking over this long catalogue of words, of so little practical use, we are almost inclined to say with Butler," For all a rhetorician's rules But teach him now to name his tools."

All tropes and figures rise naturally out of a well stored and brilliant imagination, an exuberance of thought, and the diffusive influence of the passions. The poet, the orator, animated himself, expands animation, life, and action to every object that comes in his way. To return now tovigour or energy of style.

How much this is promoted by figurative language will appear from this, that in proportion as the mind labours with any vivid emotion or conception, it is prone to give it a substantial form, to clothe it in metaphorical language. Now, a lively trope conveys not only a livelier, but often a juter idea of an object, than can be communicated by proper words in the most copious paraphrases. Thus, when Virgil calls the two copious two thunderbolts of war, he exhibits a more lively image of the rapid force and success of their arms, than could have been given in plain words. The next-mentioned great quality of style, was Harmony. As in music we require sound, uniformity, variety, and proportion, so we also require them, not only in compositions addressed to the ear, but in written compositions; for the reader considers of what he reads as if it was spoken by himself or by others. His ear, in some measure, runs over the page as well as his eye. Numbers are not confined to poetry; there is a rhythm, though of a more slow and sober kind, in prose. Here too we require sonorousness, uniformity, and variety of cadence. For these purposes there must be an intermixture of long and short words, and long and short sentences. As to the modulation of the voice in speaking, as well as of pronunciation, looks, and gesture, these belong to elocution, of which we have many professors. The sun of the style consists in the power to speak from feeling.—Si vis me here, &c.

The harmony of style is very much promoted by the use and invention of compound words, which any one is at liberty to contrive at pleasure, if he adorns what he supposes to be the language. As an example of all this, we produce a beautiful passage, which is a rural and domestic scene in Thomson's Seasons:

"In the pond The finely-chequered duck before her train Rows gaudily. The stately-sailing swan Give out his snowy plumage to the gale, And arching proud his neck, with oary feet Bears forward fierce, and guards his oiser-Isle Protective of his young. The turkey nigh, Loud-threatening reddens; while the peacock spreads His every-coloured glory to the sun, And swims in radiant majesty along."

Spring, line 773—32.

Nothing can be more harmonious.

Sublimity of style consists in language suitable to sublime emotions. Nay, the more plain and simple the images appear, the greater the surprise, wonder, and astonishment. It sometimes stands forth with rapidity and vehemence, and sometimes, like the tranquility of general views, exhibited in general terms.

As an instance of the power of simplicity in every species of composition that aims at the sublime and beautiful, we may contrast the style and manner of Michael Angelo and Zuccero in painting. Michael Angelo painted his figures naked; Federico Zuccero, who painted the cupola of Florence, peopled it with a multitude of both sexes, extremely well dressed in the fashion of the times. The style of Michael Angelo was sublime and beautiful; that of Zuccero little, and in process of time ridiculous.

Instances of the sublime are so abundant in poetry both sacred and profane, and in oratory, at least by that of the antients, that we leave the task of illustration on these two heads to our readers; but description and narration too, in prose, also admit of the sublime; and here it will be found to consist chiefly in the selection of the grandest objects and most striking circumstances, figurative language, brevity, and, above all, closely connected with brevity, the use of general
of the Active World, Feb. 1797. The metaphor being aptly kept up, gives beauty to the two first sentences here; the last rises into a style somewhat higher.

Having thus treated briefly of the principal qualities of style in general, we come now to a view of the proper character of the orator, as dependent on the different kinds of prose composition, which may be divided into four: the familiar or colloquial, the rhetorical, the philosophical, and the historical.

The "familiar or colloquial style, is that commonly adopted in polished conversation, of letters, meaning epistles, and of written dialogue, comical or serious. The style of conversation should be simple and plain: no elaborate sentences; no affectation of wit or eloquence; scarcely any great attention to grammatical accuracy: at least that attention should never be visible. To repeat what has been said ungrammatically, for the purpose of making oneself heard, is done by some persons, and it is most miserably pedantic. The greatest powers of conversation are shown in the turn and tone of conversation, in an ingenious and pleasing manner, leading it. It is easy to pour forth a show of knowledge, if one is allowed to lead the conversation; not so easy to illustrate any topic extemporaneous. The former shows only reading, the latter learning. There are a kind of babblers, familiarly called cockneys of the conversation, who, having furnished and loaded their memories at home, in set conversations or literary meetings, however denominated, say their lessons to an audience, and display an artificer and ingenuity, which is often imitated, and sometimes intelligently. This great metropolis abounds in illustrations of this position. In letters greater care and preparation is both allowable and required. Of epistolary writing we have some excellent models in the correspondences of Swift, Pope, Arbuthnot, Gay, and other wits of their time; but none, either in England or France, for ease, elegance, and energy of style, and the care observed with the utmost accuracy, to give their epistles of Cicero, Brutus, and other Romans of high rank and cultivated genius. As to written dialogue, the style of this seems to hold a middle ground between the familiar or colloquial, and the rhetorical, which may be divided into three kinds: the style proper for short and popular essays, that for a popular assembly, the senate of bar, and that for the pulpit. The subjects of the first-mentioned species of writing, are moral, critical, or entertaining; the thoughts must be condensed and close, and every thing to be said, said briefly, because the whole work itself is but short, and supposed to be read at some moment of leisure. The style should be plain and simple, that every one may understand it: yet so elegant that to one may be disagreeable who is not disposed to the present model of essays, in every respect, is Mr. Addison's papers in the Spectator, Guardian, and Freeholder.

The style of eloquence proper for a publication, admits of every possible variation or inflection, according to the tone and temper of the auditory, to what they can bear, or what they can listen to. One may be in a posture to sympathize with, rank, and in a humourous strain, or serious, solemn, rapid, impassioned, and vehement. This rule holds in some degree in speeches addressed to juries and to our house of commons. In the house of peers, the orators judge in civil cases, and that branch of the legislature which moderates and checks any effrontery that may appear in the resolutions of the more popular branch, the eloquence of the orator is to be, as it indeed is, more guarded, and better confined.

We have instances of the most pathetic and sublime eloquence among savage tribes. Witness the celebrated address of Logan, an Indian chief, to lord Dunmore, governor of Virginia. The great orators united the bold and unconfined tone of the rudest, with the knowledge and art of the most refined nations. The circumstances of climate, and form of government, in which they were placed, gave rise to the appeal in many, not in few laws, and the appeal in many, not in few instances of eloquence.

The eloquence of the pulpit is altogether of a serious, solemn, pathetic, and sublime cast. Here no rhetorical artifices are either admissible or necessary; the preacher must speak the truth, and nothing but the truth; and truth in such a manner as is increasing and important, so sublime and awful, that they are not to be heightened by any exaggerations of fancy. The language of scripture too, is infinitely more energetic and impressive than that of any human composition. The preacher has only to speak from believing, and to convince his audience that he really believes what he says, by the simplicity, truth, and profound knowledge of his subject and conduct. This is the charm that gave efficacy to the preaching of the bishops and Christian fathers, and success to the missionaries from Rome in modern times. Auditors in every discourse are incomparable, and this will arise out of the subject, treated in a rational and sensible manner. Never was any English divine more esteemed and admired, either as a preacher or a man, than Blackstone. He was an unguarded, disinterested, and unpretending man, who, as he sat in his congregation, while his action, and every look and gesture was adapted to the nature and variety of the subject and conduct.

Philosophical or didactic style. In pure philosophy illustrated by mathematics, nothing more is requisite or proper than purity and perspicuity. But moral philosophy, which is a combination of facts and principles, as natural philosophy is of facts and mathematics, admits of great eloquence, and should be made entertaining as possible.

Historical style. History may be divided into three heads. 1. Natural history. 2. Anecdotes of men. 3. History of voyages and travels. All of them contain, at least, materials for history. 3. Civil history, or the condition, actions, vicissitudes, and improvements of men united in society under different forms of government. To each of
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these there is a style in some measure appropriate, though in all the style should vary with the
variations of the subject. In natural
history, purity or propriety, and perspicuity of style is sufficient; nothing more is required.
But descriptions of natural appearances also
admit of elegance, and even sublimity, as
well as accuracy; of which Buffon furnishes
a pleasing example. It is a pity that so
clear a style, when well used, should be denied
the propriety of his countrymen to mere
theory. His obtrusion of theory, often whimsical and extravagant, is, indeed, so offensive
to a sober inquirer into the productions of
nature, that a strict and severe plausibility
is rather better pleased with the plainsness
of Pliny, and of Linnæus, whose views of both
plants and animals are at once so accurate and so considerable that you are enabled
to contemplate the sublime horrors of this
awful scene." Newt. Tour in England and
Scotland.

On viewing the scene, the reverend
Mr. Hall also raises his tone. "After seeing
the smoke ascending for more than a mile
as I advanced, and then saw the Clyde roaring and raging as if provoked at
resistance. The question started in my
mind, is nature then so basing and noisy in
her productions, or has the air or tone, the
character and passions of the observer, so
affected the fluid of contemplation, that you
contemplate the sublime horrors of this
awful scene." Newt. Tour in Scotland, by
an unusual Route, with a Trip to the Orkneys and Hebrides.

Civil history. This being addressed to
the whole world, to every country and every
generation, to philosophers, legislators, kings and
princes, the general style, air or tone, should be that of dignity; but it should not
be always elevated. It should vary with the
particular subject which is treated, which
may be done without descens into mean
measure.

The historian, Robertson, whose greatest
excellence, and a great excellence it is, con-
sists in the choice and beautiful order in which he deduces events from the causes that
gave them birth, i. e. shape, not sufficiently var-
rions in his style. He never condescends into
garden chor, or by the fireside; he never
descends from his pulpit.

It is to be observed, however, that some
designs admit of greater variety of style than
others. The Abbé St. Réal, who has given
so fine a specimen of the concise and rapid
style, in his History of the Conspicacy of
Venice, had not an opportunity, and could
not of propriety, or matter of his manner, so much as Mr. Hume in his
History of England, with occasional Sketches
of the principal States of Europe for seven hundred Years. Neither Thucydides nor
Sallust, confined by their designs to particu-
lar events and a very short period of time,
could expatiate at leisure on a variety of sub-
jects like Herodotus, who records the com-
ingenious acts of the Greeks and Barbari-
s for a long period of time; the scenes of
which narrative is extended over a consider-
able part of the three grand divisions of the
ancient world, and to a period of two cen-
turies. Thucydides writes the history of a
single war, and the scene of the events is con-
fined generally to the narrow spot of Greece.
The histories of Sallust are still more circumscribed in respect of both action and space.
The events of this great and strongly excited by the contemplation of one great
and approaching catastrophe, the dig-
ning concisness of Thucydides and Sallust,
for the greatest beauty. The arrangement
of Thucydides, his writing in the manner
of the event, and the approach of an event,
are defended in his style, as his subject and
his manner are admirable; yet it must be admitted that the style proper
for different plans or designs in history, admits
of modifications for different genius of
different historians. The retreat of the ten
thousand Greeks was a single event, and
embraced but a small portion of time; yet the
easy, graceful, and southern drawings of Néopomp, the Athenian hero, in an art
so admirable in its kind, though different from the
charming simplicity and melody of Her-
rodotus, the energy of Thucydides, the brevity
of Sallust, the dignity of T icy, and his happy
initiators among the moderns, Marenna and
Buchanan, and the elegant purity and pre-
cision of Julius Caesar. In a word, though
there are certain general qualities of style suited to a great and elevated subject, he is agree-
able熏tinctured, not deformed by a diversity
of genius.

Non una quidem
Nec diversa tamen quidallis decete esse sororum.

Now, to conclude, by recapitulating what
has been now said on the present article.
As speech is the power, so rhetoric is the art
of communicating our sentiments in the
fullest and most impressive manner. As the ends
for which we communicate our sentiments are
various, the form, style, or manner of dis-
course, spoken or written, is different also;
according to the emotions to be expressed
and excited, whether of surprise, com-
placey, admiration, wonder, astonishment,
virtue, ridicule, or scorn. The
first and cardinal point in every composition, is
the master of the subject; to have a clear con-
ception of all that we wish to say. " Out
of the mouth of the heart the mouth spoken." As
the analogies of language are formed before the rules of grammar, so literary works
were composed before the canons of criticism
and rules of rhetoric. These rules are of
more use in preventing the false glare of
turgidty, fustian, bombast, and conceit, than
of avail to inspire the most excellent qualities
of speaking or writing. An attention to these
rules will obviate banishes.

A well-considered, understanding, with a lively imagination and a feeling heart, are the grand sources of
excellent composition: a taste for which may
be further gained by reading the best of the models in the same manner that
the constant contemplation of the best pictures
forms insensibly a just and nice taste for painting; but should never be forgotten
that the highest excellences of skill are attained
where the fire of imagination is smothered by an anxious fear of offending against
any rules; and that the absence of faults and blemishes is dearly bought by the
absence of elegance and every beauty.

RHEUM, a thin serious humour, occasionally coming out of the glands about the
mouth or throat.

RHEUM, rubbhar, a genus of the mono-
gynous order, in the cucurbita class of plants,
and in the natural method ranking under the
12th order, holarrhæce. There is no calyx;
the corolla is sessile and persistent; and there
is one triangular stamen. There are seven
species. The most noted are:

1. The rhipidopodium, or common rubbhar,
as large, thick, fleshy, branching, deep-
striking root, yellow within; crowned by
ever large, rounded, heart-shaped, smooth
leaves, on thick, slightly-furred, foot-
shoots; and an upright strong stem, two
or three feet high, terminated by thick close
spikes of white flowers. It grows in trash
and Seythia, but has been long in the Eng-
lish gardens. Its root affords a gentle purge.
It is, however, of inferior quality to some of
the following sorts; but its young stalks in
spring being cut and peeled, are used for
pars.

2. The palamutum (see Picta Nat. Hist. fig.
346), a palument-leaved true Chinese rubbhar,
as thick fleshy root, yellow within;
crowned by very large, rounded, heart-shaped, smooth
leaves, on thick, slightly-furred, foot-
stalks; and an upright strong stem, five or six feet high or more, termi-
nated by large, soft white flowers. This
is now proved to be the true foreign rubbhar, of
the purgative quality of which is well known.

3. The campactus, or Tartarian rubbhar,
as large, fleshy, branched root, yellow within;
crowned with very large, heart-shaped, somewhat lobed, sharply indented, smooth
leaves, and an upright large stem, five or six feet high, branching above; having all
the branches terminated by nodding panicles of
white flowers. This has been supposed to be
the true rubbhar; which, however, of
superior quality to some sorts, is accounted
inferior to the thorn palamutum.

4. The undulate, undulated or wave-
leaved Chinese rubbhar, has a thick, branching,
deep-striking root, yellow within; crowned
with large, oblong, undulate, somewhat hairy
leaves, having equal foot-shoots, and an
upright strong stem, four or five feet high,
terminating by long loose spikes of white flowers.

5. The ribes, or current rubbhar of Mount
Lubusans, has a thick fleshy root, very broad
leaves, full of stipulated protuberances, and
with equal foot-shoots and branches; three
or four feet high, terminated by spikes
of flowers, succeeded by berry-like seeds,
being surrounded by a purple pulp. All
these plants are perennial in root, and the
leaves and stalks are annual. The roots being thick, sandy, generally divided, strike deep into the ground; of a brownish colour, without roots, the leaves rise in the spring, generally come up in a large head folded together, gradually expanding themselves, having thick, wool-stalks; and grow from one to two feet high, in height, and breadth, spreading till round; amidst them rise the flower-stems, attaining their full height in June, when they flower, and are succeeded by large triangular seeds, ripening in August. Some plants of each sort merit culture in gardens for variety; they will effect a simi-
larly with their luxuriant foliage, spicis, and flowers; and, as medical plants, they demand culture both for private and public use.

They are generally propagated by seeds sown in spring, or as soon as they are ripe, or early in the spring, in any open bed of light, deep earth. Scatter the seeds thinly, either by broad-cast all over the surface, and raked well in, or in shallow drills a foot and a half apart, and a half inch deep. The plants will rise in the spring, but not flower till the second or third year: when they are come up two or three inches high, thin them to eight or ten inches wide, and clear the ground through those designed always to stand will afterwards be hoed out to a foot and a half or two feet distance, observing if any are required for the pleasure-
ground, &c. for variety, they should be transplant ed, where they are to remain in autumn, when their leaves decay, or early in spring, before they shoot: the others re-
maining where some must have the ground kept clean between them; and in autumn, when the leaves and stalks decay, cut them down, and slightly dig the ground between the rows of plants, repeating the same work every year. The roots remaining, they increase naturally; and in the second or third year many of them will shoot up stalks, flower, and perfect seeds; and in three or four years the roots will be arrived to a large size, though older roots are generally prefer-
ed for both.
Rhinoceros, is found in various parts of Africa, and seems to have been the kind which was known to the ancient Romans, and by them cultivated in public gardens, and in combats of animals. In size it equals that of the common single-horned species; and its habits and manner of feeding are the same; but it differs greatly in the appearance of its skin, which, instead of the ordinary marked armour-like folds of the former, is merely a very slight wrinkle across the shoulders, and on the hinder parts with a few fainter wrinkles on the sides, so that, in comparison with the common rhinoceros, it appears almost smooth; the skin, however, is rough or tuberculated, especially in the larger species; but what constitutes the specific or principal distinction is, that the nose is furnished with two holes. In size it is smaller than the other, and situated above it, or higher up on the front. These horns are said to be loose when the animal is in a quiet state, but become firm and immovable when it is enraged. This observation is confirmed by Dr. Sparrman, who observed, in a specimen which he shot in Africa, that they were fixed to the nose by a strong appendix, or tendons, so as to allow the animal the power of elevating them at any time according to the fixture on proper occasions. This, indeed, is treated by Mr. Bruce, the celebrated Abyssinian traveller, as an absurd idea; but, on the contrary, I think, these additional horns, which are surrounded by the rains, trees of a softer consistence, and of a very succulent quality, which seem to be destined for his principal food. For the purpose of gaining the highest branches of these trees, his upper lip is so elastic, and of a bending property, as to be shot out so as to increase his power of laying hold with this in the same manner as the elephant does with his trunk. With this lip, and the additional horns, he can reach the upper branches which have most leaves, and these he devours first; having stripped the tree of its branches, he does not, therefore, abandon it; but, placing his snout as low in the trunk as he finds his horns will carry, he rolls up the body of the tree, and reduces it to thin pieces like so many laths; and when he has thus prepared it, he embraces as much of it as he can in his monstrous jaws, and twists it round with such exquisiteness as an ox would do a root of celery, or any such potato or garden-stuff.

When pursued, and in fear, he possesses an astonishing degree of swiftness, considering his size, the rapidity with which he runs, the great extent of his body, his great weight before, and the slenderness of his legs. He is long, and has a kind of trot, which, after a few minutes, increases in a great proportion, and makes him pass a surprising distance; but this is the way he is understood with a degree of moderation. It is not true, that in a plain he can beat the horses in swiftness. I have passed him with ease, and seen many savage mounted do the same, and, though it is certainly true that a horse can very seldom come up with him, this is owing to his cunning but not his swiftness.

The eyes of the rhinoceros are very small, and he seldom turns his head, and the horse sees nothing before him. To this he owes his death, and never escapes if there is so much plain as to enable the horse to get before him. His pride and fury, then, make him lay aside all thoughts of escaping, but by victory over his enemy. He stands for a moment at bay, then, at a start, runs straight forward at the horse like the wild boar, whom, in his manner of action, he is not so much resembles. The horse easily avoids him by turning short aside, and this is the fatal instant: the naked man, with the sword, drops from behind the principal horseman, and, unseated by the rhinoceros, who is seeking his enemy, the horse, he gives him a stroke across the tendon of the heel, which renders him incapable of further flight or resistance.

In speaking of the great quantity of food necessary to support this enormous mass, we shall consider the vast quantity of water which he needs. No country but that of the Shanghills, which he possesses, deluged with six month's rain, and full of large and deep basins, made in the living rock, and shaded by dark woody vegetation, or watered by long and deep rivers, which never fall low or to a state of dryness, can supply the vast drafts of this monstrous animal. But it is not that drinking alone that he frequents the marsh and marshy places: large, fleshy, and strong, as he is, he must submit to prepare himself against the weakest of all adversaries. The great consumption he constantly makes of water necessarily confines him to certain limited spaces; for it is not every place that can maintain him; he cannot emigrate, or seek his defence among the sands of Abarah.

The adversary just mentioned is a fly (probably of the genus.Runicus), which attacks the rhinoceros, as well as the camel and many other animals, and would, according to Mr. Bruce, as easily subdue him, but for the strategem which he practises of rolling himself up, or being made by night, into a ring, besides he clothes himself in a kind of case, which defends him from his adversary the following day. The pleasure that he receives from being in the midst of a cloud of dust, the darkness of the night, deprive of his usual vigilance and attention. The hunters steal secretly upon him, and lying on the ground wounding him with their javelins, mostly in the belly, where the wound is mortal.

RHINOMACER, a genus of insects of the order coleoptera. The generic character, antennae setisegous, seated on the snout; feelers four, growing thicker towards the end, the last joint truncate. There are three species: the curculio, that inhabits Italy: the attehnoides, that inhabits Sweden: and the ceratodes, found in Calabria.

RHIZOBALUS. A genus of the tereyzyz-morsen, in the polycandia class of plants, and in the natural method ranking under the 24th order, trinitia. The calyx is monozyzyzyzy, phylly, and downy; the corolla consists of five petals, which are round, conoical, phylly, and much larger than the calyx, white, conspicuous, filiform, and longer than the corolla: the stile are four, filiform, and of the length of the stamina; the pericarpum his four drugy, kidney-shaped, compressed, with a fleshy subcutaneous coat, mastic, but not a continuous, root inzg a kidney-shaped kernel.

Of this there are two species: the most remarkable is the peka. The nut is sold in the shops as American nuts: they are flat, tu- bulees, and kidney-shaped, having a kernel of the same shape, which is sweet and agreeable.

RHIZOPHORA, the mangrove or mangle, a genus of the monogyzy, order in the doceandia class of plants, and in the natural method ranking under the 12th order, holozal. The calyx is quadrangulate, the corolla four-petalled; there is one seed, very long, and carnous at the base. There are six species.

These plants are natives of the East and West Indies, and often grow 40 or 50 feet high. They grow only in water and on the bays of the sea. They advance a day. They preserve the verdure of their leaves throughout the year. From the lowest branches issue long roots, which hang down to the water, and penetrate into it, so as to constitute this position almost a kind of natural and transparent terrace, raised with such solidity over the water, that one might walk upon them, was it not that the branches are too much incumbered with leaves. The most common method, however, is that of laying the small lower branches in baskets of mould or earth till they have taken root.

The description just given pertains chiefly to a particular species of mangrove, R. magnolia, denoted by the West Indians black mangroves, on account of the brown dusky colour of the wood. The bark is very brown, smooth, and generally used in the West Indies for tanning of leather. Insence bark has leaves, and those of the same size, but is lighter, thinner, and more tender. The wood is nearly of the same colour as the bark: hard, plant, and very heavy. It is frequently used for fuel; the fires which are made of this wood being both clearer, more ardent and durable, than those made of any other materials whatever. The wood is almost incorruptible, never splinters, is easily worked, and is not, for its enormous weight, would be commodiously employed in almost all kinds of work, as it possesses every property of good timber. To the roots and branches of mangroves that are immersed in the water, and frequently attach themselves, so that wherever this curious plant is found growing on the sea-shore, oyster-fishing is very easy; as in such cases these shell-fish may be literally said to be set.
from all parts of the trunk. The bark is slender, of a brown colour, and, when young, is smooth, and adheres very closely to the wood; it when old, splits or cracks, and is easily detached from it. Under this bark is a skin as thick as parchment, red, and adhering closely to the wood, from which it cannot be detached till the tree is Killed and dried. The wood, when split open, is heavy, of a deep red, with a very fine grain. The pit or heart of the wood being cut into small pieces, and boiled in water, imparts a very pleasant and tincture very light and brittle. This species is generally called upon grove, from the use to which the bark is applied by the inhabitants of the West Indies. This bark, which, from the great abundance of surface is easily detached when green from the wood, is beaten or bruised between two stones, until the hard and woody part is totally separated from that which is soft and tender. This last, which is the true cortical substance, is divided into narrow, interlaced, or curled, of unequal size, and are exceedingly strong, and not apt to rot in the water.

**RHODIOLA, rosea-wort, a genus of the Caprifoliaceae order, in the Dioceta class of plants, and in the natural method ranking under the 13th order, succulent.** The male calyx is quadripartite, the corolla tetrapetalous. The female calyx is quadripartit and there is no corolla. The nectar is four; the pistils four; and the anthers four. There are two species, the rosea and the bibernata: the first grows naturally in the cliffs of the rocks and rugged mountains of China, and the Westfalia. It has a very thick fleshy root, which, when bruised or bruised sends out an odour like roses. It has thick succulent stalks, like those of the pine, about nine inches long, with thick succulent leaves united at the top. This shrub is terminated by a cluster of yellowish herbaaceous flowers, which have an agreeable scent, but are of short continuance. The second sort is a native of Cochlin China. Both species are easily propagated by parting their roots, and require a shady situation and dry unduged soil. The fragrance of the first species, however, is greatly diminished by cultivation.

**RHODODENDRUM, dwarf rose-bay, a genus of the monogynia order, in the decidua class of plants, and in the natural method ranking under the 18th order, becomes.** The calyx is quinqupartite; the corolla funnel-shaped; the stamens declinating; the capsule quinquelocular. There are nine species; the most remarkable of which are

1. The hirsutum, with asked hairy leaves, grows naturally on the Alps and several moun-

tains of Italy. It is a low shrub, which seldom rises two feet high, sending out many vigorous branches covered with a light-brown bark, and growing pretty close to the branches. They are hairy, having a great number of fine iron-coloured hairs on their edges and underside. The flowers are produced in bunches at the end of the wood, and usually one four scanty petal cut off into five oblong segments, and of a pale-red colour.

2. The fennugreek, with smooth leaves, hairy on their under side, is a native of the Alps and Apenines. It is a small shrub, and covered with barbed iron-coloured hairs, and grows upon rocks in cold and dry situations, and is seldom found near the sea. The bark is grey; the wood, as we have said, white, and when green, supple; but dries as soon as cut down. It becomes very light and brittle. This species is generally called upon grove, from the use to which the bark is applied by the inhabitants of the West Indies. This bark, which, from the great abundance of surface is easily detached when green from the wood, is beaten or bruised between two stones, until the hard and woody part is totally separated from that which is soft and tender. This last, which is the true cortical substance, is divided into narrow, interlaced, or curled, of unequal size, and are exceedingly strong, and not apt to rot in the water.

3. The chamissonis, or ciliated-leaved dwarf rose-bay, is a low deciduous shrub, native of mount Baldus, and near Salzburg, in Germany. It grows to the height of about a foot; the branches are numerous, produced irregularly, and covered with a purplish bark. The leaves are oval, spear-shaped, small, and in the under surface of the colour of iron. The flower is produced at the end of the branches in bunches, of a wheel-shaped figure, pretty large, of a fine crimson colour, and handsome appearance. They appear in July.

4. The dauriam, or Daurian dwarf rose-bay, is a low deciduous shrub, and native of Dauria. Its branches are numerous, and covered with a brownish bark. The flowers are wheel-shaped, large, and of a beautiful rose-colour; they appear in May, and are succeeded by oval capsules full of seeds, which in England do not always ripen.

5. The maximum, or American mountain laurel, is a deciduous shrub, and native of Virginia, where it grows usually on the sides of the highest mountains, and on the edges of cliffs, precipices, &c. where it reaches the size of a moderate tree, though with us it seldom rises higher than six feet. The flowers continue by succession sometimes more than two months, and are succeeded by oval capsules full of seeds.

6. The pectinum, or pontic dwarf rose-bay, is an evergreen shrub, native of the East, and of most shady places near Gibraltar. It grows to the height of four or five feet. The leaves are spear-shaped, glossy on both sides, and placed on short foot-stalks on the branches: the flowers, which are produced in clusters, are bell-shaped, and of a fine purple colour. They appear in July, and are succeeded by oval capsules, which in England seldom attain to maturity.

In Siberia, a species of this plant is used with great success in gouty and rheumatic affections; and the inhabitants of Siberia call it shrub, from which they take it for want of a common word to express it, as we do the Chinese plant of that name. This practice shows that the plant, used in small quantities, must be innocent.

**RHODORA, a genus of the decandria monogynia order, in the natural method ranking with those that are doubtful.** There is no calyx; the petals are four, oblong, obtuse, and narrowing at the base; the stamens are four, inserted in the corolla, and having large anthers; the seed-vessel unicellular, and contains one seed. There are only two species. The montana is a shrubly plant growing in Guiana, and remarkable for the great number of branches sent off from its trunk in every direction, and for the fetal smell of the wood and bark of this plant. The other is a native of Cayenne.

**RHOMBOIDES.** See Geometry.

**RHOMBIUS.** See Geometry.

**RHUBARB.** See Rheum, and Pharc.

**RHUMB, in navigation, a vertical circle of any given place, or the intersection of such a circle with the horizon; in which last sense rhumb is the same with a point of the compass.

**RHUM-B-LINE, is also used for the line which a ship describes when sailing in the same collateral point of the compass, or oblique to the meridians. See Navigation.**

**RIUS, sumach, a genus of the trigynia order, in the pentandria class of plants, and in the natural method ranking under the 43rd order, domose. The calyx is quinqupartite; the petals five; the berry monospermous. There are 33 species, of which the most remarkable are

1. The coriaria, or elms-leaved sumach, grows naturally in Italy, Spain, Turkey, Syria, and Palestine. The branches of this tree are used instead of oak-bark for tanning of leather; and it is said that the Turkey leather is all tanned with this shrub. It has a fig-like stalk, which divides at bottom into many irregular branches, rising to the height of eight or ten feet; the bark is hairy, of a herbaceous brown colour: the leaves are winged, composed of seven or eight pair of foliæ, terminated by an old one, blunted on their edges, hairy on their under side, of a yellowish-green colour, and placed alternately on the branches; the flowers grow in loose panicles on the end of the branches, which are of a whish herbaceous colour, each panicle being composed of several spikes of flowers sitting close to the footstalks. The leaves and seeds of this sort are used in medicine, and are esteemed very restringent in the stomach.

2. The typhulium, Virginian sumach, or vinegar-plant, grows naturally in almost every part of North America. This has a woody stem with many irregular branches, which are generally crooked and deformed. The young branches are covered with a soft velvety-like down, resembling greatly that of a young stag's horn, both in colour and texture, to which the species have given it the appellation of stag's horn. The leaves are winged, composed of six or seven pair of cal-

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*Note: The text seems to be a mix of different sections, possibly from various botanical sources, and may not form a coherent whole.*
long heart-shaped lobes. The flowers are produced in close tufts at the end of the branches, and are succeeded by seeds, enclosed in purple woolly succulent covers, so that the branches are of a beautiful purple colour in a green hedge, and after they fall in autumn, change to a purplish colour at first, and before they fall to a feathery muri. It has got the name of the vinegar-plant from the double reason of the young greenish-garlic, which is terminated by producing either new or adding to the strength of old weak vinegar, whilst its ripe berries afford an agreeable acid, which might supply the place when necessary of the lime used for pickling. The powerful astrinency of this plant in all its parts recommends it as useful in several of the arts. As for example, the ripe berries baled with alum make a good dye for hats.

The plant being the natural successor of oak-bark in tanning, especially the white glove-leather. It will likewise answer to prepare a dye for black, green, and yellow colours; and with martial vitrul it makes a good paint. It flows from incisions made in the trunk or branches, makes, when dried, the basis of a varnish little inferior to the Chinese. Bees are remarkably fond of its flowers; and it abounds most of May in the flowering shrubs. The natives of America use the dried leaves as tobacco.

3. The glabrum, with winged leaves, grows naturally in North America. This is commonly called by the gardeners New England swinch. The stem of this is stronger and rises higher than that of the former; the branches spread more horizontally; the leaves, covered with greyish powdery wax, are also the foot-stalks of the leaves. The leaves are composed of seven or eight pairs of lobes terminated by an old one. The undersides of the lobes are of a dark green, and their under hairy but smooth. The flowers are produced at the end of the branches in very close panicles, which are large, and of a bright red colour.

5. The capsulina, or narrow-leaved swinch, grows naturally in many parts of North America, where it is known by the titles of beach swinch, probably from the place where it grows. This is of humber height even. The leaves are seldom rising more than four or five feet high in Britain, dividing into many spreading branches, which are smooth, of a light brown colour, with winged leaves, composed of four or five pairs of narrow leaves, Terminated by an old one. The leaves are of a light green on both sides. The flowers are produced in loose panicles at the end of the branches, of a yellowish herbaceous colour.

These are hardy plants, and will thrive in the open air here. The first and fourth sorts are not quite so hardy as the others, so must have a better situation, otherwise their branches will be injured by severe frost in the winter.

6. Besides these, Limnanthes has included in this genus the toxoodendron, or poison tree, under the name of rhois vernis, or poison-ash. This grows naturally in Virginia, Pennsylvania, New England, Carolina, and Japan, and is a strong woody stalk to the height of twenty feet and upwards; though in this country it is seldom seen above twelve, by reason of the plant's being extremely tender. The bark is brown, inclining to grey; the leaves are a compound of three or four pairs of lobes, terminated by an odd one. The leaves vary greatly in all the plant, but for the most part they are oval and spear-shaped. The foot-stalks become of a bright purple towards the latter part of summer, and in autumn all the leaves are of a beautiful purple before they fall off. All the species of sumach abound with an acid malleable juice, which is reckoned poisonous; but this property is most remarkable in the vernis.

The natives are said to distinguish this tree in the dark by its extreme coldness to the touch. The juice of some sorts of sumachs, when exposed to the heat of the sun, becomes so thick and clumsy, that it is used for bird-line, and the insipid juice of the poison-ash is said to be the fine varnish of the Chinese. The juice of the poison-ash, applied to the feet, is said by Hughes, in his Natural History of Barbados, to drive the vermin caused by the West Indians. The resin called gum sumach is from the rhois capsulina. See Corallia.

RHYME. See Poetry.
RHYTHMICAL, in music, an epitaph applied to the property or quality, in the antient melopoeia and modern melody, by which the cadences, accents, and quantities, are regulated and determined.

RIAL, or RIAL. See Coin.
RiAL, or RIAL. See Coin.
RIDELAND, or RIBBAN, a narrow sort of silk, chiefly used for head-ornaments, badges of chivalry.
RIBES, the currant and gooseberry-bush, a genus of the monogynia order, in the pen-tandria class of plants, and in the natural method ranking under the 47th order, stellate. The calyx is sepulchrate; the corolla monopetalous and sub-spherical; and there are three seeds. There is one species, a herb of Great Britain.
RICHIERIA, a genus of the class and order Dioscoria, pantanaria. The capsule is cotyled, six-valved, three-celled; seeds solitary; stile triphal. There is one species, a tree of the West Indies.
RICINUS, or PALMA CHRISTI, a genus of the monadelphia order, in the monadina class of plants, and in the natural method ranking under the 38th order, tricoceae. The male calyx is quinquipartite; there is no corolla, the staminodia are three. The female calyx is tripartite; there is no corolla, but three bifid styles, with a triocular capsule, and a single seed. There are six species, of which the most remarkable is the common, R. Christi. This tree is of speedy growth, and in one year it attains at its full height, which seldom exceeds twenty feet. The trunk is subglobeous; the pith is large; the leaves broad and palmated; the flower-spike is simple, and thickly set with yellow blossoms in the shape of a cone; the capsules are triangular and prickly, containing three smooth grey mottled seeds. When the fruits begin to turn black, they are gathered, dried in the sun, and the seeds picked.
out. They are afterwards put up for use as wanted, or for exportation.

Caster oil is obtained either by expression or by distillation. The first method is practised in England; the latter in Jamaica. It is common first to parch the nuts or seeds in an iron pot over the fire; but this gives the oil an empyreumatic taste, smell, and colour; and it is best prepared in the following manner: A large iron cast-iron of boil is first prepared, and half-filled with water. The nuts are then thrown in, boiling in pieces in deep wooden mortars, and after a quantity is beaten, it is thrown into the iron vessel. The fire is then lighted, and the larriq slowly but powerfully two hours, and kept constantly stirred. About this time the oil begins to separate, and swims on the top, mixed with a white froth, and is skimmed off till no more rises. The skimmed oil is set aside in a large barrel and strained through a cloth. When cold, it is put up in jars or bottles for use.

Caster oil, thus made, is clear and well flavoured, and if put into proper bottles will keep for years. The expressed or castor oil soon turns rancid, because the mucilaginous and acid parts of the nut are squeezed out with the oil. On this account the preference is given to well-prepared oil by decoction. A gallon of the seeds yields about two pounds of oil, which is a great proportion.

Before the disturbances in America, the planters imported train oil for lamps and other purposes about sugar-work. It is now found that the castor oil can be procured as cheap as the fish oil of America. It burns clearer, and has not any offensive smell. This oil takes all the colours of the painter, or for the apothecary in ointments and plasters. As a medicine, it purges without stimulus, and is so mild as to be given to infants soon after birth. All oils arenoxious to the skin, as castor oil, which makes easy to them. It is generally given as a purge after using the cabbage-bark some days.

The ricinus Americanus grows as tall as a little tree, and is so beautiful that Miller says it is a plant in every garden worth having, and he planted it himself in Chelsea. It expands into many branches; the leaves are sometimes two feet in diameter, and the stem as large as a middle-sized brown-staff; towards the top of the branch it has a cluster of flowers, somewhat resembling a bunch of grapes; the flowers are small and stigmatic, but on the body of the plant grow bunches of rough triangular hooks, each containing three speckled seeds, generally somewhat less than horsebeans; the shell is brittle, and contains white kernels of a sweet, oily, and nauseous taste. From this kernel the oil is extracted; and if the medicine should become official, the seeds may be imported at a reasonable rate, as the plant grows wild and in great plenty in all the British and French Antilles.

Of the ricinus communes, there are a great many varieties; all of them fine majestic plants, annual, or at most biennial, in this country; but in their native soil they are said to grow to the height of a tree. They are propagated by seeds sown on a hotbed, and require the same treatment as other tender exotics.

RICETTS. See INFANCY.

RICOTIA, a genus of the siliquose order, in the tetradynamia class of plants, and in the natural method ranking under the 30th order, siliqua. The siliqua is unilocular, oblong, and compressed, with thin valves. There is one species.

RIDING, in the sea language, is a term variously applied: thus, a ship is said to ride, when her anchors hold her fast, so that she does not drive by the force either of the wind or tide. A ship is said to ride across, when she is at anchor, her head or stern directed up to the hounds, and both yards and arms topped alike. She is said to ride well, when she is built so as not to overcast herself in a head-swat or ebb tide, nor to turn her from stem to stern. To ride athwart, is to ride with her side to the tide. To ride betwixt wind and tide, is to ride so that the wind has equal force over her one way, and the tide the other, and to have more power over the ship than the tide, she is said to ride wind-road, or to ride a great wind.

RIDING-CLERK, one of the six clerks in charge of a vessel; he is, in his turn, annually keeps the log, and publishes the control-loots of all books that pass the great seal that year.

RIESARME, in law, is a plan used in an account of debts or receivages of accounts, by which the defendant alights, there is nothing in arrear.

RIFLE, a fire-arm which has the inside of its barrel cut with from three to nine lines or grooves. The number of these grooves differs according to the size of the barrel and fancy of the workman. All these grooves are not regulated by any invariable rule.

Rides are said to have been known as far back as the middle of the sixteenth century. See Plate Riff, &c., fig. 1, which represents a cast taken of the inside of a rifled-barrel thirty inches long and $\frac{1}{2}$ of an inch in diameter, and in which the grooves take one turn in the whole length. It will of course be observed, that the ribs in the drawing represent the grooves in the rifle. The method of loading them is as follows:

When the proper quantity of powder (one drachm avariopeus) is put down at the muzzle, and a piece of calico or linen cloth is folded over it as a wad, a circular piece of strong calico is grooved on one side, and laid on the mouth of the piece with the grease side downwards; and a bullet of the right size as the bore of the piece, before the grooves were cut, being placed upon it, is then forced gently down the barrel with it; by which means, the calico includes the lower half of the bullet: and by its interposition between the bullet and the grooves, prevents the lead from being cut by them, and by means of the grease side down, without it being necessary to use any violent efforts, which would destroy the circular shape of the bullet.

In order to the cause of the superiority of a rifle-barrel gun over one with a smooth barrel, it will be necessary to refer to Mr. Robins's discovery of the cause of the irregularities which occur in the flight of shot, or smooth-bore balls, which we shall give in his own words, Tracts on Gunny, p. 156, &c.

Almost every projectile, besides the forces we have hitherto considered, namely, its weight, in this period of the air which directly opposes its motion, is affected by a third force which acts obliquely to its motion, and in a variable direction; and this consequently deflects the projectile from its rectilinear, and will be increased in that part of the plane in which it began to move; impelling it sometimes to one side, and sometimes to the other, occupying thereby very great intervals of the repeated ranges of the same piece,though each time found pointed in the same manner; and this force operating thus irregularly, I conceive to be the principal source of all that uncertainty and variability in the art of gunnery, which hath hitherto been usually attributed to the difference of powder. The reality of this force, and the cause which produces it, will, I hope, appear from the following considerations.

In order to the invariable character of shot, that no bullet can be discharged from the piece generally in use, without rubbing against its sides, and thereby acquiring a whirling motion as well as a progressive one. And as this motion is generated in the course of a whirling, if it can be conspire in some degree with the progressive motion, and in another part be equally opposed to it, the resistance of the air on the bare part of the bullet will be hereby affected, and will be increased in that part where the whirling motion conspires with the progressive, and diminished where it is opposed to it. And by this means the whole effect of the resistance would be made to act in a direction opposite to the direction of the whole body, will become oblique thereto, and will produce those effects already mentioned. If it was possible to predict the position of the axis round which the bullet should wind, and if that axis were unchangeable during the whole flight of the bullet, then the aberration of the bullet by this oblique force would be in a given direction, and the inaccuracy produced thereby would regularly extend the same way, from one end of its track to the other. For instance: if the axis of the wind were perpendicular to the horizon, then the deflection would be to the right or left; if that axis were horizontal, and perpendicular to the direction of the bullet, then the deflection would be upwards or downwards. But as the first position of this axis is uncertain, and the second may shift in the course of the bullet's flight, the elevation of the bullet is not necessarily in one certain direction, nor tending to the same side in one part of its track that it does in another; but if it usually is continually changing the tendency of its deflection, as the axis, round which it whirs, must frequently shift its position to the progressive motion by many inevitable accidents?
To prove the truth of his theory, Mr. Nobbs made the following experiments, before several members of the Royal Society:

"The first experiment, exhibited on this occasion, was to cause the whirling motion of a bullet, commencing with its progressive motion, to be diverted from that vertical plane, in which its motion began, by an increased resistance of what we asserted. Since no other power but that unequal resistance, which we here insist on, can occasion a body in motion to deviate from the vertical plane, in which it has once moved."

"Now by means of screens of exceedingly thin paper, placed parallel to each other at proper distances, this deflection in question may be many ways investigated. For by firing bullets which shall traverse these screens, the flight of the bullet may be traced out; and it may easily appear, whether they do or do not keep invariably to one vertical plane. This examination may proceed on three different principles, which I shall here separately explain.

"For first, an exact vertical plane may be traced upon all these screens, by which the deviation of any single bullet may be more readily investigated; only by measuring the distance of its hop forward, from the vertical plane thus delineated, and by this means the absolute quantity of its aberration may be known."

"Or if the description of such a vertical plane should be esteemed a matter of difficulty and nicety, a second method may be followed; which is that of resting the piece in some fixed notch or socket, so that the piece may have some little play to the right and left, yet all the lines, in which the bullet can be directed, shall intersect each other in the centre of that fixed socket; by this means, if two different shot are fired from the piece thus situated, the horizontal distances of the traces made by the two bullets on any two screens, ought to be in the same proportion to each other as the respective distances of these screens from the socket, in which the piece was fired. And if these horizontal distances differ from that proportion, then it is certain, that one of these shot at least hath deviated from a vertical plane, although the absolute quantity of its deviation cannot be with any certainty ascertained, because it cannot be known, what part of it is to be imputed to one bullet, and what to the other.

"But if the constant and invariable position of the notch or socket, in which the piece was placed, be not in doubt, an hypothesis in this very nice affair, the third method, and which is the simplest of all, requires no more than, that two shot be fired through three screens, without any regard to the position of the bullet at each time. For, in this case, if the shot diverge from each other, and both keep to a vertical plane, then if the horizontal distances of their traces on the first screen be in the same proportion to the zonal distances on the second and third, the two remainders will be in the same proportion with the distances of the second and third screen from the first. And if they are not in this proportion, then it will be certain, that one of them at least hath been deviated from the vertical plane; though here, as in the last instance, the quantity of that deflection in each will not be known."

All these three methods I have myself made use of at different times, and have ever found the success agreeable to my expectation. But what I thought the most eligible for the experiments, which I proposed to shew to this Society, was the employment of the two last, and the apparatus was as follows:

"On — being the first day appointed for these trials, the weather was unfavourable, and the experiments on that account more round than could have been wished, though they were far from inconclusive.

"But on the next Thursday two screens were set up in the large walk in the Charter-house garden; the first of them at 240 feet distance from the wall (which wall was to serve for a third screen), and the second two hundred feet from the same wall. And at fifty feet before the first screen, or at 300 feet from the wall, there was placed a large block, weighing about 200lbs. weight, and having fixed into it an iron bar with the socket at its extremity, in which the piece was to be laid. The piece itself was of a common length, and was bored for an ounce ball. It was each time loaded with a ball of 17 to the pound (so that the windage was extremely small) and with a quarter of an ounce of good powder. The screens were made of the thinnest tissu-paper, and the resistance they gave to the bullet (and consequently their probability of deflecting it) was so small, that a bullet firing one time near the extremity of one of the screens, left a short line of confusion on it towards the edge, which was so very weak, that it appeared difficult to handle it without breaking. These things thus prepared, five shot were made with the piece rest on the notch described above; and the horizontal distances between the first shot, which was taken as a standard, and the four succeeding ones, both on the first and second screen, and on the wall, measured in inches, were as follows:

1st screen 2nd screen wall
1 to 2 1,72 R 3,13 R 16,7 R
3 10, L 15,6 L 69,25 L
4 1,25 L 4,5 L 13,0 L
5 2,15 L 5,1 L 19,0 L

"Here the letters R and L denote, that the shot in question went either to the right or left of the iron bar.

"In the position of the socket in which the piece was placed, was supposed fixed (and I presume no person then present conceived, during these trials, that it could possibly vary the tenth of an inch from its first situation), then the horizontal distances, measured above the first and second screen, and on the wall, ought to be in the proportion of the distances of the 1st screen, the 2nd screen, and the wall, from the socket. But by only looking over these numbers, it will be found that none of them are in that proportion; the horizontal distance of the 1st and 3d (for instance) on the wall being nine inches more than it should be by this analogy.

"If without supposing the invariable position of the socket, we examine the comparative horizontal distances according to the third method described above, we shall in this case discover divergences still more extraordinary. For by the numbers set down above, the horizontal distances of the 2d and 3d shot on the two screens, and on the wall, are as under:
Here, if, according to the rule given above, the distance of the first screen be taken from the distances on the other two, the remainder will be 7 and 74,2; and these numbers, if each shot kept to a vertical plane, ought to be in the proportion of 1 to 3, that being the proportion of the distances on the second screen and of the wall from the first. But the last number 74,2 exceeds what ought to be by this analogy, by 39,7, so that in this there is a deviation from the vertical plane of above 39 inches, and this too in a transit of little more than eighty yards.

But further, to shew that these irregularities do not depend upon any accidental circumstances of the ball's fitting or not fitting the piece, there were five shot more made with the same quantity of powder and shot as before, but with smaller bullets, which ran much lesser in the piece. And the horizontal distances being measured in inches from the first to the bullet to each of the succeeding ones, the numbers were as follow:

<table>
<thead>
<tr>
<th>1st screen</th>
<th>1st screen</th>
<th>wall</th>
</tr>
</thead>
<tbody>
<tr>
<td>12.0</td>
<td>31.4</td>
<td>R</td>
</tr>
<tr>
<td>3.4</td>
<td>12.75</td>
<td>L</td>
</tr>
<tr>
<td>4.7</td>
<td>5.3</td>
<td>R</td>
</tr>
</tbody>
</table>

Here, again, on the supposed same position of the piece, the horizontal distance on the wall, between the first and third, will be found to be above fifteen inches less than it should be, if each kept to a vertical plane. And like irregularities, though small, do occur in every other experiment. And if they are examined according to the third method set down above, and the horizontal distances of the third and fourth, for instance, are compared, these on the first and second screen, and on the wall, appear to be thus:

<table>
<thead>
<tr>
<th>1st screen</th>
<th>2nd screen</th>
<th>wall</th>
</tr>
</thead>
<tbody>
<tr>
<td>22.5</td>
<td>38.5</td>
<td></td>
</tr>
</tbody>
</table>

And if the horizontal distance on the first screen is taken from the other two, the remainders will be 15.15 and 27.4; where the least of them, instead of being twice above the first, as it ought to be, is 23.35 short of it. So that here there is a deviation of above 23 inches.

From all these experiments the deflection in question seems to be incontestably evinced. But to give some further light to this subject, I took a barrel of the same bore with that hitherto used, and bent it at about three or four inches from its muzzle to the left, the bend making an angle of 3° or 4° with the axis of the piece. This piece, thus bent, was fired with a loose ball and the same quantity of powder hitherto used, the screens of the last experiment being still continued. It was natural to expect that if this piece was pointed by the general direction of its axis, the ball would be canted to the left of that direction by the barrel near its mouth. But as the bullet, in passing through that bent part, would, as I conceived, be forced to roll upon the right-hand side of the barrel; and thereby the left side of the bullet would turn up against the sin, and would give it a resistance on that side; I predicted to the company then present, that if the axis on which the bullet whirled did not shift its po-

Rifle.

sition after it was separated from the piece, then, notwithstanding the bend of the piece to the left, the bullet itself might be expected to deviate towards the right; and this, upon trial, did most manifestly happen. For one of the bullets fired from this bent piece, passed through the first screen about 14 inch distant from the trace of one of the shots fired from the barrel in the last set of experiments. On the second screen the traces of the same bullets were about three inches distant, the bullet from the crooked piece being still passing on both screens to the left of the other; but comparing the places of these bullets on the wall, it appeared that the bullet from the crooked piece, though it diverged from the track of the other on the two screens, had now crossed that track, and was deflected considerably to the right of that it was obvious, that, though the bullet from the crooked piece might at first be canted to the left, and had diverged from the track of the other barrel, with which it was compared; yet by degrees it deviated again to the right, and a little beyond the second screen crossed that track, from which it before diverged; and on the wall was deflected fourteen inches further, on the contrary side. And this experiment is not only the most convincing proof of the reality of this deflection here contended for; but is likewise the strongest confirmation, that it is brought about by the same cause, and by the very circumstances, which we have all along described.

To prevent this irregularity, rifled barrels are made use of; and here it happens, that, when the pieces are in the zone of the horizontal, the deflection of the bullet follows the sweep of the rifle; and thereby, besides its progressive motion, acquires a circular motion round the axis of the piece, which circular motion will be continued to the bullet, after its separation from the piece; by which means a bullet discharged from a rifled barrel is constantly made to whirl round an axis, which is coincident with the axis of the piece.

And it follows, that the resistance on the foremost surface of the bullet is equally distributed round the pole of its circular motion; and acts with as much force on every side of the line of direction, as to the same resistance can produce no deviation from that line. And (which is still of more importance,) if by the circular irregularity of the foremost surface of the bullet, or by any other accident, the resistance should be stronger on one side of the pole of the circular motion than on the other; yet, as the place, where this greater resistance acts, must perpetually shift its position round the line in which the bullet flies, the deflection, which this inequality would occasion, if it acted constantly with the same given tendency, is now continually retarded by the straining of contrary tendencies of that disturbing force, during the course of one revolution.

This perpetual correction of a deflactive effect on the foremost surface of the bullet, in consequence of the bullet round the line of its direction, may perhaps be exemplified, by considering what happens to a castle-top, whilst it spins upon its point. For it will be easily acknowledg'd that this continual revolution on its point could not for the least portion of time in that situation. And if we examine how this happens, we shall find, that, though the bullet itself is not exactly over the point it spins on, yet that inequality cannot instantly bring it to the ground according to the course of its motion; but, during one revolution, the centre of gravity of the bullet is at no time on every side of the top; and thereby it raises it as much in one place, as it depressed it in another. And this reasoning (supposing that the tendency of the centre of gravity of the top to descend, and being owing to the action of the unequal resistance on the topmost surface of a bullet fired from a rifled barrel) will easily explain how, notwithstanding that inequality, the bullet keeps true to its track without deflection. And what is here advanced, is further confirmed by the general practice with regard to arms, that it is well known to every archer, that the feathers of an arrow are placed in a spiral form, so as to make the arrow spin round its axis; without which it would be oblivious to the eye, that the arrow undulates in the air, and did not keep accurately to its direction. And the same principle, that every school-boy finds himself under the necessity of making his shuttlecock spin, before he can depend upon the truth of his effort, and lays down no one in twenty of these he could ever traced.

This may suffice as to the general idea of the form and convenience of a rifled piece; and here it will be expedient to insert some experiments, by which it will appear, how well it answers the purpose I have mentioned above; I mean that of keeping the ball to its regular track, by preventing that deflection, which, as we have seen, takes place in the bullets fired from common pieces.

And first, considered, that in consequence of the round about the manner in which it produces this defect; it is evident, that would follow, that the same hemisphere of the bullet which lies foremost in the piece, must continue foremost during the whole course of its flight.

To examine this particular, I took a rifled barrel carrying a bullet of six to the pound; but instead of its branded leaden bullet, I used a wooden one of the same size, made of a soft springy wood, which bent itself easily into the rifles without breaking. And, firing the piece thus loaded against a wall at such a distance, as the bullet might not be injured by the blow; I always found, that the same surface, which was foremost in the piece, continued foremost without any sensible deflection, during the time of its flight.

And this was easy to be observed, by examining the bullets, for the marks of the rifles, and the part that impinged on the wall, were sufficiently apparent.

Now, as these wooden bullets were but the mottled part of the weight of those of lead; I conclude, that effect, had been any unequal resistance or deflative power,
it effects must have been extremely sensi-
tive upon this light body; and consequently in a
proper perpendicular, so long as it only rises or
drops four degrees from the perpendicular, in
the direction of the wind; and, bringing it in
this situation, the bullet generally continued
about one fourth the height of the air, rising by
computation to near three quarters of a mile
perpendicular height.

"In these trials I found, that the bullet
commonly came to the ground to the key-
ward of the piece, and at such a distance from it, as nearly corresponded to its angle of
inclination, and to the effort of the wind;
usally falling not nearer to the piece than
a hundred, nor farther from it than a hundred
and fifty yards. And this is a strong con-
mofrmation of the almost steady flight of this
bullet for about a mile and a half. For were
the same trial made with a common piece,
I doubt not that the deviation would often
amount to half a mile, and perhaps consider-
ably more; though this experiment would be
a very difficult one to examine, on ac-
count of the little chance there would be of
discovering where the ball fell.

It now remains to speak of the sights,
which also affect the precision of the shot,
and which, in a certain degree, cannot consti-
tute a part of a rifle, as they may be applied
with a plain bored barrel; yet as that is
d seldom done, and as they are always used
with a rifle, it will not be proper to omit
mentioning them.

It may be strictly said, that no part of
the path of the bullet when fired from a rifle
or musket is in a right line, as gravity acts
upon the bullet the instant it quits the mouth
of the piece; and although at a short dis-
tance the effect is not very perceptible, yet
it is considerably so at 100 yards; and at
200 yards, the ball would probably strike
the ground before it could reach the object
aimed at, by the power of gravity alone.
In any case, it is found necessary to aim exactly at
such a height above the object, as the ball
would have been depressed by, by the power of
gravity, had it been aimed at it point-blank;
so that we suppose this depression to be a
foot in a hundred yards, we must aim a foot
above the object. But here another incon-
vienience arises; for if we aim above the
object by raising the muzzle of the piece,
the object is exsicated from our view by the
intervention of the barrel; so that we are
prevented from measuring the distance with
the eye, and instead of one, are liable to
aim two or three feet above the object.

This second difficulty is removed by de-
pressing the breech of the gun, instead of
elevating the muzzle; and the quantity of the
depression is measured with great nicety,
by what are called the "graduations" of the
piece, or the incline of the muzzle, at right
angles with its axis, is fixed a piece of flat
thin iron (see Plate fig. 3), about six inches
from the breech, and on the centre of its top,
as a scale or notch is filed. This is called the
back sight. The front sight is nothing more
than the small knob of iron or brass, which
is fixed on all bowing pieces, about half an
inch from the muzzle. When aim is taken,
the eye is raised over the back sight, till the
target or object, with the object B, which
is then brought upon the object, and forms
the right line ABCD, Plate fig. 2.

But here it is evident, that the breech of
the barrel is depressed in the proportion of
the angle of elevation of the line of sight or
BC; that the axis of the barrel forms an inclined plane with the
right line AEC; that the course of the
ball, if not acted upon by gravity, would be
in the line ECF; and that the ball would
strike at E, considerably above the object
D. But being depressed in its course by
the law of gravity, it will make the curve
H and descend to D.

By looking at the figure it is immediately
seen, that the object aimed at had been at
I, or any point nearer than D, the ball
would have passed over it; and if it had been
at K or farther than D, it would have passed
under it. The height of the back sight
must be regulated by experiment. The govern-
ment rifles have only one fixed sight, which
are intended for 200 yards; but if an enemy
is seen at 100 yards, aim must be taken at
the knee; if at 100 the head; and if at 250
yards, the head must be aimed at; and at
300, the sight becomes useless, as it would
be necessary to aim over his head, and then
the inaccuracy before mentioned recurs
to prevent which, three additional sights
are used as in figure 3, where the sight
A is calculated for 150, B for 200, and C for
300 yards; beyond which distance it be-
comes almost useless to fire at any object
of the size of a man.

Mr. Robinson, who has done more on this sub-
ject than any other person, concludes an ex-
cellent paper with predicting, that whatever state
shall thoroughly comprehend the nature
and advantages of rifled-barrel pieces; and have
facilitated and completed their con-
struction, shall introduce into their armies
their general use, with a dexterity in the
management of them; will by this means
acquire a superiority, which will almost equal
any thing that has been done at any time
by the particular excellence of any one kind
of arms; and will perhaps fall but little short
of the wonderful effect of the Huguenot
story relates to have been formerly produced, by
the first inventors of fire-arms.

RIGGING of a ship, is all her cargo
and ropes, belonging to her masts, yards, 
See Ship-build.

RIGHT, in geometry, signifies the same
with straight: thus a straight line is called a
right one.

Riot, in law, not only degrades
property, for which a writ of right lies, but also
any title or claim, either by virtue of a condi-
tion, mortgage, &c. for which no action
is given by law, but an entry only.

By statute, the Mar. cap. 2, the fol-
lowing particulars relating to the ill conduct
of king James II. were declared to be illegal,
and contrary to the ancient rights and liber-
ties of the people, viz. his exercising a power
for regulating his own laws; his levying money
without consent of parliament; violating the freedom of elections;
causing partial and corrupt jurors to be re-
turned on trial; and excessive bail to be taken,
and excessive fines to be imposed, as well
as cruel punishments to be inflicted, &c.

RIM, in a watch, or clock, the edge or
border of the circumference or circular part
of a wheel.

In some instruments of navigation and astronomy, a
brass instrument, made in the form of a ring,
and serving to take the altitudes of the sun. See
Plate Mosei. cap. 290.

At C is a small hole, in the direction CD,
which is perpendicular to E, and is this distance
DE, parallel to the vertical diameter AB. From C, as
a centre, they describe a quadrant of a circle
CED; which being nicely divided into 90°,
or subdivided upon the inner surface of the
ring the places where rays, drawn from C to
these degrees, cut the said surface.

To use this ring, they hold it up by the
sized, and turn the side with the hole C
towards the sun; and then the sun-beams
passing through the hole, make a luminous
spot among the degrees, whereby the alti-
dude is found. Some prefer the ring to the
astrolobe, by reason its divisions are larger;
however, it is far from being exact enough
to be much depended on in astronomical
observations, which are better made by quad-
drants. See Astrolabe, and Quadrant.

RIOT, in law. When three persons
or more shall assemble themselves together,
with an intent mutually to assist one another,
against any who shall oppose them in the
execution of some enterprise of a private
nature, with force or violence, against the
peace, or to the manifest terror of the people,
which enterprise is of an unlawful, riotous,
or unlawful; if they only meet for such a
purpose or intent, though they shall after
depart of their own accord without doing any
thing, this is an unlawful assembly. 1 Haw.
135.

If after their first meeting, they shall move
forwards towards the execution of any such
act, whether they put their intended pur-
pose into execution or not; this according to
the general opinion is a riot. Id.

By 34 Ed. Ire. c. 1, it is enacted, that if
a justice finds persons riotously assembled,
he alone has not only power to arrest the
offenders and hindering any unlawful be-
aviour, or imprison them if they do not
offer good bail; but he may also authorize
others to arrest them, by a bare verbal com-
mand, without other warrant; and by force
thereof, the persons so commanded, may pur-
sue and arrest the offenders in his absence as
well as presence. It is also said, that after
any riot is over, any one justice may send
his warrant to arrest any person who was
concerned in it, and that he may send him
goad till he shall find sureties for his good
behaviour. 1 Haw. 160.

The punishment of unlawful assemblies, if
to the number of twelve, may be capital,
according to the circumstances which attend
them; but from the number of three to
eleven, is by fine and imprisonment only.

The same is the case by riots and routs by
the common law, to which the pillory in very
numerous cases has been sometimes super-
added. 4 Black, c. 11.

By stat. 1 Geo. I. cap. 5, if any persons
who to the number of twelve or more, unlawfully
and riotously assembled, continue together
for an hour, after being required, by a justice
of the peace, or other magistrate, to disperse
they shall be deemed guilty of felony without
benefit of clergy. However, prosecutions
upon this statute must be begun within one year after the offence is committed.

Rivers, as every body has seen, are always broadest at the mouth, and narrower towards their springs; but this is less known; and, probably more deserving curiosity, is, that they run in a more direct channel as they immediately leave their sources; and that their divisures and turning become more numerous as they proceed.

It is a certain sign among the native Ezrians, that they are near the sea, when they find the rivers widening, and every now and then changing their direction. And this is even now believed by the Europeans themselves, in their journeys through those trackless forests.

As those inundations, therefore, increase as the river approaches the sea, it is not to be wondered at, that they sometimes divide and thus disambiguate by different channels. The Dnieper is divided amongst the Euxine by seven mouths; the Nile, by the same number; and the Wolga, by seventy.

The largest rivers of Europe are, first, the Wolga, which is about six hundred and fifty leagues in length, extending from Reschow to Astrachan. It is remarkable of this river, that it abounds with water during the summer months of May and June; but all rest of the year is so shallow as scarcely to cover its bottom; or, allow a passage for loaded vessels that trade up its stream. The next in order is the Danube. The course of this is about four hundred and fifty leagues, from the mountains of Switzerland to the Black Sea. The Don, or Tanais, which is four hundred leagues from the source of that branch of the Volga called Sofiana, to its mouth in the Euxine Sea. In one part of its course it approaches near the Wolga; and Peter the Great had actually begun a canal, by which he intended joining those two rivers; but this he did not finish. The Niépr, or Borysthones, which rises in the middle of Muscovy, and runs the course of three hundred and fifty leagues, to empty itself into the Black Sea. The Old Cossacks inhabit a great part of this river; and frequently cross the Black Sea, to plunder the maritime places on the coasts of Turkey.

The Dvina, which takes its rise in a province of the same name in Russia, that runs a course of three hundred and fifty leagues, and discharges into the White Sea, a little below Archangel.

The largest rivers of Asia are, the Hwang-ho, in China, which is about eight hundred and fifty leagues in length, coming from its sources at Hsia Li, and joining the Tsze Lien, in the mouth of the Gulph of Ching. The Jénisea of Tartary, about eight hundred leagues in length, from the lake Schling to the icy Sea. This river, by some, supposed to supply most of that great quantity of drift-wood which is seen floating in the seas, near the Arctic circle. The Oby, of five hundred leagues, running from the lake of Kila into the Northern Sea. The Amour, in Eastern Tartary, whose course is about five hundred and seventy-five leagues, from its source to its entrance into the sea of Kalla. The Kuan, in China, five hundred and fifty leagues in length, The Ganges, one of the most noted rivers in the world, and about as long as the former. It rises in the mountains which separate India from Tartary, running through the dominions of the Great Mogul, discharges itself by several mouths into the bay of Benga.

It is not only esteemed by the Indians for the depth and pureness of its streams, but for a supposed sanctity which this appears to be in its waters. It is visited annually by several hundred thousand pilgrims, who pay their devotions to the river as to a god; for savage simplicity is always known to mistake the blessings of the Deity for the Deity himself; and when the temples, or shrines, are built, of distant countries, to expiate for all kinds of sins, and to be buried in its stream. The water is lowest in April or May; but the rains beginning to fall soon after, the flat country is inundated by that season. It is said about the end of September; the waters then begin to retire, leaving a prolific sediment behind, that enriches the soil, and, in a few days time, gives a luxuriance to vegetation, beyond what can be conceived by an European. Next to this may be reckoned the still more celebrated river Euphrates. This rises from two sources, north and south of the city Erzewan, on the Turcomania; and unites about three days journey below the same, whence, after performing a course of five hundred leagues, it falls into the Gulph of Persia, fifty miles below the city of Bassora in Arabia. The river bas in extended, from its source to its discharges into the Arabian sea, four hundred leagues.

The largest rivers of Africa are, the Senegal, which runs a course of not less than five thousand leagues, comprehending the Nile, which some assert is so large as to fall into it. Later accounts, however, seem to confirm that the Niger is lost in the sands, about three hundred miles up from the western coast of Africa; but it may, the Senegal is well known to be navigable for more than three hundred leagues up the country; and how much higher it may reach is not yet discovered, as the dreadful fatality which often occurs in its mouths, only deter the curiosity, but even avarice, which is a much stronger passion. The celebrated river Nile is said to be nine hundred and seventy leagues, from its source among the mountains of the Moon, or Upper Egypt, to its opening into the Mediterranean Sea. Upon its arrival in the kingdom of Upper Egypt, it runs through a rocky channel, which some river travelers have mistook for its cata
cracts. In the beginning of its course, it receives many lesser rivers into it; and Pliny was mistaken, in saying that it received none. In the beginning also of its course, it cuts across the rock of rubies, below three hundred leagues from the sea, runs in a direct line. Its annual overflows arise from a very obvious cause, which is almost universal with the great rivers that take their source near the Lane. The rainy season, which is periodical in those climates, floods the rivers; and as this always happens in our summer, so the Nile is at that time overflowed. From these inundations the inhabitants of Egypt derive happiness and plenty; and, when the river does not arrive at its accustomed height, they prepare for an indifferent harvest. It begins to overflow about the 17th of June. Thus thinks he it should be for forty days, and decrease and increase about as much more. The time of increase and decrease, however, is much more indifferent now than it was among the ancients. Berossus, in the history of Africa says, that a hundred days rising, and as many falling; which shows that the inundation was much greater at that time than at present. M. Buffon has ascribed the present diminution, as well to the lessening of the mountains of the Moon, by their substance having so long been washedrounded by the continual friction of the winds, and the rapidity of the sea. On the side of tableland, these winds blow in a contrary direction; and, for that reason, the climate of the interior of Africa is equable.
down with the stream, as to the rising of the earth in Egypt, that has for so many ages received this extraneous supply. But do not find, by the buildings that have remained since the times of the antients, that the earth is much raised since then. Besides the Nile in Africa, we may reckon Zara, and the Coamza, from the greatness of whose openings into the sea, we may imagine, if these streams, we form an estimate of the great distance whence they come. Their courses, however, are spent in watering deserts and savage countries, whose poverty or fences have kept strangers away.

But of all parts of the world, America, as it exhibits the most lofty mountains, so also it supplies the largest rivers. The principal of these is the great river Amazon, which, from its source in the lake of Lauiticochi, to its discharge into the Western ocean, performs a course of more than twelve hundred leagues. The width and depth of this river is answerable to its vast length; and, where its width is most contracted, its depth is augmented in proportion. So great is the body of its waters, that other rivers, though before the object of the Rille during the summer. It proceeds after their junction, with its usual appearance, without any visible change in its breadth or ripidity; and, if we may so express it, remains great without ostentation in some places it displays its whole magnificence, dividing into several large branches, and encompassing a multitude of islands; and at length, discharging itself into the ocean, by a channel of an hundred and fifty miles, and above thirty feet in depth. This great river, that may almost rival the former, is the St. Lawrence, in Canada, which rising in the lake Asiniobolus, passes from one lake to another, from Christiano to Aleppo; and thence to lake Superior; thence to the lake Hurons; to lake Erie; to lake Ontario; and, at last, after a course of nine hundred leagues, pours their collected waters into the Atlantic Ocean. The river Mississippi is more than seven hundred leagues, commences at a source near the lake Asiniobolus, and ending at its opening into the Gulf of Mexico. The river Plata runs a length of more than eight hundred leagues from its source, in Paraguay, to its mouth. The river Oroonoko is seven hundred and fifty leagues in length, from its source near Pusto, to its discharge into the Atlantic ocean.

Such is the amazing length of the greatest rivers; and even in some of these, the most remote sources very probably yet continue unknown. In fact, if we consider the number of rivers which they receive, and the little acquaintance we have with the regions through which they run, it is not to be wondered at that geographers are divided concerning the source of many of them. As among a number of roots by which nourishment is conveyed to a stately tree, it is difficult to determine precisely that by which the tree is chiefly supplied; so among the branches of a river, it is even more difficult to tell which is the original. Hence it may easily happen, that a similar branch is taken for the capital stream; and its runnings are pursued and delineated, in prejudice of some other branch that better deserves the name and the description. In this manner, in Europe, the Danube is known to receive thirty lesser rivers; the Volga or thirty-three. In Asia, the Ilo- latino receives thirty-five; the Jenise above sixty; the Oly as many; the Amour about forty; the Nauquin receives thirty rivers; the Ganges twenty; and the Euphrates about twenty. In Africa, the Senegal receives more than twenty rivers; the Nile receives not one for five hundred leagues; and, then only twelve or thirteen. In America, the river Amazon receives above sixty, and they are of considerable size; the river St. Lawrence about forty, counting those which fall into its lakes; the Mississippi receives forty; and the river Plata above fifty.

The inundations of the Ganges and the Nile have been already mentioned, and it might be added, that almost all great rivers have their periodical inundations from similar causes. The author already quoted observes, that, besides these annually periodical inundations, there are many rivers which overflow at intervals. Thus most of those in Peru and Chili have scarce any motion by night; but upon the appearance of the morning sun they assume their former rapidity; this proceeds from the rains, which, melting with the heat, increase the stream, and continue to drive on the current while the sun continues to dissolve them.

There are some rivers which are said to lose themselves in channels under the earth, and to flow for several miles in secret and undiscovered channels. On this circumstance is founded one of the most beautiful fables of antiquity, relative to the fountain of Arethusa, in Sicily. The same thing is affirmed of the Rhine, and even of the river Mole, in Surrey, which, from this circumstance derives its name. With respect to the two latter rivers, however, some doubts are entertained of the fact.

On this subject there is a memoir of the academy of sciences, written by M. Guettard. "It is very surprising (he observes) if we reflect on it, that a river in its course, which is very often very extensive, should not meet with spongy soils to swallow up its waters, or gently drain them into the sea; nevertheless, there has been hitherto known but a small number of rivers whose waters thus disappear, this phenomenon has been accounted very extraordinary, both by the ancients and moderns. M. Guettard next describes what he has observed in several rivers of Normandy, which are lost and afterwards appear again; these are five in number, viz. the Rille, the Ithon, the Aure, the river of Sep-Audé, and the Drôme. The three first disappear gradually, and then come in sight again; the fourth loses itself entirely by degrees, but afterwards re-appears; the fifth loses some of its water in its course, and ends by precipitating itself into a cavity, whence it is never seen to rise again.

What seems to occasion the loss of the Rille, the Ithon, and the Aure, is the nature of the soil through which they pass. M. Guettard has observed that it is in general porous, and that, as it is impermeable, the cavities of which are not well compacted together; it sinks suddenly down by its own weight in some places, and there forms great holes; and when the water overflows the meadows, it frequently makes many cavities in several parts of them. If we therefore suppose inequalities in the channels of these rivers, and that there are certain places in which the water stagnates or sinks to the earth, it must there dilate the ground, if we may use that expression; and having carried away the parts which unite the grains of sand together, those grains will become after- wards no other than a kind of sponge, in which the waters will infiltrate themselves, provided nevertheless that they find a passage under ground through which they may run. This conjecture appears to be so well founded, that each of these three rivers loses itself nearly in the same manner, that is, through cavities which the people of the country call beitors, and which swallow up more or less according to their largeness. M. Guettard, who has carefully examined them, remarks, that besides the sandy soil of a tunnel, whose diameter and aperture is at least two feet, and sometimes exceeds eleven; and whose depth varies in manner from one and two feet, to five, six, and seven feet; the cavity sometimes loses almost all its water in the space of two short leagues; the Ithon does very near the same. But M. Guettard observes something curious concerning this river, that formerly did not receive a name, kept its course without any interruption, as appears by the history of the country; very likely the mud, which had been collected together in several parts of its channel, might have occasioned the said cavities under ground through which it may take its course. M. Guettard seems also much inclined to believe, that there are, in these parts, subterraneous cavities through which the waters may flow; and in consequence of this he reports a number of facts, all tending to prove the truth of it, or at least to prove that there must be hollow quarries serving for strainers to these waters. Upon which occasion he goes into a discussion of this question: Are the subterraneous rivers, and is the proposition of some persons in favor of this particular well founded? He makes it appear by several instances which he quotes, and by many reasons which he alleges, that there are at least very great presumptions in favor of this opinion. We are too apt not to look beyond the exterior of things: we feel resistance upon the surface of the earth; when we go deep, we often find it. This is therefore hard for us to imagine that it cannot contain subterraneous cavities sufficient to form channels for hidden rivers, or for any of their branches.
considerable body of water; in a word, that it can contain vast caverns; and yet every thing seems to indicate the contrary. A fact that forms the subject of the Riff, concerning which we have spoken, and particularly of the Riffe, proves in some measure that there are considerable lakes of water in the mountains which limit its course; this fact is, that in winter the greater part of their basins become springs, which supply the river's channel with as much water as they had absorbed from it during the summer. Now from whence can that water come, unless from the reservoirs or basins, that are inclosed in the mountains, which being lower than the river in summer, absorb its water, and being higher in winter by the rain they receive, send it back again in their turn?

M. Guettard strengthens this conjecture by several instances that render it very probable: he remarks at the same time, that this alternate effect of the betoires swallowing up the water and restoring it again, causes prings an invisible obstacle to the recesses of water within the channel of the river. It has indeed been several times attempted to stop those cavities; but the water returns with such violence in winter, that it generally carries away the materials with which they were stopped.

The river of Sap-André is lost in part, as we have before said, in the same manner as the Lhôn and the Riffe; but there is something more remarkable in it than in those rivers, to wit, that, at the extremity of its course, where there is no perceptible cavity, it is ingulphed, but without any fall; the water passes between the pebbles, and it is impossible to force a stick into that place any further than into the betoires of which we have spoken. What makes this river take that subterraneous direction, is an impediment which its stream meets with in that place; it is there stopped by a rising ground six or seven feet high, whose bottom it is very likely that the surface of a fresh water will be, and that, having been able to make its way over it. At some distance it appears again; but in winter, as there is a greater quantity of water, it passes over that eminence, and keeps an undisturbed course, till it discharges itself into the Dronc, after having lost some of its water in its course, vanishes entirely near the pit of Sancy; in that place it meets with a sort of subterraneous cavity near 25 feet wide, and more than 13 deep, where the river is in a manner stopped, and into which it enters, though without any perceptible motion, and never appears again.

M. Guettard finishes this memoir with some observations upon the ferre. This river is lost in the same manner as the Riffe; and though it is very near Paris, this singular fact is unknown to almost every body; was it not for the account of M. l'Abbé le Bœuf, M. Guettard would have been also ignorant of it. And as he thinks the chief object of a naturalist ought to be to collect, examine, and communicate to every body, he examines the means which might be employed to restrain the water of the ferre. The same object has made him add a description of the manner how the River of Sap-André, or natural springs, bear no currents disturbed; for it is now very certain that it does not lose itself, but that its channel is extremely confined, in the place where it was pretended that it lost itself, by two or three feet of water at the foot. M. Guettard makes it appear that it might not be impossible to widen that place, and give a sufficient channel to the river, which would render it navigable, and be of vast utility to all the country.

The many advantages which accrue to a country from an abundance of rivers, especially large navigable ones, are too obvious to require any particular detail; but the disadvantages and calamities occasioned by them are frequently more conspicuous and fatal. Whole tracts of countries are sometimes Overflowed on a sudden, and every thing swept away at once; or if the deluge proceeds not such a length, yet by the quantity of stagnating water which is left, marshes are produced, which bring on diseases in the neighboring parts. It becomes therefore an object well worthy the public attention, how to secure the banks of rivers, or to form their channels in such a manner that the stagnant water may be carried off into the ocean without producing the mischievous effects abovementioned. In a treatise on rivers and canals published in the Phil. Trans., Mr. Smith, the subject at length. Having laid down a number of theorems concerning the descent of the water in rivers, he points out a method of determining whether the motion of the water in a particular place is from the inclination of the bottom of its channel, or merely from the pressure of the upper parts of the water upon the lower. "For this purpose," says he, "a pole must be thrust down to the bottom, and held perpendicularly to the current of the water, with its upper end above the surface; if the water swells and rises immediately against the pole, it shows that its flowing is by virtue of a preceding declivity; but, on the contrary, the water stops for some moments before it begins to rise against the pole, it is a proof that it flows by means of the compression of the upper waters upon the lower."

This is the simple method of measuring the velocity of the current of a river, according to our author, is as follows: "Take a cylindrical piece of dry light wood, and of a length something less than the depth of the river; and, having prepared it, let there be suspended as many small weights as may be necessary to keep up the cylinder in a perpendicular situation in the water, and in such a manner that the other end of it may just appear above the surface of the water. Fix to the centre of that end which appears above water a small and straight rod precisely in the direction of the cylinder's axis; to the end that, when the instrument is suspended in the water, the deviations of the rod from a perpendicularity to the surface of it may indicate which end of the cylinder advances the fastest, whereby may be discovered the different velocities of the water at different depths; for if the rod inclines forward, it is evident that the direction of the current, it is a proof that the surface of the water has the greatest velocity; but if it inclines back, it shows that the swiftest current is at the bottom; if it remain perpendicular, the velocities at the surface and bottom are equal.

"This instrument being placed in the current of a river or canal receives all the perceptions of the water throughout the whole depth and will have an equal velocity with that of the whole current from the surface to the bottom at the place where it is put in; and by that means may be found, both with ease and exactness, the mean velocity of that part of the river for any determinate distance and time."

"But to obtain the mean velocity of the whole section of the river, the instrument must be put successively both in the middle and towards the sides, because the velocities at these places are extremely different from each other. Having by this means found the difference of time required for the currents to run over an equal space, or the different distances run over in equal times; the mean proportional of all these trials, which is found by dividing the common sum of them all by the number of trials, will be the mean velocity of the river or canal."

"If it is required to find the velocity of the current only at the surface, or at the middle, or at the bottom, a sphere of wood, of such a size as may be suspended in equilibrium with the water at the surface or depth which we want to measure, will be better for the purpose than a cylinder, because it is only affected by the water of that part of the current where it remains suspended.

It is a very easy guide both to the cylinder, and the globe in that part which we want to measure, by means of two threads, or small cords, which two persons must hold and direct, one on each side of the river; taking care at the same time neither to retard nor accelerate the motion of the instrument."

Our author next proceeds to deduce from his theory the best methods of removing the defects and inconveniences which must necessarily happen to rivers and canals in a series of years. From his theory he draws the following conclusion: that the deeper the waters are in their bed in proportion to its breadth, the more their motion is accelerated; so that their velocity increases in an inverse ratio of the breadth of the bed, and also of the greatness of the section; whence are deduced the two following universal principles. 1. The velocity of water in a river or canal, without augmenting the declivity of the bed, we must increase the depth and diminish the breadth of its bed. 2ly. But to diminish the velocity of water in a river or canal, we must, on the contrary, increase the breadth and diminish the depth of its bed.

The above proposition is perfectly conformable to observation and experience: for it is constantly seen, that the current is the swiftest where the waters are deepest and the breadth of the bed the least, and that they flow slowest where their depth is the least and the breadth of the bed the greatest. The velocity of the waters," says M. de Buffon, "augments in the same proportion as the section increases through which they pass diminishes, the force of impulsion from the back waters being supposed always the same. Nothing," continues he, "produces so great a diminution in the swiftness of the waters, and makes them so slow as to cause the contrary, the increase of the volume of water augments its velocity more than any.
The celebrated Wolfe in his hydraulics assures us, that "it is a constant and universal practice, for accelerating the current of waters, to deepen the bed, and at the same time to render it narrower. When the velocity which a river has acquired by the elevation of its springs and the impulse of the back water, is at last totally destroyed by the different causes of resistance, becoming exactly equal to, or greater than, the first, the bed and current at the same time being horizontal, nothing else remains to propagate the motion, except the sole perpendicular compression of the upper waters upon the lower, which is always in a direct ratio of their depth. But this necessary resource, this remaining cause of motion in rivers, augments in proportion as all the others diminish, and as the want of it increases; for as the waters of rivers in extensive plains lose the acceleration of motion acquired in their descent from their springs, their quantity accumulates in the same bed by the junction of several streams together, and their depth becomes consequently immense. This junction increases the accumulation of many streams in the same bed, which we see universally in a greater or lesser degree in all rivers throughout the known world, and which, in a measure, corresponds with the diminution of their waters, usually attributed, says Signor Guiglielmin, to the infinite wisdom of the supreme Author of Nature. The velocities of flowing waters is very far from being in proportion to the quantity of velocity of the bed. If it was a river whose velocity is uniform and double to that of another, it ought only to run with double the swiftness when compared to it; but in effect it is found to have a much greater, and its rapidity, instead of being only double, will be triple, quadruple, and sometimes even more; for its velocity depends much more on the quantity and depth of the water, and on the compression of the upper waters on the bottom, than the swiftness of the bed. Consequently, whenever the bed of a river or canal is to be dug, the declivity must not be distributed equally throughout the whole length; but, to give a wider current to the declivity, it must be much more in the beginning of its course than towards the end where it disengages itself, and where the declivity must be almost insensible, as we see is the case in all natural rivers; for when they approach near the sea, their declivity is little or nothing; yet they flow with a rapidity which is so much greater, as they contain a greater volume of water; so that in great rivers, although a large extent of their bed should be absolutely horizontal, and without any declivity at all, yet their waters do not cease to flow, and to flow even with great rapidity, both from the impulsion of the back-waters, and from the compression of the upper waters upon the lower in the same section. Whosoever is well acquainted with the principles of the higher geometry, will easily perceive that it would be no difficult matter to dig the bed of a canal or river, but that the velocity of the current should be everywhere equal. It would be only giving it in the form of a curve along which a moving body should recede from a given point, and describe spaces everywhere proportional to the times, allowance being made for the quantity of effect of the compression of the upper waters upon the lower. This curve is what is called the horizontal isochrone, being the natural and mean and mud, etc., most necessary higher proportionately the free running off of the water; for it is evident, that the waters so far back from these obstacles, until the horizontal level of the bottom of the bed becomes higher than the top of the obstacles, must be entirely kept up and hindered from running off in proportion. Now as the waters must continue to come down from their sources, if their free running off is hindered by any obstacles whatever, their relative height back from them must necessarily be increased until their elevation, combined with the velocity of their current proceeding from it, is arrived to such a pitch at the point where the obstacles exist, as to counterbalance the pressure and the impediment proceeding thence, which frequently does not happen until all the lower parts of the country round about are laid under water. Now it is certain from all experience, that the beds of rivers and canals in general are subject to some or other of the obstacles above-mentioned. It rocks or trees do not bar their channels, at least the quantity of their waters, and hence the streams never fail to bring down, particularly in floods, and which are usually deposited according to the various windings and degrees of swiftness in the current, must unavoidably, in course of time, fill up, in part different places in the channel, and hinder the free running off of the back-waters. This is certainly the case, more or less, in all rivers, and in all canals of long standing, as is notorious to all those well acquainted with them. Hence, if these accidents are not carefully and with a constant attention prevented, inundations occur which sometimes lay waste whole districts, and ruin the finest parts of the land. Rivers with sand, hence rivers become unavailing, and canals useless for the purposes for which they were constructed. Canals, in particular, as their waters for the most part remain stagnant in them, are still more liable than rivers to have their beds fill up by the subsiding of mud, and that especially for some distance above their sluices; insomuch that if continual care is not taken to prevent it, or usually it is often long after, they will soon become incapable of receiving and passing the same vessels as formerly. Nay, the very sluices themselves, if the floors of their bottoms are not of a depth conformable to the bed of the canal, will produce the same accidents as those we have been speaking of; for if they are placed too low, they will be continually filling up with sand or mud; if too high, they have the same effect as banks or lands in rivers, that is, they will collect all the back-waters under their level from running off, and soon fill up the bed to that height by the subsiding of mud. This effect is much accelerated by the shutting of the lower sluices, which makes a great volume of water rush up to those next above them, fill the whole is filled and become stagnant. Now it is evident, that this state of things must contribute far more to the subsidity of mud, and all other matters brought in by the current, than can be the case in rivers whose currents constantly flow.

The waters of all rivers and canals are from time to time muddy; their streams, particularly during rains and floods, carry along with them earth and other substances, which are compelled by the current to run into the dikes, and to make the lower waters of the rivers and canals, or into the lands, the back-waters, and the bottom of the dikes. This is not to be discovered, because the waters of the lower reaches are usually found in a station of water, much above high-water mark of the sea. On the contrary, the rivers and canals are only susceptible of being cleared of their mud and sand, when the water is full or high, and on the contrary, the water of the lowest waters is never clear in the sea, or in other waters. The water in the rivers and canals is generally, in most canals and rivers, much higher than the seas. The reason of this is, that the rivers and canals receive and collect from all the surrounding district, and discharge into the sea. This is a very remarkable thing, which the engineer and hydraulicist often observes, that the water in the rivers and canals is always higher than the seas and the ocean, and that the water in the canals is always higher than the rivers. This is the case in all countries, and particularly in the countries of Holland and Flanders, where the canals are very high, and the rivers and canals are much higher than the seas. This is the case in all countries, and particularly in the countries of Holland and Flanders, where the canals are very high, and the rivers and canals are much higher than the seas. This is the case in all countries, and particularly in the countries of Holland and Flanders, where the canals are very high, and the rivers and canals are much higher than the seas.
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bed of the canal below the horizontal level of the bed of the sluice will serve to no manner of purpose, either for navigation, or for carrying off the back-waters, but will soon fill up with mud, in spite of all means used to the contrary, except that of digging it continually anew to no manner of purpose.

Setting off from this determined point, at the mouth of a river, or at the bottom of the last sluice upon a canal, which are to be cleaned and deepened, the work must be carried on, in consequence uniformly throughout the length of the sluices backwards, into the country as far as is found necessary for the purposes intended. This is to be done after the following manner:

1st. One must dig up and carry away all windings, and bed of the canal below the horizontal level of the bed of the sluice will serve to no manner of purpose, either for navigation, or for carrying off the back-waters, but will soon fill up with mud, in spite of all means used to the contrary, except that of digging it continually anew to no manner of purpose.

2dly. If the declivity of the bed should be still too little to give a sufficient current to carry off the water as often and as fast as is necessary, the whole bed itself must be regularly deepened, and what is dug out from the bottom or sides of the channels, to render it narrower in proportion to its depth.

3dly. Wherever the banks are too low to contain the stream in all its situations, they must be sufficiently raised; which may be conveniently done with what is dug out from the bed; and the whole being covered with turf will render these banks firm and solid against the corrosion of the water. It is proper at all times to lay upon the banks what is dug from the bed, by which they are continually strengthened against the force of the current.

4thly. It is often necessary to diminish the windings and sinuosities in the channel as much as possible, by making new cuts whereby its course may approach towards a right line. This is a great resource in flat countries subject to inundations; because thereby all the declivity of a great extent of the river, and all the windings, may be thrown into a small space by cutting a new channel in a straight line; as may generally be done without obstacle in such countries as we are speaking of, and hereby that the current will be very greatly augmented, and the back-waters carried off to a surprising degree.

5thly. Wherever there is a confluence of rivers or canals, the angle of their junction must be made as acute as possible, or else the worst of consequences will arise from the corrosion of their respective streams; what they carry off from the sides will be thrown into irregular banks in the bottom of the bed. This acute angle of the junction must be neither too much or too little by taking the direction at some distance from the point of confluence.

6thly. Wherever the sides or banks of a river are liable to a more particular corrosion, from the confluence of streams, or from irremediable windings and turns in the channel, they must be secured against it as much as possible by weirs: for this corrosion not only destroys the banks, and alters the character of the river, but also fills up the bed, and produces all the bad effects we have spoken of above.

7thly. If the principal and greatest attention in digging the beds of rivers and canals is directed to the quantity and form of their declivity. This must be done uniformly throughout their whole extent, or so much of it as is necessary for the purposes in hand, according to the principles laid down of securing the form of the windings, their beds, and of the floors of their sluices, at the mouths where they discharge their waters, being fixed, the depth of the rest of the beds, and the quantity of declivity, must be regulated in consequent order as to increase regularly the quantity of the declivity in equal spaces the further we recede from their mouths, and proceed towards their sources or to the part where the regular current is to take place.

If the depth and volume of water in a river or canal is considerable, it will suffice, in the part next the mouth, to allow one foot perpendicular of declivity through six, eight, or even, according to Deschales, ten thousand feet in horizontal extent; at most it must not be above one in six or seven thousand feet of declivity in equal spaces must slowly and gradually increase as far as the current is to be made fit for navigation; but in such a manner, that at this upper end there may not be above one foot of perpendicular declivity in four thousand feet of horizontal extent. If it is made greater than that in a regular bed containing a considerable volume of water, the current will be so strong as to be found very unfit for the purposes of navigation.

Mr. Massey calls the centre of the current, or more properly, line of greatest current, that line which passes through all the sections of a river, in the point where the velocity of the current is the greatest of all. If the current of a river is regular, and in a right line, its centre, or line of greatest velocity, will be precisely in the centre of the sections; but on the contrary, if the bed is irregular and full of turns and windings, the centre, or line of greatest current, will likewise be irregular, and will have its relation and direction with regard to the sections through which the waters flow, approaching successively, and more or less, to all parts of the bed, but always in proportion and harmoniously to the irregularities in the bed itself.

This division of the line of greatest current from the centres of the sections through which it passes, is a cause of many and great changes in the beds of rivers, such as the following:

1st. In a straight and regular bed, the greatest corrosion of the current will be in the middle of the bottom of the bed; because it is that part which is nearest to the line of greatest current, and at the same time which is most acted upon by the perpendicular direction of the water. In this case, whatever matters are carried off from the bottom will be thrown by the force of the current, equally toward the two sides, where the velocity of the stream is the least and slowest.

2dly. If the bed is irregular and winding, the line of greatest current will be thrown towards one side of the river, where its greatest force will be exerted in proportion to the local causes which turn it aside; in short, in a round stream there will be a gyration, or turning round of the stream, from its bearing against the outer side of the angle; this part will be corroded away, and the bottom near it excavated to a great depth. This matter, when cleared out, will be thrown against the opposite bank of the river where the current is the least, and produce a new ground called an alluvion.

3dly. Inequalities at the bottom of a river retain and diminish the velocity of the water, and sometimes may be so great as to make them reflow; all these effects contribute to the subsiding of sand, earth, and other matters, which cease not to augment the volume of the obstacles themselves, and produce shallows and banks in the channel. These in time, and by a continuance of the causes, may become islands, and so produce great and permanent changes and irregularities in the bed. The perfusion of the centre of the current against the sides of the bed are so much the greater as they are made under a greater angle of incidence; whence it follows, that the force of percussion will be the quantity of water excavated to the bottoms or sluices of rivers, and to the walls of buildings which are exposed to that percussion, are always in a direct compound proportion of the angle of incidence, of the greatness and depth of the section together, and of the quantity of velocity of the current.

4thly. It may happen in time, that the excavation of the bottom, and the corrosion of the sides, will have so changed the form of the river as to bring the force of percussion into equilibrium with the velocity and direction of the current; in that case, all further corrosion and excavation of the bed ceases.

5thly. This gives the reason why when one river falls into another almost in a perpendicular direction, and makes it too great an angle of incidence, this direction is changed in time, by corruptions and alluvions, into an angle much more acute, till the whole comes into a straight line.

6thly. So great and such continued irregularities, from local causes, may happen in the motion of a river as will entirely change its antient bed, corrode through the banks andislands, be the greatest violence of percussion of the stream, and open new beds in grounds lower than the old one is become.

7thly. Hereupon the state of the old bed will entirely depend on the quantity of water, and on the velocity and direction of the current in the new one; for immediately after this division of the waters into two beds is made, the velocity of the current in the old will be diminished in proportion to its less depth. In consequence, the waters will precipitate more of their mind, &c. in equal spaces than they did before; which will more and more raise up the bottom, sometimes even till it becomes equal with the surface of the stream. In this case, all the water of the river will pass into the new bed, and the old one will remain entirely dry. It is well known that this has happened to the Rhine near Leyden, and to many other rivers.

8thly. Hereupon the formation of the new branches and mouth, by which great rivers discharge their waters into the sea.
But in proportion as a river, that has none of these obstacles in its bed, approaches towards its mouth, we see the velocity of its current augment, at the same time that the deadness of the bank to the sea, is. At Ferrara, they are twenty feet high; whereas, nearer the sea, they do not exceed ten or twelve feet, although the channel of the river is not larger in the one place than in the other.

The mouths of rivers, by which they discharge their waters into the sea, are liable to great variations, which produce many changes in them.

1. The velocity and direction of the current at the mouths are in a continual variation caused by the tides, which alternately retard and accelerate the stream.

2dly. During the flowing of the tide, the current of the river is first stopped, then turned in the opposite direction, and entirely changed to a considerable extent: if we may believe M. de Buffon, there are rivers in which the effect of the tides is sensible at 150 or 200 leagues from the sea.

3dly. This state of things is a cause of a great quantity of sand, mud, &c. being precipitated and accumulated in the channel near the mouth. This continually raises and widens the bed, and at last changes it entirely into a new place, or at least opens new mouths to discharge the waters at the Rhine, the Danube, the Wolda, the Indus, the Ganges, the Nile, the Mississippi, and many other rivers, are instances of this.

4thly. All these effects are less sensible at the mouths of little rivers, as their currents oppose no sensible obstacle to the flowing of the tides; so that the ebb carries off again what the flow had brought in.

Whenever the course of a river throughout a considerable extent of country, approaches the coast, it will have a very great rapidity; and the velocity where-with it runs diminishing the effect of its natural gravitation, the middle of the current will rise up, and the surface of the river will form a convex curve of sufficient elevation to be perceived by the eye; the highest point of this curve is always directly above the line of greatest current in the stream.

On the contrary, when rivers approach near enough to their mouths for a sensible effect to be produced in them by the flowing of the tides; and also, when in other parts of their course they meet with obstacles at the sides of their channel; in both these cases the surface of the water at the sides of the current is higher than in the middle, even though the stream should be rapid. In this situation of things, the surface of the river forms a concave curve, the lowest point of which, or that point which lies on the line of greatest current. The reason of this is, that there are in this case two different and opposite currents in the river; that by which the waters flow towards the sea, and preserve their motion even to a considerable distance; and that of the waters which re-mount, either by the flowing of the tide, or by their meeting with local obstacles, which form a counter current.

An island in the mouth of a river produces the same effect as obstacles at the tides, regarding being had to the difference of situation of each.

Eddies and whirlpools in rivers, in the centre of which there appear conical or spiral cavities, and about which the water turns with great rapidity and sucks in whatever approaches it, proceed in general from the mutual percussion of these two counter currents; the movement being produced by the action of the centrifugal force, by which the water endeavours to recede, in a direct ratio of its velocity, from the centre about which it moves.

If rivers persevered always nearly in the same state, the best means of diminishing the velocity of the current when it is found too great for the purposes of navigation, would be by widening the channel; but as all rivers are subject to its quantity and increase and decrease, and consequently to very different degrees of velocity or current, this method is liable to produce very detrimental effects; for, when the waters are low, if the channel is very large in proportion, the stream will excavate a particular bed, and the water depth will be increased in this particular bed, and thereby will strike against the sides of the channel, so as to destroy the banks and cause great damages.

It would be possible to prevent in part the bad effects proceeding from the current striking against the banks, by opening, at those places where it strikes, little gulfs into the land, dug in such a form and direction as that the striking current should enter and circulate therein, so as to destroy, or at least, greatly diminish its velocity. This effect would be felt for a considerable way down the river.

This same method might probably be used with success against the destruction of bridges, weirs, &c. by the violence of the stream during floods, which being dug into the outer side of those turnings in the river which are immediately above the place to be secured from the violence of the stream, would successively diminish its velocity, its force and dangerous effects, a considerable way down the river.

RIVINA, a genus of the monogynia order, in the tridentaria class of plants. The perianthus is four-leafed, coloured, and permanent, the leaflet oblong and obtuse; there is no corolla, unless the calyx is conserved in the bud, or it may be of eight filaments, shorter than the calyx, approaching by pairs, permanent; the anthers are small. The pericarp is large and roundish; the style very short; the stigma simple and obtuse. The base of the calyx is green, the inside of the calyx is white.

The juice of the berries of the plant will stain paper and linen of a bright red colour, and many experiments made with it to colour flowers have succeeded extremely well. The juice of the berries was pressed out, and mixed with common water, putting it into a phial, shaking it well together for some time, till the water was thoroughly tinged; then the flowers, which were white when put in, were cut off, and their stalks placed into the phial; and in one night the flowers have been finely variegated with red; the flowers on which the experiment was made, were the tuberose and the double white narcissus.

RIX-DOLLAR, a silver coin current in different parts of Europe. See Coin.

ROACH. See CYPRINUS.

ROAD, in navigation, is a place of anchorage at some distance from shore, where vessels usually moor, to wait for a wind or tide proper to carry them into harbour, or to set sail. When the bottom is firm, clear of rocks and sheltered from the wind, it is called a good road; and if there is but little land on any side, it is termed an open road.

The roads in his majesty’s dominions are free to all merchant vessels, belonging to his subjects and allies. Captains and masters of ships who are forced by storms, &c. to cut their cables, and leave their anchors in the roads, are obliged to mark or buoys, on pain of forfeiting their anchors, &c. Masters of ships coming to moor in a good road anchor their vessels; and if it be a little land on any side, that is, so that the cables, &c. do not mix, on pain of answering the damages; and when there are several vessels in the same road, the outermost to the sea-ward is obliged to keep a light in his lantern in the night-time, to apprise vessels coming in from sea.

ROASTING. See METALLURGY.

ROB, in pharmacy, the juices of fruit purified and inspissated till it is of the consistence of honey.

ROBBERY, in law is a felonious taking away of another man’s goods from his person or presence against his will, putting him in fear and of force to steal the same. West. Symbol. To make a robbery there must be two persons, the person to be laid in the indictment. 1 H. 11. 532. It is immaterial of what value the thing taken is; a penny, as well as a pound thus forcibly exported, makes a robbery. 1 Haw. 34.

If a man forces another to part with his property, for the sake of preserving his character from the imputation of having been guilty of an unnatural crime, it will amount to a robbery, even though the party was under no apprehension of personal danger. Latch. Cor. Law. 257.

If any thing is snatched suddenly from the head, hand, or person of any one, without any struggle on the part of the owner, or without any evidence of force, or violence being exerted by the thief, it does not amount to robbery. But if any thing is broken or torn in consequence of the sudden seizure, it would be evidence of such force as would constitute it a robbery. A lady’s purse was torn by a diamond pin from her head, and an ear was torn by pulling off an ear-ring; each of these cases was determined to be a robbery. Latch. Cor. Law. 264.

By 7 C. H. c. 21, if any person shall, with
any offensive weapon assault, or by menaces, or in any fierce or violent manner, demand any money or goods, with no reasonable intent to rob; but generally, one should be guilty of felony, and be transported for seven years.

If any person being out of prison, shall commit any robbery, and afterwards discovers any two persons guilty of robbery, he shall have the king's pardon.

The hundred in which a robbery on the highway is committed, is liable to pay the damage when it is committed between the rising and setting of the sun, in any day, except Sunday, in case the robbers are not taken in forty days; and any being made after the fourth day, and any who apprehends and prosecutes a robber on the highway, so as to convict him, is entitled to receive of the sheriff of the county where the robbery was committed, the sum of forty pounds, with the help of the judge, and such person's producing a proper certificate from the judge before whom the robber was convicted.

ROBERGL, a genus of the class and order decandria pentagynia. The cal. is five-parted; pet. five; fr. four, the outer one or two, simple or valved. There is one species a shrub of Guiana. -

ROBINIA, false acacia, a genus of the decandria order, in the diadelphia class of plants; and in the natural method ranking under the 32d order, papilionaceae. The calyx is quadrate; the leguminous gibbs and elongated. There are seventeen species. The most remarkable is the caragana, the leaves of which are conglutinated, and composed of a number of small foliolates, of an oval figure, and banded leaves, that are in one common stock. The flowers are leguminous, and are clustered on a filament. Every flower consists of a small bell-shaped petal, cut into four segments at the edge, the upper part being rather the staminate. The seed is small, open, and rounded. The wings are large, oval, and a little raised. Within are ten stammas united at the base, curved towards the top, and rounded at the summit. The style is a slender stem, formed by the filaments of the stammas, the pistil is perceivable, consisting of an oval Gerran, terminated by a kind of button. This Gerran becomes afterwards an oblong flatish covered with pubescent, containing two or three seeds, of a large size and shape irregular and unequal; yet in both respects somewhat resembling a lentil.

This tree grows usually in the severe climates of Northern Asia, in a sandy soil mixed with black loam. It is particularly found on the banks of great rivers, as the Ob, Jenissi, &c. It is very rarely met with in the inhabited parts of the country, because cattle are very kind of its fruit, and by the height of its roots; and it is so hardy, that the severest winters do not affect it. Giraldus found it in the neighbourhood of Tobol's, buried under fifteen feet of snow and ice, yet laid it not suffered the least damage. Its culture exists in being planted or sowed in a sandy loamy soil, which must on no account have been lately manured. It thrives best near a river, or on the edge of a brook, or pond; but presently dies if planted in a marshy spot. If planted upon a rich soil, well tilled, it will grow to the height of twenty feet, and in a very few years will be as big as a common birch tree.

In a dry and soil this tree degenerates, and becomes a mere shrub: the leaves grow hard, and their fine bright green colour is changed to a dull deep green. The Tonga- nir Tartars, and the inhabitants of the northern parts of Siberia are very fond of the fruit of this tree, it being almost the only sort of pulse they eat. The leaves and tender shoots of this tree make excellent fodder for several sorts of cattle. The roots being sweet and succulent, are very well adapted for fattening hogs; and the fruit is greedily eaten by all sorts of poultry. After several experiments somewhat similar to the methods used with swine and indigo, a fine blue colour was procured from its leaves. The smaller kind of this tree seems still better adapted to answer this purpose. The striking elegance of its foliage, joined to the pleasing yellow colour of its beautiful flowers, should, one would imagine, bring it into request for forming handsome hedges. Besides the qualities above recited, it possesses the uncommon advantage of growing exceedingly quick, and of being easily transplanted. There are large plantations of it in Sweden, Norway, Lapland, and Iceland.

The robinia spinosa is a beautiful hardy shrub, and on account of its robust strong prickle, might be introduced into this country as a hedge plant, with much propriety. It resists the severest cold of the climate of St. Petersburg, and perfects its seed there. It rises to the height of six or eight feet; does not send out suckers from the root, nor ramble so much as to be kept with difficulty within bounds. Its flowers are yellow, and the general colour of the plant a light pleasing green.

ROBINSONIA, a genus of the icosophora monogynia class and order. The cal. is five-parted; pet. five; berry straited, two-celled; cells one-seeded; seeds villose. There is one species, a tree of Guiana.

ROCHFORTIA, a genus of the class and order pentandria digynia; the cal. is five-parted; cor. one-petalled, funnel-shaped; fruit two-celled, many-seeded. There are two species, of Jamaica.

ROCK-CRYSTAL. See Quartz.

ROCKET. See Pyrotechny.

ROCKS are divided into five classes: namely, 1. Primitive rocks; 2. Rocks of transition; 3. Stratified, or secondary rocks; 4. Alluvial deposits; 5. Volcanic rocks.

Rocks primitive.

The rocks belonging to this class are distinguished from all others in containing no remains of organic bodies, and being derived by the rocks of the other classes, but themselves covering any other class of rocks. The term primitive was applied by Lehaman, to whom we are indebted for the first scientific division of rocks, on the supposition that the rocks so denominated were formed before any other; and the term has been continued by Werner, because he has embraced the same hypothesis. The following table contains the different divisions of primitive rocks, arranged in the order in which Werner thinks they were formed.

1. Granite.
2. Gneiss.
4. Arglitaceous shisus.
5. Topazels.
6. Porphyr.
7. Serpentine.
8. Primitive limestone.

Let us take a view of each of these in order.

Granite is composed essentially of felspar, quartz, and mica, crystallized and united to each other. The size and proportion of the constituents vary exceedingly; but the felspar usually predominates, and the proportion of mica is smallest. Its texture is granular, and its hardness usually very considerable; hence it admits a fine polish, and is very beautiful and durable. Granite sometimes contains shorl accidentally mixed with it, and still more rarely garnets. Granite rocks are sometimes composition, and sometimes not.

They are very common, especially in great chains of mountains. Granite contains few ores. Those of iron and tin occur most frequently. See Granite and Gneiss.

Gneiss, like granite, is composed essentially of felspar, quartz, and mica; but they form plates which are laid on each other, and separated by thin layers of mica. The beds of gneiss sometimes alternate with layers of granular limestone, shisotse, hornblende, and porphyry.

Micaeous shisus. This rock is composed essentially of quartz and mica, which alternate in plates. The mica is usually most abundant. It is grey or brown, and sometimes greenish. The texture of micaeous shisus is essentially shisous. Its stratification is very distinct. It very frequently contains garnets, and sometimes felspar, cyanite, granite, and tourmalines. In mountains, beds of micaeous shisus often alternate with those of granular limestone and hornblende shisus, and are associated with those of actinize, pyrites, galena, and other metallic bodies. Indeed almost all the metals are found in it either in beds or veins.

Argilitaceous shisus. This rock is composed essentially of silex or silicious shisus; but it sometimes contains accidentally quartz, felspar, shil, hornblende, and pyrites. It is always shisous; but the thickness of these layers varies considerably. The beds of this rock are often interrupted by subordinate beds of other minerals; the chief of these are chlorite-shisus, talc-shisus, zeichen-schifer, clum-shisus. These frequently pass into argilitaceous shisus. Sometimes also beds of granular limestone, hornblende, and some metallic ores, alternate with argilitaceous shisus. This rock usually covers micaeous shisus.

Micaeous shisus are more common in this rock, but less so than in the two preceding. They are usually in veins.

Porphyry. The term porphyry is applied to all rocks consisting of a compact ground, in which distinct and separate crystals of some other substance are embedded. Werner confuses it to certain primitive rocks which belong to a particular formation. These, considered relative to their ground, are divided into five species, each of which is denominated from its ground.

1. Hornstone porphyry. The hornstone is sometimes conchoidal, sometimes splintery,
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and of a red or green colour. The crystals are quartz and felspar.

2. Felspar porphyry. The ground is usually red. The crystals are felspar and quartz.

3. Sienite porphyry. The ground is a mixture of felspar and hornblende. The crystals are felspar and quartz.

4. Pitchstone porphyry. The ground is red or green, sometimes brown, and even black.

5. Clay porphyry. The ground is an indurated clay, commonly red, which sometimes passes into jelly-like hornstone. The crystals are felspar and quartz; sometimes it contains hornblende, and more rarely mica.

Porphyry mountains are not stratified, and contain no beds of foreign substances. They are not rich in ores, yet frequently contain veins worth working.

Sienite. This rock is composed essentially of crystals of felspar and hornblende, immediately and intimately united. The felspar usually predominates. When the felspar is compact, the rock assumes a porphyritic structure. It sometimes contains accidentally grains of quartz and mica, but in a very small proportion. Its texture is granular, rarely stratified; it does not contain foreign beds. It sometimes contains metallic veins. It usually covers porphyry.

Serpentine. This rock is essentially simple. Sometimes it contains, accidentally, talc, asbestos, and statite; and sometimes mica, garnets, and granular limestone, magnetichornstone, arsenical pyrites, &c. Serpentine rocks are not stratified. Seldom contain beds of foreign minerals. They contain few ores, and seldom any worth working.

Primitæ limestone. This rock is essentially simple: its mass is granular limestone of a greyish white colour. Sometimes it is accidentally mixed with mica, quartz, hornblende, tremolite, actinote, asbestos, talc, &c. Its texture granular, the grains have a foliated texture, and a crystallized appearance. This rock sometimes contains metallic veins of pyrites, chalcedony, magnetichornstone, blonde, and pyrites.

Primitæ traps. The word trap is Swedish, and signifies a stair. It was applied by the Swedish mineralogists to certain rocks whose structure was similar to that of the jutting out under the other, gave an appearance somewhat like a stair. The term was adopted by other nations, and was applied indiscriminately to a great variety of rocks; which, yet bore a certain resemblance to each other. This generalization, however, introduced much confusion into the subject, which was first cleared up by Werner and his disciples. Under the term traps Werner comprehends certain series of rocks, distinguished chiefly by the hornblende, which they all contain. In the most antient, the hornblende is almost pure; this purity gradually diminishes, and in the most recent traps the hornblende-degenerates to a kind of interlaced clay stone. It is three formations of traps: 1. Primitæ traps; 2. Transition traps; 3. Secondary traps. The first only occupy our attention at present.

The primitive traps are composed almost entirely of felspar, which is sometimes mixed with felspar, more rarely with mica and pyrite. There are four species: 1. Common

ground are two species of rocks of grauwacke, common and shistose.

Grauwacke. There are two species of rocks of grauwacke, common and shistose.

Common grauwacke is a siltstone composed of grains of quartz, kieschieder, and argillaceous shistus, agglomerated by a cement of clay. The grains are sometimes very small, sometimes as large as a hazel nut.

Grauwacke are traversed by veins of quartz. They contain sometimes shells and reeds petrified. They contain no foreign beds. These rocks are distinctly stratified. The strata do not run parallel to those of the other rocks on which they lie. They usually cover transition limestone, and do not rise to any great height. They are rich in ores.

Transition traps. The principal base of all the rocks belonging to this formation is grauwacke. This constitutes many of the primitive traps; but in the transition traps, the mixture is much more intense, the grain is much finer, and the mass much more homogeneous, and its constituents are more or less blended together. Transition traps consist principally of two species, mandelstein and globular trap.

1. Mandelstein or argilloglaucon. By this term is implied all rocks composed of a compact ground, containing interbedded in it minerals of a round or almond form, or containing cavities of that form. They are distinguished into primitive, transition, and secondary mandelsteins. Transition mandelstein consists of a ground of shistose hornblende, decomposed and resembling wacken or foruginous clay. The cavities are sometimes empty, sometimes full, and then they contain quartz and clodeline. This stone of Derbyshire is referred to this species. It contains round masses of calcareous spar.

2. Globular trap. This is a shistose grunstein, partly decomposed and reduced to the state of a fine grained wacken. It is composed of large spherical bodies, consisting of concentric layers; the central part being hardest.

Transition traps are not stratified. They form separate conical mountains, usually near those of transition limestone. They contain some metallic veins of copper, iron, tin, &c.

CLASS III.

Rocks secondary.

These rocks are distinguished by the resemblance of organs of the original rocks, which they contain abundantly. They are usually stratified. The following table contains a list of these different rocks, arranged according to the supposed time of their formation.

1. Sandstone, 6. Pit coal,
2. Gritstone, 7. Eiselstein,

Sandstone. This rock is composed of quartz, varying in size; sometimes also grains of kieschieder, and very splintery of felspar. These grains are cemented together, sometimes by means of clay, sometimes of mud or lime, and sometimes of quartz. The cement varies in quantity, but never predomin-
The size of the grains varies much; when large, the rock is usually called pudding stone.

2. This rock is very distinctly stratified. The beds of it often alternate with beds of compact limestone, red clay, slate, and a species of sandstone, which is fine-grained, and mixed with laves of mica, which gives it the appearance of micaceous shist. It contains two metallic ores of value. Sometimes coal is found in it.

Secondary limestone. This rock is simple, and composed of compact limestone. Occasionally it contains crystals of quartz, pyrite, etc. Shells occur very frequently in it. It is very distinctly stratified. Its beds are sometimes separated by beds of shistose bituminous marl and sandstone, and by terraces of hornstone and flat often arranged in beds. It is often traversed by metallic veins, chiefly of galena, grey copper ore, malachite, etc.

Chalk. The strata of chalk may be considered perhaps as analogous to those of secondary limestone. They consist entirely of limestone and are traversed by thin beds of flint in terraces. Shells often occur converted into silicious matter, and sometimes pyrites in spherical masses. No metallic ores ever occur in them.

Gypsum. The strata of gypseum usually occur in mountains alternating with those of sandstone, limestone, marl, clay, rock salt. They often contain foreign crystals, chiefly quartz, aragonite, horsetail, garnet; sometimes they contain sulphur. Few petrofacies are found in them except the bones of quadrupeds. They contain scarcely any metallic ores. See Sulphate of Lime.

Rock salt. The mountains which contain strata of rock salt are to be referred to a particular formation of gypseum, with which they usually alternate. They contain no ores.

Pit coal is found in two different formations. The first of these is distinguished particularly by the name of coal formation, or mountains of coal. They are usually composed of beds of: 1. Very brittle sandstone, containing often small particles of mica; 2. Limestone of very large grains; 3. Shistose clay; 4. Marl; 5. Limestone; 6. An argillaceous porphyry distinguished by the name of secondary porphyry; 7. Ferruginous clay; 8. Coal. The beds of coal vary in thickness, and in number.

This formation of coal occupies countries of no great elevation. They occur chiefly at the bottom of chains, and in the intermediate valleys. The strata of coal in the north of England belong to it.

Coal is found in other situations, especially in the secondary trap formation. Those of Scotland belong to this class.

Argillaceous lavas. The beds of this mineral usually alternate with those of indurated clay, shistose clay, marl, brachiopods, and sandstone. They frequently contain calamine mixed with galena. The impressions of plants and marine petrofacies are often observable in them. They usually form small insulated lumps, and are not very common.

Secondary traps. The mountains of secondary traps are composed of various rocks; some of which belong exclusively to this formation; others are found also in other mountains. The rocks peculiar to secondary traps are: 1. Basalt; 2. Wacken; 3. Basaltic tuff; 4. Secondary mudstone; 5. Porphyry shistus; 6. Graustein; and, 7. Secondary graustein.

1. Basalt, considered as the mass of a mountain, is a rock more or less composed of a glassy, or glassy, and obsidional, structure, and for its ground the mineral called basalt. It contains usually grains of olivine, augite, basaltic hornblende, magnetic ironstone, and sometimes kaolite, felspar, quartz, &c.; sometimes also mica, actinolite, clinohumite. Sometimes we observe the ironstone is so detritus that in case its cavities are filled with zeolite, steatites, limestone, &c.

It usually appears in large separate masses often prismatic. It is very common often forming detached mountains.

2. Wacken sometimes forms beds in the secondary traps. It is usually between clay and basalt. It neither contains olivine nor augite, but crystals of basaltic hornblende, and about 10 per cent of felspar. The last substance distinguishes wacken from basalt, which very seldom contains it.

3. Basaltic tuff results from the decomposi- tion of certain basalt. It consists of fragments of this rock, and contains the remains of vegetables, &c., agglutinated by a cement of clay.

4. The amygdaloids or medullates of the secondary traps have for their base a clay-andalusite, and decomposed granite, often penetrated with silicious matter. It has a good deal of resemblance to wacken, and sometimes passes into it; at other times it assumes a more compact texture, and passes into basalt. Its cavities are sometimes empty, sometimes filled with green earth, zeo- lite, limestone, &c.

5. Porphyry, sithistus is a rock whose structure is shistose, and its texture porphyritic. Its base is kaolinite, containing grains of felspar, and sometimes of hornblende. It has a good deal of resemblance to basalt, and often passes into it. But it is more nearly a chemical compound, being more transparent, sonorous, and hard.

6. Graustein is a rock composed of small grains of felspar and hornblende, which graduate into each other and form a mass almost homogeneous of an ash grey colour. It contains olivine and augite.

7. Secondary graustein, like the primitive and transition, is composed of hornblende and felspar; but its grains are less perfectly crystallised, and less intimately mixed. It usually covers rocks of basalt.

Such are the rocks peculiar to thesecondary
trap formation. They have all less or more of a crystallised structure; whereas the other minerals found in secondary traps, but not peculiar to them, are mechanical depositions. Wacken and basalt form the passage from the one to the other. The mechanical depo-
sitions, sand, clay, &c., are usually lowermost; they are covered by wacken. Some of the other substances always occupy the summits. These consist of a considerable abundance of petrofacies, but no ores except some veins and grains of iron. They are usually insulated; very seldom forming chains. Some of the other substances always occupy the summits.

Traps. Some of the trap formations present a greater abundance of petrofacies, but no ores except some veins and grains of iron. They are usually insulated; very seldom forming chains. The mountains of basalt and porphyry shistus are usually covered by rocks. They are hardly ever covered by other rocks. They usually cover sandstone, coal, secondary limestone, shistose clay; and veins of them are not uncommon in primitive mountains.

Class V.

Rocks volcanic.

This name is given to all the minerals thrown out during volcanic eruptions. The most complete account of them has been given by Dolomieu, who devoted the greatest part of his life to the study of volcanoes. Part of his division was published by him in the Journal de Physique for 1794; and an account of the whole has been given by Brochard from notes taken during a course of geology given by Dolomieu in 1797. Volcanic products have been divided by this celebrated geologist into five classes: 1. Minerals modified by the fire of volcanoes; 2. Substances not modified by the fire, but thrown out unaltered; 3. Substances subjected by the fire of volcanoes; 4. Minerals altered by the sulphurous acid vapours of volcanoes; 5. Volcanic minerals, affected by the action of the atmosphere.

Minerals modified by the fire. This set of minerals is subdivided into two heads. The first comprehends those minerals which, though they have been modified by fire, yet exist in no other combination. The second consists of those which retain obvious marks of the action of fire. Those of the first head have been distinguished by the name of compact lavas; those of the second by the name of porphyry.

Compact lavas bear so close a resemblance to certain rocks of an origin not volcanic, that it is extremely difficult to distinguish them. Some have the appearance of basalt; others of granite, porphyry, and various secondary traps. Dolomieu divides them into four species according to their base.

1. Compact lavas with an argillaceous

core. Their colour is usually black. Fracture imperfectly conchoidal. Texture very compact. Sonorous. Shell argillaceous. Attract the magnetic needle. Very common in volcanic countries. Frequently contains crystals of augite, felspar, hornblende, garnet, leucite, olivine, mica. A specimen of the lava of Catania in Sicily, analysed by Dr. Kennedy, contained:

<table>
<thead>
<tr>
<th>Component</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sodium</td>
<td>51.00</td>
</tr>
<tr>
<td>Magnesium</td>
<td>19.00</td>
</tr>
<tr>
<td>Iron oxide</td>
<td>14.50</td>
</tr>
<tr>
<td>Iron</td>
<td>9.50</td>
</tr>
<tr>
<td>Soda</td>
<td>4.00</td>
</tr>
<tr>
<td>Muriatic acid</td>
<td>1.00</td>
</tr>
</tbody>
</table>

99.0.

Specific gravity 3.20. A specimen of the lava of Sta Venere in Sicily he found to contain:

<table>
<thead>
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<th>Component</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sodium</td>
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</tr>
<tr>
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<tr>
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<td>14.25</td>
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<tr>
<td>Iron</td>
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<tr>
<td>Soda</td>
<td>4.00</td>
</tr>
<tr>
<td>Muriatic acid</td>
<td>1.00</td>
</tr>
</tbody>
</table>

97.5.

Compact lavas with a petrosilicaceous base. Colour very variable, grey, black, and white; but all become white before the blow-pipe. Fracture conchoidal. Grain fine and compact. Shells slightly argillaceous. Does not affect the magnetic needle. Contains unifiny
Nearly the same result had been previously obtained by Dr. Kennedy.

Volcanic sands and ashes. The sands are composed of grains varying in size. They are usually mixed with crystals of felspar, such as orthoclase, microcline, &c. and often cover a great extent of ground. Vesuvius has covered the country for 50 leagues round it with a bed of sand twelve feet thick. Volcanic ashes are merely very fine sand. They are so light that during the eruptions of Etna, the winds often transport them as far as Egypt.

Agglutinated matters. These are merely sands and ashes covered and cemented together by a torrent of molten lava.

Calced substances. All stony bodies which have undergone a kind of calcination by volcanic fires are denoted by this name. All volcanic matters often undergo this change. Their grain is rendered more harsh, and their feel more dry. The fergusious lavas become more red, and cease to be attracted by the magnet.

Minerals not modified by the fire. These remain as they were in the mountain before the commencement of volcano action, and are thrown out by it unaltered. The study of them is important, because they inform us of the internal structure of volcanic mountains.

They generally belong to the primitive rocks. Sometimes they are fragments of rocks, and sometimes groups of crystals. They are thrown out in general at the beginning of eruptions.

Volcanic ashes sometimes emit torrents of muddy water. From these have originated the minerals called volcanic tufas. Their colour is various.

Substances sublimed. An immense quantity of matter is exhaled by volcanoes; partly in the state of gas or steam, partly in a visible form.

Hydrogen gas, carbonic acid, sulphurous acid, muriatic acid, nitric acid, &c. have been detected issuing from them.

The mineral substances which are sublimed from them, and which afterwards are deposited on their sides, are sulphur, which is very abundant; mineral oil, and various salts, especially nitrates of ammonia, soda, copper, and iron; sulphate of iron; and carbon of soda. Metallic bodies are also found among these substances: iron, copper, antimony, arsenic, cinnabar, &c.

Substances altered by sulphurous acid vapours. The sulphur volatile by volcanics is often converted into an acid, which, acting upon the lavas, changes their appearance considerably. They become of a yellowish-white colour, much lighter and dryer, and are more easily pulverized. They contain an unusual proportion of silica, because the sulphurous acid has combined with the alumina, and formed a salt afterwards washed away by the rain. The same vapours often attack stony matters not volcanic.

The principal products of the action of these vapours on lavas are alum and sulphas of lime, magnesium, and iron. These salts, especially the first, are collected with great advantage.

Volcanic substances altered by the action of the atmosphere. All rocks undergo greater or smaller changes when long exposed to the atmosphere, but these changes are much greater and more rapid in volcanic rocks than in others. Sometimes, however, they are very slow. Hence the age of volcanoes cannot be determined by the state of their volcanic eruptions.

The argilo-ferruginous lavas become first petrified; the petrified strata become of a dirty grey. By degrees they assume an earthy appearance, and pass at last to a kind of friable clay. The scoria undergo the same changes much more rapidly. The earthy matters produced by this decomposition are afterwards washed down by the waters, and form large beds, which constitute a very fertile soil. The porous lavas are often partly filled with earth washed down by rains from decomposed lavas. Dolomieu supposed many crystals to owe their existence to the inclusions of such waters.

Besides the real products of volcanoes, there are rocks which have been more or less altered by the action of fires not volcanic. These fires have often originated in the combustion of strata of coal. These have been called pseudo-volcanic rocks. These rocks are four in number; namely, porcelain jasper, brown, earthy scoria, and a particular variety of polierischei.

Porcelain jasper is considered as a stiostoic clay, which has been calcined. Burnt clay resembles brick: it has been exposed to a lesser fire than porcelain jasper. Like that mineral it is considered as having been originally a stiostoic clay. Earthy scoria are light porous substances like scoria. They appear to have been melted. They are usually near the strata. A variety of polierischei sometimes occurs, which apparently have been to a clay exposed to a moderate degree of heat, and rather dried than calcined. To these pseudo-volcanic minerals may be added the vitrified sorts, not uncommon in the highlands of Scotland. They seem to have originated from artificial fires. See GEOLOGY, MOUNTAINS, MINERALOGY, &c.

ROD, a land measure of sixteen feet and a half: the same with perche and pole. 

ROE, in gauging. See GAUGING.

ROE, the spawn or seed of fish. That of male fishes is usually distinguished by the name of milt, or milt, and that of the female, by hard-milt, or spawn.

So inconceivably numerous are these ovula, or small eggs, that Mr. Petit found 342,144 of them in a carp of eighteen inches; but Mr. Leenebenock found in a carp no more than 211,069. This last gentleman observes, that there are four times this number in a cod, and that a common one contains 9,344,000 eggs.

ROella, a genus of the monogynia order, in the pteridaria class of plants; and in the natural method ranking under the twenty-ninth order, campagnaera. The corolla is funnel-shaped, with its bottom shut up by staminal infundibulae; the stigma is bi-lobed, the capsule bilocular, and cylindrical inferior. There are five species, shrubby plants of the Cape.

ROGUE, in law. See VAGRANT.

RHIORA, a genus of the class and order triamium monogynia: the eal is bell-shaped, five-petalled, unisexual; stigma simple, revolute: caps. There is one species, a shrub of Guiana.

ROLANDRA, a genus of the class and order synergasia polygama superbia. The
fleorses are banded in a head with scales interspersed; called two-celled, one-sowered, and single-ecorys hermaphrodite. There is one species, a shrub of the West Indies.

ROLL, in manufactories, something wound and folded up in a cylindrical form.

Frame rolls, represented by the genus feet, exist as sallies, gauges, and creases, which are apt to break, and take plats not easy to be got out, if folded otherwise. Ribbons, laces, galloons, and pads of all kinds, are also thus rolled.

A roll of tobacco is tobacco in the leaf, twisted on the mull, and wound twist over twist, about a stick or roller. A great deal of tobacco is sold in America in rolls of various weights; and it is not till its arrival in England, Spain, France, and Holland, that it is cut. A roll of parchement properly denotes the quantity of sixty skins.

Theautists made all their books up in the form of rolls, and in Cicero's time the library consisted wholly of such rolls.

Roll, in law, signifies a schedule or parchement which may be rolled up by the hand into the form of a pipe.

In these schedules of parchement all the pleading, memorials, and acts of court, are entered and filed by the proper officer; which being done, they become records of the court. Of these there are in the exchequer several kinds, as the great workhouse-roll, the cointry-roll, the subsidy-roll, &c.

Roll is also used for a list of the names of persons of the same condition, or of those who have entered into the same engagement. Thus a court-roll of a mayor, bailiff, or in which cases, and services of each tenant are copied and enrolled.

Roll, master, that in which are entered the soldiers of every troop, company, regiment, &c. As soon as a soldier's name is written down on the roll, it is death for him to desert.

Rolls-office, is an office in Chancery-lane, London, appointed for the custody of the rolls and records in chancery. Rolls of parliament, are the manuscript registers, or rolls of the proceedings of our antient parliaments, which before the invention of printing, were all engrossed on parchement, and preserved properly in every country; in which rolls are also contained a great many decisions of different points of law, which were frequently in former times referred to the decision of that high court.

Roll, or Roller, is also a piece of wood, iron, brass, &c., of a cylindrical form, used in the construction of several machines, and in several works and manufactories.

A rolling-mill shewn in fig. 4. Plate, consists of two iron rollers A B, mounted in a strong iron frame, which consists of two distinct parts D E, both firmly fixed to the iron floor F; each has a long mortise through it, in the bottom of which is the brass socket for the pivot of the roller A; and in the upper part is the brass of the upper roller; this last brass is fixed to a piece of iron G, fig. 5, which slides up and down in the mortise, and is prevented from raising at the end of a stroke, by a screw a, screwed through the brass of the end of the frame D; the roller is prevented from falling by its own weight, by the brass b in the under side of the pivot, which is attached by two screw-bolts d to a collar upon the screw a, so that when the screws are turned by a hand-spike put between the teeth of the wheel H, the rollers A and B may be brought nearer together or farther off, as occasion requires. It is a stout iron bar, fixed between the frames D E by a wedge i at each end. The face is level with the top of the lower roller; at a small distance above this, is another bar k, fixed by two screws, between these are laid several blocks of iron L, so as to fill up all the space, except the opening, through which the bar to be flattened is introduced; thus is a small trough of iron plate, bored full of holes, to which fluid water is brought by a small pipe p. The upper roller is put in motion by a strong shaft H, which conveys the power from a water-wheel, &c.; and the lower one is moved by a cog-wheel S, on the shaft R, which turns another T, on the axis of the lower roller. The machine is placed near to a furance, where the iron bars are to be rolled, are heated to a welding heat; the mill is then put in motion, and the iron bars taken out, with a pair of pinches, and their ends put through the opening between the bars k and L, before the roller s, which then square and squeeze the iron flat, and to the proper thickness throughout, while other men behind the machine, convey it away. The rollers can be set nearer or farther off by turning the pair of keys described. The plough-mouth is principally used for making hoops for barrels, and iron plates; the water brought by the pipe p is to prevent the roller from being heated by the iron.

ROLLER, in surgery, a long and broad handle, usually of linen-clot, rolled round any part of the body, to keep it in, or dispose it to a state of health.

RONDELETTA, a genus of the monogynia order, in the penicillin class of plants, and in the natural method ranking with those of which the order is doubtful. The corolla is funnel-shaped; the capsule bilocular, inferior, and polyporous, rounded, and crowned. There are 14 species, shrubs of the West Indies.

ROOD, a quantity of land equal to forty square perches, or the fourth part of an acre.

ROOF. See Architecture.

ROOK, in ornithology. See Corvus.

Root, in mathematics, a quantity considered at the basis or foundation of a higher power; or which being multiplied into itself any number of times, produces a square, cubic, &c., quadratic, &c., quantity; called the second, third, fourth, &c., power of the root, or quantity, so multiplied into itself; thus a is the square root of a x a, or + a, and 4 the square root of 16 a a = a 2 ; again, a is the cube-root of a x a x a = a 3 ; and 3 the cube-root of 3 x 3 x 3 = 27 ; and so on. See Algebra.

The roots of equations are expressed by placing the radical sign + over them, with a number denoting what kind of root they are: thus the square or second root of 16 is expressed by + 16; the cube or third root of 27 by + 27; and, in general, the nth root of a raised to the mth power, is expressed by a m/n. When the root of a compound quantity is wanted, the vinculum of the radical sign must be drawn over the whole; thus the square root of a 2 + b 2 is expressed by a 2 + b 2 ; and it ought to be understood, that when the radical sign has no number above it, to denote what root is wanted, the square root is always meant; as + a, or + a 2 , is the square root of a, or the square root of 16. ROPE, hemp, hair, &c., spun into a thick yarn, and then several strings of this yarn twisted together in the same manner as a single rope. When it is laid up on a board it is called a cord, and when very thick, a cable. All the different kinds of this manufacture, from a fishing-line or whipcord to the cable of a first-rate ship of war, go by the general name of cordage.

Cordage is made of every substance that is sufficiently fibrous, flexible, and tenacious, and chiefly of the inner barks of plants. The Chinese and other orientals even make them of the ligneous parts of several plants, such as certain hemp, and reeds, the stems of the aloes, the fibrous covering of the coconuts, the filaments of the cotton-pot, and the leaves of some grasses, such as the sparte (lygern, Limn.). The aloe (agave, Limn.) and the aloes is exceed all others in strength. But the barks of plants are the most productive of fibrous matter fit for this manufacture. Those of the linden tree (tilia) of the willow, the bramble, the meadowsweet, are frequently used; but of all these the hemp is preferred, and employed in all cordage exceeding the size of a line, and even in many of this denomination.

Hemp is very various in its useful qualities; the hemp in Europe comes to us tho' gh Riga, to which port it is brought from very distant places southward. It is known by the name of rigma relis (that is, clean hemp). Its fibre is not the longest (for the dressed state of it, get it) but it is the finest, most flexible, and strongest. The next to this is supposed to be the Petersburgh break hemp. Other hampers are esteemed nearly in the following order: Petersburgh-out, hemp from Köningsburg, Archangel, Sweden, Memel. Chucking is a name given to a hemp that comes from various places, long in the fibre, but coarse and hard, and its strength is inferior to hemp which appears weaker. Its texture is such, that it does not admit splitting with the hatchet, so as to be more completely dressed; it is, therefore, kept in its coarse form, and used for inferior cordage. It is, in length and strong hemp, but will not make fine work. There are doubtless many good hamps in the southern parts of Europe; but little of them is brought to our market. Cordage, half clean, &c. are portions of the above-mentioned hamps, separated by the dressing, and may be considered as broken fibres of those hamps.

Only the first qualities are manufactured for the rigging of the royal navy, and for the ships of the East India company.

ROPE-MAKING, is an art of very great importance; and there are few that better deserve the attention of the intelligent observer. Hardly any art can be carried on without the assistance of the rope-maker. Cordage makes the very sinews and muscles of a ship, and every improvement which can be made in its preparation, either in respect to strength, beauty, or durability, must be of great importance to the mariner, and to the commerce and the defence of nations.

The aim of the rope-maker is to unite the strength of a great number of fibres. This would be done in the completed manner by
ROPE-MAKING.

Laying the fibres parallel to each other, and fastening the bundle at the two ends; but this would be of very limited use, because the fibres are short, not exceeding three feet and a half at the most, and must therefore be entangled together, in such a manner that the strength of a fibre shall not be able to draw it out from among the rest of the bundle. This is done by twisting or turning them together, which causes them mutually to compress each other. When the fibres are so disposed in a long skain, that their ends extend each other along its length, without any of them meeting in one place; and this skain is twisted round, we may cause them to compress each other to any degree we please; and the friction on a fibre which we attempt to pull out, may be more than its cohesion can overcome. It will therefore break. Consequently, if we pull at this twisted skain, we shall not separate it by drawing one parcel out from among the rest, but the whole fibres will break; and if the distribution of the fibres has been very equal, the skain will acquire the same strength in every part. If there is a large bundle, where many ends of fibres meet, the skain will break in that part.

We know very well that we can twist a skain of fibres so very hard, that it will break with great attempt to twist it further. In this state all the fibres are already strained to the utmost of their strength. Such a skain of fibres can have no strength. It cannot carry a weight, because each fibre is already strained in the same manner as if loaded with as much weight before it as bear. What we have said of this extreme case is true in a certain extent of every degree of twist that we give the fibres. Whatever force is actually exerted by a twisted fibre, in order that it may sufficiently compress the rest to hinder them from being drawn out, must be considered as a weight hanging on that fibre, and must be deducted from its absolute strength of coherence, before we can estimate the strength of the skain. The absolute strength of a skain is the remainder of the absolute strength of the fibre, after we have deducted the force employed in twisting them together. From this observation we find one fundamental principle in rope-making, that twisting, beyond what is necessary for preventing the fibre from being drawn out without breaking, diminishes the strength of the cordage, and should be avoided when in our power.

It is necessary then to twist the fibres of hemp together, in order to make a rope; but we should make a very bad rope if we contended ourselves with twisting together a bunch of hemp fibres before we endeavors to withstand the strain to which the rope is to be exposed. As soon as we let it go out of our hands, it would untwist itself, and be again a loose bundle of hemp; for the fibres are strained, and they are so made as to twist downwards or vice elastic, they contract again, and thus untwist the rope or skain. It is necessary to confine the twist in such a manner, that the tendency to untwist in one part may act against the same tendency in another, and balance it. The process, therefore, of rope-making becomes more complicated.

The first part of this process is spinning of rope-yarns, that is, twisting the hemp in the first instance. This is done in various ways, and with different machinery, according to the nature of the intended cordage. We shall confine our description to the manufacture of the larger kinds, such as are used for the stringing and running rigging of ship.

An alley or walk is inclosed for the purpose, about 200 fathoms long, and of a breadth suited to the extent of the manufacture. It is sometimes covered above. At the upper end of the rope-walk is set up the spinning-wheel, of a form resembling that in Plate Misc. fig. 210. The band of this wheel goes over several rollers called whirns, turning on pivots in brass holes. The pivots at one end come in and out of the frame, and terminate in little hooks. The wheel being turned by a winch, gives motion in one direction to all those whirns. The spinner has a bundle of dressed hemp round his waist, with the two ends fastened. The hemp is laid in this bundle in the same way that women spread the flax on the distaff. There is great variety in this; but the general aim is to lay the fibres in such a manner, that as long as the bundle lasts there may be an equal number of the ends at the extremity, and that a fibre may never offer itself double or in a sight. The spinner draws out a proper number of fibres, twists them with his fingers, and so sets them in the greatest degree of order, that he fixes it to the hook of a whirn. The wheel is now turned, and the skain is twisted, becoming what is called a rope-yarn, and the rope-walks backwards down the rope-walk. The parcel of yarns, as far as it is necessary, are twisted with it more fibres out of the bundle. The spinner spins this with his fingers, supplying hemp in the proportion as he walks away from the wheel, and to the care that the fibres came in equally from both sides of his bundle, and that they enter always with their ends, and not by the middle, which would double them. He should also endeavour to enter them at the heart of the yarn. This will cause all the yarn to wind regularly in making it up, and will make the work smooth, because one end of each fibres is by this means buried among the rest, and the other end lies outward; and this, in passing through the greave barbar and the press, it tight with his thumb and palm, is also made to lie smooth. The greatest fault that can be committed in spinning is to allow a small thread to be twisted off from one side of the hemp, and then to cover this with hemp supplied from the other side; for it is evident, that the fibres of the central thread make very long spirals, and the skin of fibres which cover them must be much more oblique. This covering has but little cohesion with what is below it, and will easily detach itself. But even while it remains, the yarn cannot be strong, for on pulling it, the middle part, which lies the weight, must bear all the strain, while the outer fibres that are lying obliquely, are only drawn a little more parallel to the axis. This defect will always happen if the hemp is supplied in a considerable number of bundles, and if it is then used up whole. As soon as it is made to enter, it becomes a sort of loosely connected wrapper. Such a yarn, when untwisted a little, will have the appearance of a flax, while a good yarn looks like fig. 212. A good spinner therefore, endeavors always to supply the hemp in the form of a thin flat

skain with his left hand, while his right is employed in grasping firmly the yarn that is twisting off, and in holding it right from the whirn, that it may not run into loops or kinks.

It is evident, that both the arrangement of the fibres and the degree of twisting depend on the skill and dexterity of the spinner, and that he must be instructed, not by a book, but by a master. The degree of twist depends on the rate of the wheel's motion, combined with the retrograde walk of the spinner.

We may suppose him arrived at the lower end of the walk, or that far as is usual, for the intended length of his yarn. He calls out, and another spinner immediately detaches the yarn from the hook of the wheel, gives it to another, who carries it aside to the reel, and the second time that 19 of his own hemp out of the wheel-hook. In the mean time, the first spinner keeps fast hold of the end of his yarn; for the hemp, being dry, is very elastic, and if he were to let it go out of his hand, it would instantly unmelt, and would be much better than loose hemp. He waits, therefore, till he seers the reeler begin to turn the reel, and he goes slowly up the wheel, keeping the yarn of an equal tightness all the way, till he arrives at the wheel, where he waits, and this hemp in his hand till another spinner has finished his yarn. The first spinner takes it off the wheel-hook, joins it to his own, that it may follow it on the reel, and begins a new yarn.

Rope-yarns, for the greatest part of the large rigging, are from a quarter of an inch to somewhat more than a third of an inch in circumference, or as a size that 100 fathoms weigh from 34 to 4 pounds when wet. The different sizes of yarns are named from the number of them contained in a strand of a rope of three inches in circumference. Few are so coarse that 19 may make a strand of British cordage: 18 is not infrequent for cable yarns, or yarn spun from harsh and coarse hemp; 25 is, we believe, the finest size which is worked up for the rigging of a ship. Much finer is spun for sounding-lines, fishing-lines, and nainbow and gunny uses, and for other demands of society. Ten good spinners will work up above 600 weight of hemp in a day; but this depends on the weather. If the hemp be dry, the hemp is very elastic, and requires more attention to make smooth work. In the warmer climates the spinner is permitted to moisten the rag with which he grasps the yarn in his eight hand for each of his own hemp out of the wheel-hook. No work can be done in an open spinningmill in rainy weather, because the yarns would not take on the rag, if immediately turned, and would rot if kept on the reel for a long time.

The second part of the process is the conversion of the yarns into rope, which may be properly called a rope, cord, or line. At this we may have a clear conception of the principle which regulates this part of the process, we shall begin with the simplest possible case, the use of two yarns into one line. This is not a very usual fabric for rigging, but we select it for its simplicity.

When hemp has been split into very fine fibres by the hatchet, it becomes exceedingly soft and plant, and after it has him for some time in the form of fine yarn, it may be unraveled and drawn by force, without losing much
of its twist. Two such yarns may be put on the wheel of a spinning-wheel, and thrown, like flaxen yarn, so as to make sewing thread. It is in this way, indeed, that the sailmakers’ sewing thread is manufactured; and when it has been kept on the reel, or on balls or bobbins, for some time, it acquires its twist, as well as its uses require. But this is by no means the case with yarns spun for great cordage. The hemp is so elastic, the number of fibres twisted together is so great, and the diameter of the yarn, which is a yard of linen which remains, the elasticity of the fibre exerts itself) is so considerable, that no keeping will make the fibres retain this constrained position. The end of a rope-yarn being thrown loose, it will immediately untwist, and this with considerable force and speed. It would, therefore, be a fruitless attempt to twist two such yarns together; yet the ingenuity of man has contrived to make use of this very tendency to untwist not only to counteract itself, but even to produce another and a permanent twist, which requires force to undo it, and which will recover itself when this force is removed. Every person must recollect, that when the spinners turn the spool to their thread, and his fingers between his two hands, if he slackens the thread by bringing his hands nearer together, the thread will immediately curl up, running into loops or knots, and will even twist itself into a neat and firm cord.

The component parts of a rope are called strands, and the operation of uniting them with a permanent twist is called laying or cleaving. The latter term is slightly more applied to cables and other very large cordage.

Lines and cordage less than 14 inches circumference are laid at the spinning-wheel. The workman fastens the ends of each of two or three yarns to separate whirl-hoops. The remote ends are united in a knot. This is put on one of the hooks of a swivel called the loper, represented in fig. 213, and care is taken that the care of each end is by length and twist. A piece of soft cord is put on the other hook of the loper; and, being over a pulley several feet from the ground, a weight is hung on it, which stretches the yarn. The workman sees that they are equally stretched, he orders the wheel to be turned in the same direction as when twining the yarns. This would twine them harder; but the swivel of the rope gives way to the strain, and the yarns immediately twist around each other, and form a line or cord. In doing this, the yarns lose their twist. This is restored by the wheel. But this simple operation would make a very bad line, which would be slack, and not hold its twist; for, by the turning of the loper, the strands twist immediately together, to a great distance from the loper. By this turning of the loper the yarns are untwisted. The wheel restores their twist only to that part of the yarns that remains separate from the others, but cannot do it in that part where they are already turned round each other, because their mutual pressure prevents the twist from advancing. This is overcome, necessary to retard this tendency to twine, by keeping the yarn apart. This is done by a little tool called the top, represented in fig. 314.

It is a truncated cone, having three or more notches along its sides, and a handle called the staff. This is put between the strands, the small end next the loper, and it is pressed gently into the angle formed by the yarns which lie in the notches. The wheel being now turned, the yarns are more twisted, or hardened up, and their pressure on the twist gives it a strong tendency to come out of the angle, and also to turn round. The workman does not allow this till he thinks the yarns sufficiently hardened. Then he yields to the pressure, and the top comes away from the swivel, which immediately turns round, and the line begins to lay. Gradually yielding to this pressure, the workman slowly comes up towards the wheel, and the laying goes on, till the top is at last close to the wheel, and the work is done. In the mean time, the yarns are shortened, both by the twining of each and the laying of the cord. The weight, therefore, gradually rises. The use of this weight is evidently to oblige the yarn to take a proper degree of twist, and not run into kinks.

A cord, or line, made in this way, has all some tendency to twist a little more. However little friction there may be in the loper, the twist into which the cord has made in the laying, are not enough to balance completely the elasticity of the yarns; and the weight being appended, causes the strands to be more nearly in the same number, in the same manner as it would stretch and untwist a little any rope to which it is hung. On the whole, however, the twist of a laid line is permanent, and not like that upon twist doubled or thrown in a thread; which remains only in consequence of the great softness and flexibility of the yarn.

The process for laying or closing large cordage is considerably different from this. The strands of which the rope is composed consist of many yarns, and require a considerable degree of hardening. This cannot be done by a whirl driven by a wheel-land; it requires a strong, or a crank turned by the man. The strands, when properly hardened, become very stiff, and when bent round the top, are not able to transmit force enough for laying the heavy and unpliant rope which forms beyond the top. The strands must, therefore, be assisted by an external force. All this requires a different machinery and a different process.

At the upper end of the walk is fixed up the tackle-board, fig. 215. This consists of a strong oaken plank called a breast-board, having three or more holes in it, as A, B, C, fitted with brass or iron plates. Into these plates are put cranks, called heaves, which have hooks or forelocks, and keys, on the ends of their spindles. They are placed at such a distance from each other, that the workmen do not interfere with each other while turning their rope. The top of the breast-board is fixed to the top of strong posts well secured by struts or braces facing the lower end of the walk. At the lower end another breast-board fixed to the upright posts of a saddle, which may be fixed with struts or other similar cranks are placed in the holes of this breast-board. The whole goes by the name of the saddle; (see fig. 219). The top necessary for closing large cordage is too heavy to be held in the hand; it therefore has a long staff, which has a truck on the end. This rides on the ground; but even this is not enough in laying great cables. The top must be supported on a carriage, as shown in fig. 217, where it must lie very steady, and it needs attendance, because the struts are so heavy. The employment in attending to the manner in which the strands close behind the top; and in helping them by various methods. The top is, therefore, fixed to the carriage by lashing it with its staff to the top. The warp-post, or piece of soft rope, or strap, is attached to the handle of the top by the middle, and its ends are brought back and wrapped several times round the rope, in the direction of its twist, and bound down. This is shown at A, and it greatly assists the laying of the rope by its friction. This both keeps the top from flying too far from the point of union of the strands; and brings the strands more regularly into their places.

The first operation is warping the yarns. At each end of the walk are frames called warping frames, which carry a great number of reels or winches filled with rope-yarn. The yarns from the top-yarn end from each, till he has made up the number necessary for his rope or strand, and bringing the ends together, he passes the whole through an iron ring fixed to the top of a stake driven into the ground, and draw them through; and a knot is tied on the end of the handle, and a workman pulls it through this ring till the intended length is drawn off the reels. The end is made fast at the bottom of the warping stake, and the foreman comes back along the skein of yarns, to see that none are hanging slackener than the rest. He takes up in his hand such as are slack, and draws them tight, keeping them so till he reaches the upper end, where he cuts the yarns to a length, again adjusts their tightness, and joins them all together in a knot, to which he fixes the hook of a tackle, the other block of which is fixed to a firm post, called the warping stake, and stretched by this tackle, and then separated into its different strands. Each of these is knotted apart at both ends. The knots at their upper ends are made fast to the hooks of the cranks in the middle of the breast-board, the lower ends are fastened to the cranks in the slide. The slide itself is kept in its place by a tackle, by which the strands are again stretched in their places, and every thing adjusted, so that the slinger stands square on the walk, and then a proper weight is laid on it. The tackle is now cast off, and the cranks are turned at both ends, in the contrary direction to the twist of the yarns. (In some kinds of cordage the cranks are turned the same way with the spinning twist). By this the strands are twisted and hardened up; and as they contract by this operation, the slide is dragged up the walk. When the foreman thinks the strands sufficiently hardened, he estimates by the motion of the slide, he orders the heavens at the cranks to stop. The middle strand at the slide is taken off from the crank, this crank is taken out, and a piece of nothing at D, fig. 216. The other strands are taken off from their cranks, and are all joined on the hook which is now in the middle hole. The top is then placed between the strands, and being pressed home to the point of the cranks, the carriage is placed under it, and it is firmly fixed
ROPE-MAKING.

Some weight is taken off the sledge. The heavers now begin to turn at both ends. Those at the tackle-board continue to turn as they do at first, until they reach the point at which the sledge turns in the opposite direction to their former motion, so that the cranks at both ends are now turning one way. By the motion of the sledge-crank, the top is forced away from the knot, and the rope begins to close. The heavers at the upper end restore to the strand the twist which they are constantly losing by the laying of the rope. The workmen judge of this by making a chalk mark on the strands at points of the strand, where they lie on the stake; which are set up along the walk for their support. If the twist of the strands is diminished by the motion of closing, they will lengthen, and the chalk mark will move away from the tackle-board; but if the twist increases by turning the cranks at the tackle-board, the strands will shorten, and the mark will come nearer to it.

As the closing of the rope advances, the whole shortens, and the sledge is dragged up the walk. The top moves faster, and at last reaches the upper end of the walk, the rope being now laid. In the mean time, the sledge has moved away, and the chalk mark marks the place where it was when the laying began.

These motions of the sledge and top must be exactly adjusted to each other. The rope must be of a certain length. Therefore the sledge must always be at least as far from the top as the moment the rope should be laid; that is, the top should be at the tackle-board. In this consists the address of the foreman. He has his attention directed to both ways. He looks at the strands, and when he sees any of them hanging lower than the others, he calls to the heavers at the tackle-board to heave more upon that strand. He finds it more difficult to regulate the tension of the top. It requires a considerable force to keep it in the angle of the strands, and it is always disposed to start forward. To prevent or check this, some strands of soft rope are brought round the staff of the top, and fastened to the sledge at several times round the rope behind the top, and kept firmly down by a lanyard or bondage, as is shown in the figure. This both holds back the top, and greatly assists the laying of the rope, as it enables the strands to fall into their places, and keep close to each other, which is sometimes very difficult, especially in ropes composed of more than three strands. It will greatly improve the laying of the rope, if the top has a sharp, smooth, tapering pin of hard wood, pointed at the end, projecting so far from the middle of its smaller end, that it gets in between the strands which are closing, and supports them, and makes their closing more gradual and regular. The top, its notches, the pin, and the warp or strap, which is lapped round the rope, are all smeared with grease or soap to assist the closing.

The foreman judges of the progress of closing chiefly by his acquaintance with the walk, knowing that when the sledge is abreast of a certain stake, the top should be abreast of a certain other stake. When he finds the top far from the walk, he slackens the motion at the tackle-board, and makes the men turn briskly at the sledge. By this the top is forced up the walk, and the laying of the rope accelerates, while the sledge remains in the same place, because the strands are losing their twist, and are lengthening, while the closed rope is shortening. When, on the other hand, the rope begins to close, and fears that it will be at the head of the walk before the sledge has got to its proper place, he makes the men heave briskly on the strands, and the heavers at the sledge-crank work softly. This quickens the motion of the sledge by shortening the strands; and by thus compensating what has been undone, the sledge and top come to their places at once, and the work appears to answer the intention.

When the top approaches the tackle-board, the heaving at the sledge could not cause the strands immediately behind the top to close well, without having previously produced an extravagant degree of twist in the intermediate rope. The effort of the crank must therefore be assisted by men stationed along the rope, each furnished with a tool called a wudder. This is a stout oak stick, about three feet long, and used as a driving-stick. The rope is laid round the sides of the cranks, and the wudders keep their eye on the men at the crank, and make their motion correspond with his. Thus they send forward the twist produced by the crank, but still further in the direction of the cranks' motion.

Such is the general and essential process of rope-making. The fibres of hemp are twisted into yarns, that they may make a line of any length, and stick among each other with a force equal to their own cohesion. The yarns are made into cords of permanent twist by laying them; and that we may have a rope of any degree of strength, many yarns are united in one strand, for the same reason that many fibres were united in one yarn; and in the course of this process it is our power to give the rope a solidity and hardness which make it less penetrable by water, and which increase its strength. Some of these purposes are inconsistent with others; and the skill of a rope-maker lies in making the best compensation, so that the rope may on the whole be the best in point of strength, pliability, and durability, and the quantity of hemp in it can produce.

The following rule for judging of the weight which a rope will bear is not far from the truth. It supposes them rather too strong; but it is so easily remembered that it may be of use.

Multiply the circumference in inches by itself, and take the fifth part of the product, it will express the tons which the rope will carry. Thus, if the rope has 6 inches circumference, 6 times 6 is 36, the fifth of which is 36 divided by 5, or 7.2 tons; on which sir Charles Knowles made his experiments 34 X 34 = 1025, the quarter of which is 9.05 tons, or 4592 pounds. It broke with 4550.

This may suffice for an account of the mechanical part of the manufacture. But we have not yet noticed of the operation of tarring; and our reason was, that the methods practised in different rope-works are so exceedingly different, that we could hardly enumerate them, or even give a general account of them. It is evidently proper to tar in the state of twine or yarn, this being the only way that the hemp could be transformed. The yarn is made to wind off one reel, and having passed through a vessel containing hot tar, it is wound up on another reel; and the superfluous tar is taken off by being drawn through a box, well surrounded with spongy oakum; or it is tared in skains or haws, which are drawn by a capstern through the tar-kettle, and through a hole formed of two plates of metal, held together by a lever loaded with a weight.

It is established beyond a doubt, that a tarred cordage when new is stronger than white, and that the difference increases by keeping. The following experiments were made by Mr. Du Hamel at Rochefort over a cordage of three inches (French) in circumference, made of the best Riga hemp.

<table>
<thead>
<tr>
<th>Month</th>
<th>Weight</th>
</tr>
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<tbody>
<tr>
<td>August 8, 1741</td>
<td>White: 1746, April 14, 2645 lbs.</td>
</tr>
<tr>
<td></td>
<td>White: 2727 lbs.</td>
</tr>
<tr>
<td></td>
<td>White: 2517 lbs.</td>
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<tr>
<td></td>
<td>White: 2517 lbs.</td>
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<tr>
<td></td>
<td>White: 2517 lbs.</td>
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<tr>
<td></td>
<td>White: 2517 lbs.</td>
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Mr. Du Hamel says, that it is decided by experience, 1. That white cordage in continued service is one-third more durable than tarred. 2. That it retains its force much longer while kept in store. 3. That it resists the ordinary injuries of the weather one-fourth longer.

We know one remarkable fact: in 1758 the shrouds and stays of the Silver hull at Portsmouth dock-yard were overthrown, and when the working and service were taken off, they were found to be of white cordage. On examining the store-keeper's books, they were found to have been formerly the shrouds and rigging of the Royal William, of 140 guns, built in 1715, and rigged in 1716. She was thought top-heavy, and unfit for sea, and unrigged, and her stores laid up. Some few years afterwards, her shrouds and stays were fitted on the Silver hull, where they remained in constant and very hard service for about 30 years, while every tarred rope about her had been repeatedly renewed.

Why then do we tar cordage? It is chiefly serviceable for cables and ground tackle, which must be continually wetted, and even soaked. The result of careful observation is,

1. That white cordage, exposed to be alternately very wet and dry, is weaker than tarred cordage. 2. That cordage which is
sions, continue till November or December. Hence the name monthly rose, double virgin rose, &c.

4. The damascena, including the red damask rose, white damask rose, blue-blooded rose, red rose, white rose, red rose, &c. These varieties, like those of the other sorts, are of the French race, and have mostly been selected from the wild rose of the Alps or the Pyrenees. The flowers are usually large, and very beautiful. Marbled rose grows from four to five feet high, having brown branches, with but few prickles; and a large, double, dark crimson and red flower.

5. The Lutea, including the red and yellow Austrian rose, yellow Austrian rose, yellow rose, double yellow rose.

6. The centifolia, or hundred leaved red rose, &c. The varieties are: common Dutch hundred-leaved rose, bluish hundred-leaved rose.

7. The provincialis, or Provence rose. The varieties are: common red Provence rose, pale Provence rose; both of which have large and small leaves prunus, and larger petals than the following sort. Cabbage Provence rose, having the petals closely folded over one another like cabbages; Dutch cabbage rose, very large, and cabbages tolerable; chalking Provence rose, small rose, producing remarkably large, white, and yellow flowers. All these are large double red flowers, somewhat globular at first blooming, becoming gradually a little spreading at top, and are all very ornamental fragrant roses.

8. The muscosa, or moss Provence rose, supposed by some a variety of the common rose, having the calyx and upper part of the pedicel surrounded with a rough moss-like substance, exciting a curious singularity.

9. The cinuncer, or cinumrose. There are varieties with double-flowers.

10. The alpina, or Alpine inermis. This species, as being free from all kind of attachment common to the other sorts of roses, is esteemed as a singularity; and from this property is often called the virgin rose.

11. The Carolina, or Carolina, Virginia rose, &c. grows six or eight feet high, or more. The varieties are: dwarf Pennsylvania rose, double red flowers, American pale-red rose. These species, and varieties grow naturally in different parts of North America; they effect a fine variety, in our gardens, and are in estimation for their late flowering property, as they often continue in bloom from August till October; and the flowers are succeeded by numerous red berry-like hips in autumn, causing a variety all winter.

12. The villosa, or villosa apple-bearer rose, grows six or eight feet high. This species merits admittance into every collection as a curiosity for the singularity of its fruit, both for variety and use; for having a thick coat of an agreeable acid relish; this is often made into a tolerably good sweetmeat.

13. The pimpinellifolia, or burnet-leaved rose. These varieties have red flowers, and white flowers. They grow wild in England, and are cultivated in shrubbery for variety.

14. The spinissa, or most spiny, dwarf burnet-leaved rose, commonly called Scotch rose. The varieties are: common white-flowered, red-flowered, striped-flowered, marble-flowered. They grow naturally in England, Scotland, &c. The first variety, rises near a yard high, the others, but one or two feet, all of which are single-flowered; but the flowers, being numerous all over the branches, make a pretty appearance in the collection.

15. The eglatina, eglatine rose, or sweet-brier. The varieties are: common white-flowered, double-flowered, bluish double-flowered, yellow double-flowered, &c. This species grows naturally in some parts of England and Switzerland. It thrives in every garden for the odoriferous property of its leaves; and should be planted in the borders, and other compartments contiguous to walks, or near the habitation, where the plants will impart their refreshing fragrance very profusely all around; and the young branches are excellent for improving the colour of nosegays and bouquets.

16. The moschata, or musk rose, supposed to be a variety only of the evergreen musk rose, has all the branches terminated by large umbellate clusters of pure white musk-scented flowers. In August, it is remarkable for producing them numerously in clusters, continuing till succession till October or November.

17. The sempervirens, or evergreen musk rose. The sempervirent property of this elegant species renders it a curiosity among the rose tribe; it also makes a fine appearance as a flowering shrub. There is one variety, the delicious musk rose, sub-vexillaria. This species and variety flower in August, and is remarkable for producing them numerously in clusters, continuing till succession till October or November.

18. The scented flowers, or deep-red China rose, a most beautiful little plant, and well deserving the appellation of ever-blooming.

19. The chinensis, or pale China rose, which flowers almost the whole year. These last species we suppose to be so tender, as always to require the shelter of a green-house; but we can say from experience that they are nearly as hardy as any of our English roses.

20. The white musk roses are used in medicine. The former distilled with water yields a small portion of a butyrazeous oil, whose flavour exactly resembles that of the rose itself. This oil, and the distilled water is known by the name of musk-rose.

21. The deciduous musk rose, sub-vexillaria. These roses also, besides the cordial and aromatic virtues which reside in their volatile parts, have a mild purgative, one which remains entire in the decoction after distillation. The red rose, or contrary, has an astrigent and gratefully corrosivating virtue.

**ROSE.** See Rosa.

**ROSEMARY.** See *Rosmarinus*.

**ROSDULAS.** A genus of the class and order pentandria monogynia. The calyx is five-leaved, corolla five-petalled; anthers scrothiform; capsule three-valved. There is one species, *Rosma...*, of the genus of the monogynia order, in the dandrus class of plants, and in the natural method ranking under the 42d order, verticillae. The corolla is unequal, with its upper lip biplicate; the capsule is 16-seeded, each having a small dent. There are two species, the officinalis and chilensis. There are two varieties, the first sort, one with white-streped leaves, called the silver-rose.
ROT

mire, and the other with yellow, whence it is called the gold-striped rosemary. These plants grow naturally in the southern parts of France, Spain, and Italy; where, upon dry rocky soils near the sea, they thrive prodigiously, and perfume the air in such a manner as to dissolve hang over, or lie on the surface of the land. They are, however, handy enough to bear the cold of our ordinary winters, provided they are planted upon a level, dry, gravelly soil, on which they all endure the cold much better than in a rich ground, where growing more vigorously in summer, they are more apt to be injured by frost in winter; nor will they have such a strong aromatic smell as those on a dry and barren soil. They are to be propagated either by or corolla; the capsule is trilocular and polyspermy. There is one species, an annual of the East Indies. 

ROTA, a genus of the monogynia order, in the trinatria class of plants. The calyx is tricarpellate, the capsule is trilocular, and polyspermous. There is one species, an annual of the East Indies. 

ROTANG. See Calamus. 

ROTATION, in geometry, a term chiefly applied to the reduction of any surface or solid to a fixed and immovable line, which is called the axis of its rotation; and by such rotations it is, that solids are conceived to be generated.

The ingenious M. de Moivre shows how solids, thus generated, may be measured or cubed. His method is this: for the fluxion of such solids, take the product of the fluxion of the axis, multiplied by the circulare base; and suppose the ratio of a square to the circle inscribed in it to be \( \pi \); then the equation expressing the nature of any circle, whose diameter is \( d \), is \( \pi = \frac{4d}{\pi} \). Therefore, \( \frac{4d^2}{\pi} = \pi \) is the fluxion of a portion of the sphere; and, consequently, the portion itself \( \frac{4d^2}{\pi} = \pi \), the circumscribed cylinder \( 4d \pi = 2\pi \); and therefore the portion of the sphere is to the portion of the circumscribed cylinder, as \( 4d \pi = 2\pi \) to \( d \pi = \pi \).

ROTHIA, a genus of the class and order 1-monogynia polychaeta aquatic. The calyx is many-leaved in a single row; woolly recept. in the ray chaffy in the disk villose-seeds; in the ray baid in the disk papose. There is one species, Rotondos, or Rotundo, in architecture, an appellation given to any building that is round both within and without, whether it is a church, a sacon, or the like. 

ROTTBOELIA, a genus of the dignity order, in the triandria class of plants. The racis is jointed, rounded, and in many cases infirm: the calyx is ovate, lanceolate, flat, or orbicular, and the distance of the stamens or alternates, on the winding racis. There are 17 species, of grasses of Africa and the East Indies. 

ROTTEN-STONE, a mineral found in Derbyshire, and used by mechanics for all sorts of finer graining and polishing, and sometimes to cut stones. According to Ferber, it is a tripoli mixed with calcareous earth. See Tripoli. 

ROUND, in a military sense, signifies a wall which some officer, attended with a party of soldiers, takes in a fortified place around the ramparts, in the nighttime, in order to see that the sentries are watchful and every thing in good order. 

The centres are to challenge the rounds at a distance, and rest their arms as they pass, so that none come near them; and when the round comes near the guard, the sentry calls aloud, who comes there? and being answered, the rounds; he says, stand; and then calls the corporal of the guard, who draws his sword, and asks, who comes there? and when he is answered, the rounds, he who has the word advances, and the corporal receives it with his sword pointed to the giver's breast. In strict garrison the rounds go every quarter of an hour. 

RONDÉLAY, a kind of ancient poem, thus termed, according to Menage, from its form, because it turns back again to the first verse, and thus goes round. This is a little known among us, but is very common among the French, who call it rondéau. It consists commonly of thirteen verses, eight whereof are in one rhyme, and five in another. It is divided into couples, at the end of the second and third of which the beginning of the roundelay is repeated, and that if possible in an equivocal or passing sense. 

ROY, in law. See RIOT.

ROSEBUM, a genus of the octandria monogynia class and order. The calyx is four-leaved; corolla one-petalled, bell-shaped, four-cleft, inferior; berry quadrangular, many seeded. There is one species, a shrub of St. Malo, called Rosebum. 

ROXburgia, a genus of the octandria monogynia class and order. The calyx is four-leaved; corolla four-petalled, nectaries four, aw-shaped; anthers linear; capsule one-celled, two-valved; seeds many. There is one species, native of Ceylon and Madeira.

ROVENIA, a genus of the dignity order, in the dianthera class of plants; and in the natural method ranking under the 18th order, bicarpellae. The calyx is of 5 parts; the corolla monopetalous, with the limb rounded; the capsule is unilocular and quadrivalved. There are seven species, herbs of the Cape. 

RUBIA, madder, a genus of the monogynia order, in the tetrameria class of plants; and in the natural method ranking under the 47th order, stellate. The corolla is monopetalous and campanulate; and there are two monoepispermy berries. There are seven species, of which the principal is the fimbriat, or dyer's madder, so much used by the dyers and callico-printers. This hath a perennial root, and annual stalk: the root is composed of many long, thick, succulent fibres, almost as large as a man's little finger; these are joined at the top in a head like asparagus, and run very deep into the ground. From the upper part of this root, come out many side-roots, which extend just under the surface of the ground to a great distance, by which it propagates very fast; for these send up a great number of shoots, which, if carefully taken off in the spring soon after, they are above ground, become so many plants. These roots are of a reddish colour, somewhat transparent; and have a yellowish skin in the middle, which is tough, and of a bitterish taste. From this root arise many large four-cornered jointed stalks, which in good land will grow five or six feet long, and, if supported, sometimes seven or eight: they are armed with short horizontal prickles; and at each joint are placed five or six spear-shaped leaves: their upper surfaces are smooth; the branches are terminated by loose branching spikes of yellow flowers, which, when dry, become dark red stars. These appear in June, and are sometimes succeeded by seeds, which seldom ripen in England. For its principal uses, see Dyeing, and Calico Printing. 

RUBIACAE, an order of herbs. The virtues attributed to it are those of a deli-
gent and aperient; whence it has been usually ranked among the opening roots, and recommended in obstructions of the vesica, and couplings of the kidneys. It is an ingredient of the blood from falls or brumes, in the jaundice, and beginning dropsies. It is an ingredient in theicteric decoction of the Edinburgh pharmacopoeia. 

It is observable, that this root, taken internally, tingles the urine of a deep red colour; and in the Philosophical Transactions we have an account of its producing a like effect upon the bowels of animals who had it mixed with their food; all the bowels, particularly the more solid ones, were said to be changed, both externally and internally, to a deep red; but neither the flesh, nor carcases parts suffered any alterations: some of these bones were macerated in water for some time, and afterwards steeped and boiled in spirit of wine, lost none of their colour, nor communicated any tinge to the liquors. This root, therefore, contains a principle of great subtility of parts, and its medical virtues hence to deserve inquiry. The same trials, however, made by others, have not been found to produce the same effects as those above mentioned. Of late the root has come into great reputation as an emmenagogue. 

RUBRIC, in the canon law, signifies a title or article in certain ancient law-books; thus called because written; as the titles of the chapters of our natal bibles are, in red let-
ters. Rubrics also denote the rules and directions given at the beginning, and in the course of, the liturgy, for the order and manner in which the several parts of the office are to be performed. They are generally rules and special rubrics, a rubric for the communication, &c., in the Romish Missal and Breviary are rubrics for masses, for lands, for transfigurations, benedictions, commemorations, &c. 

RUBUS, the frondalis, a genus of the poly-
gynia order, in the icosandria class of plants; and in the natural method ranking under the 35th order, septicaim. The calyx is
RUBIDEXIA, dwarf sun-flower, in botany, a genus of the syngeccsis-polygonia frustansace class of plants, the compound flower of which is radiated; but the hema-thropic corolline of the disc are tubular and very numerous; the stamens are five very short calipiter filaments; and there is a small orbiculated seed after each of the hermaphro-dite corolline, and are all contained in the cup, a pale-blossomed receptacle. There are seven species.

RUDDER, in navigation, a piece of timber turning on hinges in the stern of the ship, and which, opposing sometimes one side to the water, and sometimes another, turns or directs the vessel in this way or that. See SHIP-BUILDING.

The rudder of a ship is a piece of timber hung on the stern-posts by four or five iron hooks, called pintles, serving for the bridle of a ship to turn her about at the pleasure of the steersman. The rudder being perpendicular, and withoutside the ship, another piece of timber is fitted to it at right angles, which comes into the ship, by which the rudder is managed and directed. This latter properly is called the helm or tiller; and sometimes, though improperly, the rudder itself. The power of the rudder is reducible to that of the lever. As to the angle the rudder should make with the keel, it is shown, that in the working of ships, in order to stay the ship bear up the soonest possible, the tiller of the rudder ought to make an angle of 55° with the keel. A narrow rudder is best for a ship's sailing, provided she can feel it; that is, be guided and turned by it: for a broad rudder will hold much water when the helm is put over to any side; but if a ship has a fat quarter, so that the water cannot come quick and strong to her rudder, she will require a broad rudder. The aft-most part of the rudder is called the rame of the rudder.

RUELLIA, in botany, a genus of the angloperma order, in the dalyamia class of plants; and in the natural method, ranking under the 4th order, persontace. The calyx is quickeperatic; the corolla sub-campanulate; the stamens approaching together in pairs; the capsule springing asunder by means of its elastic septum. There are 43 species, shrubs of the East and West Indis.

RUFF, See PERCA.

RUFF; See TERNINGA.

RUPEA, a genus of the polyandria order, in the monadophila class of plants; and in the natural-method running under the 37th order, columnifere. The calyx is double; the external are triplici.
Having learned how much the piece is square, look for that number on the line of the timber-measure; the space thence to the end of the rule is the length which, at that breadth, makes a foot of timber; and nine inches square, the length necessary to make a solid foot of timber, is 21/2 inches. If the timber is small, and under nine inches square, seek the square in the upper rank of the table, and immediately under it are the feet and inches that make a solid foot. If the piece is not exactly square, but broader at one end than the other, the method is to add the two together, and take half the sum for the side of the square. For round timber the method is to get it round with a string, and to allow the fourth part for the side of the square; but this method is erroneous, for thereby you lose nearly one-fifth of the true solidity; though this is the method at present practised in buying and selling timber.

The mason's rule is twelve or fifteen feet long, in order to be applied under the need to regulate the courses, and make the ped- droits equal, &c.

Everard's slinding Rule. See Gauging.

RUM, a species of branly, or vivis spirit, distilled from sugar-canes. See Distillation, and Spirit.

RUMEN, in comparative anatomy, the stomach, or first stomach of such animals as chew the cud, whence called ruminant animals. See Comparative Anatomy.

RUMENI, dock, a genus of the trignyta order, in the hexandria class of plants; and in the natural method ranking under the 12th order, bocotrices. The calyx is triplicate; there are three connivent petals, and one tricrestous seed. There are 36 species; of which the most remarkable are: 1. The patient, commonly called patience rubbush. This was formerly much more cultivated in the British gardens than at present; the roots of this have been generally used for the monk's rubbush, and it has even been thought to be the true kind; but others supposed it to be a second sort sloe, and to be used as such. 2. The alpinus, or monk's rubbush, grows naturally on the Alps, but has long been cultivated in the gardens of this country. This has large roots, which spread and much interchange the offsets; it is a much thicker than the former, are of a very dark brown on the outside, and yellow within. 3. The aquatics, or water-dock, grows naturally in ponds, ditches, and standing waters, in many parts of Britain. It is supposed to be the herb Britannica of the ancients. 4. The acutus, or sharp-pointed dock (the oxytopathum of the shops); but the markets are supplied with roots of the common docks, which are uniformly gathered by those who collect them in the fields, where the kind commonly called butter dock (from its leaves being used to wrap up butter) is much more common than this. These plants are but seldom cultivated, and so easily multiplied by their numerous seeds, that they soon become troublesome weeds where they once get an entrance.

RUMINANT, in natural history, is applied to an animal which chews over again what it has eaten before; which is popularly called chewing the cud. Payer, in a treatise De Ruminantibus, says that there are some animals which really ru-

minate; as oxen, sheep, deer, goats, camels, lamas, and squirrels; and that there are others which only appear to do so, as mole, crickets, mice, beetles, crabs, mules, &c. The latter class, he observes, have their stom- passes composed of muscular fibres, by which the food is ground up and down and as in those which really ruminate. Mr. Ray observes, that ruminants are all four-footed, hairy, and having a long, external, and internal permanent horns, others with deciduous ones.

RUMPHIA, a genus of the monogenesis order, in the triandria class of plants, and in the natural method ranking with those of which the order is doubtful. The calyx is trin; the petals three; the fruit a triocular plum. There is one species, a tree of the East Indies.

RUNDLE, or Rundell. See Heraldry.

RUNDLET, or Rundlet, a small vessel, containing an uncertain quantity of any li- quor, from three to twenty galleons.

RUNNER, in the sea-language, a rope belonging to the ganet, and used for bolt- tackles. It is reeved in a single block, joined to the end of a pennant, and has at one end a hook to hitch into any thing; and at the other end a double block, into which is reeved the tail of the tackle, or the ganet, by which means it purchases more than the tackle would without it.

RUNNET, or Rensnet, is the juice or gastric fluid found in the stomachs of sucking quadrupeds, which as yet have received no other denomination than their mother's milk. In ruminating animals, which have several stom- ches, it is generally found in the last, though sometimes in the next to it. If the rumnet is dried in the sun, and then kept close, it may be preserved in perfection for years. Not only the rumnet itself, but also the stomach in which it is found, curnades milk without any previous preparation. But the common method is, to take the inner mem- brane of a calf's stomach, and well seized, to salt and hang it up in brown paper when this is used, the salt is washed off, then it is macc- nated in a little water during the night, and in the morning the infusion is poured into the 26th RUMINATIONE, p. 521, col. 3.

RUPA, a genus of the tetraneura monogyna class and order. There is no calyx; the petals are four; stamens inserted in the middle of the petals; pericarpium one-celled, two-seeded.

RUPERT'S DROPS, a sort of glass-drops with long and slender tails, which burst to pieces on the breaking off those tails in any part; said to have been invented by prince Rupert, and therefore called by his name. Concerning the cause of this surprising plan nonone scarcely any thing that bears the least appearance of probability has been of- fered. Their explosion is attended in the dark with a flash of light; and, by being boiled in oil, the drops are deprived of their explosive quality.

RUPPIA, a genus of the tetragna order, in the tetradria class of plants; and in the natural method ranking under the 15th order, inanimate. There is neither calyx nor corolla; but four pedicelled seeds. There is one species.

RUPTURE, in surgery, the same with hernia. See Surgery.

RUSCUS, hrake-holly, or butcher's broom, a genus of the monogynia order, in the dicadria class of plants, and in the natural method ranking under the 11th order, samen- taceae. The male calyx is hexaplisp; there is no corolla; the nectarium is central, ovate, and perforated at the top. The fru- it is a small berry, covered with a viscid, a trilocular two-seeded berry. There are five species. The most remarkable is the aculeatus, or common butcher's broom, common in the woods in many parts of England. As this plant grows wild in most parts of England, it is rarely admitted into gardens; but if some of the roots are planted under tall trees in large plantations, they will spread into large clumps; and as they retain their leaves in winter, at that season they will have a good effect. The seeds of this plant generally lie a year in the ground before they vegetate; and the plants so raised are long before they arrive at a size large enough to make any figure, and therefore it is much bet- ter to transplant the roots. The root of this plant is accounted aperient, and in this in- tention is sometimes made an ingredient in dirty-cookings and diet-drinks, for opening slight obstructions of the visera, and promoting the fluid secretions. This plant is used by the butchers for besoms to sweep their blocks. Hucksters place the boughs round their ha- ries, and use them to clean their mics; for they cannot make their way through the prickly leaves.

RUSH, in botany. See Juncus.

RUSSELIA, a genus of the dicademia angiosperma class and order. The calyx is five-leaved; corolla tube, very long; capsu- late acuminate. There is one species, a shrubby plant of the Havannah.

RUSSIA COMPANY, in commerce. See Company.

RUST, the oxide of a metal. Iron, for instance, when exposed to the air, soon be- come oxidized, and glassy, tinged with a brown or yellow powder, well known by the name of rust. This change is occasioned by the gradual combination of the iron with the oxygen of the atmosphere, and, accord- ing to new chemistry, it is now deno- minated the oxide of iron.

RUSTIC, in architecture, implies a ma- nner of building in imitation of nature, rather than according to the rules of art.

RUTA, rue, a genus of the monogeny order, in the dicadria class of plants; and in the natural method ranking under the 26th order, multisiquitica. The calyx is quin- quepartite; the petals concave; the recepta- cle surrounded with 10 malliform pori; the capsule is bilocular. In some forms the fifth part of the number is excluded. There are seven species, of which the most remarkable is the hortensis, or common broad-leaved garden rue, which has been long cultivated for medicinal use.

Rue has a strong ungrateful smell, and a bitterish penetrating taste; the leaves, when full of vigour, are extremely acrid, insomuch as to inflame and blister the skin, if much handled.

RUTHILE, or Rue, found in Hungary, Italy, and France. It is generally crystal-
lized. The primitive form of the crystals is a rectangular prism, whose base is a square, and the form of its molecules is a triangular prism, whose base is a right-angled isosceles triangle, and the height is to any of the sides of the base about the right angle, nearly as three to five. Specific gravity from 4.18 to 4.24. It is not affected by the mineral acids.

**RUYSCHIA**, in botany, a genus of the monogynia order, in the pentandria class of plants; and in the natural method ranking with those that are doubtful. The calyx is pentahylous; the corolla is pentapetalous; and the berry many-seeded. There are two species, parasitical shrubs of Guiana.

**RYANIA**, a genus of the polyandria monogynia class and order. The calyx is five-leaved; corolla none; stigma four; berry suberous, one-seeded, many-seeded. There is one species, a tree of Trinidad.

**RYE.** See **SECALE**.

**RYNCHOPS, skinner, in ornithology,**

S, the eighteenth letter of our alphabet, in abbreviations stands for societies, or persons; as R. S. for regius societatis socius, i.e. fellow of the royal society. In medicinal prescriptions, S. A. signifies secundum artum, i.e. according to the rules of art; and in the notes of the antidots, S. stands for Sextus; S. C. for secundus consultum; S. P. Q. R. for senatus populusque Romanus; S. S. for stratum super stratum, i.e. one layer above another alternately; S. V. B. E. Q. V. for si vales bene et ego quoque vales, a form used in Cicero's time, in the beginning of letters.

Used as a numeral, S. antiently denoted seven; in the Italian music, S. signifies solo; and in books of navigation, S. stands for south; S. E. for southeast; S. W. for south-west; S. S. E. for south-south-east; S. S. W. for south-south-west. See **COMPASS**.

**SABELLA, a genus of vermues testacea;** animal a nereis, with a ringed mouth, and two thicker tentacles behind the head: shell tubular, composed of particles of sand, broken shells, and vegetable substances united to a membrane by a gluttonous cement. There are 24 species.

**SABELLIANS, a sect of Christians of the third century, that is, the opinioned Sabellius, a philosopher of Egypt, who openly taught that there is but one person in the Godhead.**

**SABLE.** See **MUSTELA**.

**SABLE.** See **HERALDRY**.

**SABURRE.** See **GIRR**.

**SAC BUT, a bass wind-instrument, resembling the trumpets, so contrived as to be capable of being drawn out to different lengths, according to the acuteness and gravity of the scale required.**

The sacbut is usually about eight feet long, and when extended to its full length, about fifteen. There are, however, sacbuts of different sizes to execute different parts; particularly a small one called by the Italian trombone piccolo, and the Germans klein alt possema, proper for the counter-tenor.

**SACCHARINE ACID. See **OXALIC** **ACID**.

**SACCHARUM, sugar, or the sugar-cane;** a genus of the digynia order, in the triandria class of plants; and in the natural method ranking under the 4th order, gramina. The calyx is two-valved; the corolla is also bivalved. There are eleven species of this genus. The most remarkable is the officinarum. It is a native of Africa, the East Indies, and of Brazil, whence it was introduced into Europe. In India islands soon after they were settled. In the manner of their growth, form of their leaves, and make of their panicle, the sugar-canes resemble the reeds which grow in wet marshy grounds in England, or elsewhere; except that the canes are far larger, and, instead of being hollow as the reeds, are filled with a white pith, containing the sweet juice or liquid, which stamps such value upon these plants. The intermediate distance between each joint of a cane is of different lengths, according to the nature of the soil, richness of the manure, and different temperature of the weather during its growth; it seldom exceeds, however, four inches in length, and an inch in diameter. The length of the whole cane likewise depends upon the above circumstances. It generally grows to perfection in about fourteen months, when its height, at a medium, is about six feet, sometimes more, sometimes less. The body of the cane is strong, but brittle; of a fine straw-colour, inclining to a yellow. The extremity of each is covered, for a considerable length, with many long sharp spines, which generally are sawed on their edges; the middle longitudinal ribs being high and prominent. The sugar-cane is propagated by planting cuttings of it in the ground in furrows, dug parallel for the longest part, and let parallel and level, and even, and are covered up with earth; they soon shoot out new plants from their knots or joints; the ground is to be kept clear, at times, from weeds; and the canes grow so quick, that in eight, ten, or twelve months, they are fit to cut for making of sugar from them. When ripe, they cut off the reeds at one of the joints near the roots; they are then cleared of the leaves, and tied up in bundles, and sent to the mills, which are worked either by water or horses.

The bottom part of the sugar-cane top is about the thickness of one's finger; and as it contains a good deal of the natural sweetness of the plant, it is usually cut into pieces of an inch and a half long, and given to the saddle-horses in the West Indies. It is very nourishing food, and fattens them space. The mill-horses, mules, and asses, are likewise fed, during the sunny days, on sugar-cane tops and the skimming of the sugar-coppers; which last must be administered sparingly at first, for fear of gripping, and perhaps killing them. For the manufacture, &c., of sugar, see **SUGAR**.

**SACCOLATS, salts formed from the saccharic acid, and but little known.**

1. **Saccolat of potas; small crystals soluble in eight times their weight of water.**

2. **Saccolat of soda; the same soluble in five times their weight of water.**

**Saccolat of ammonium; has a sourish taste; heat separates the ammonium.**

**Saccolat of lime, of barytes, of magnesia, and of alumina, are all insoluble in water.**

**SACK of wool; a quantity of wool containing just twenty-two stone, and every stone fourteen pound.**

In Scotland, a sack is twenty-four stone, each stone containing sixteen pounds.

**SACK of cotton-wool; a quantity from one hundred and a half to four hundredweight.**

**SACKS of earth, in fortification, are canvas bags filled with earth.** They are used in making intrenchments in haste, to place on parapets, or the head of the breaches, &c., or to repair them, when beaten down.

**SACLACTIC ACID.** This acid was discovered by Scheele in 1780. After having obtained oxalic acid from sugar, he wished to examine whether the sugar of milk would furnish him the product. Upon four ounces of pure sugar of milk, finely powdered, he poured twelve ounces of diluted nitric acid, and put the mixture into a large glass retort, which he placed in a sand-bath. A violent effervescence ensuing, he was obliged to remove the retort from the sand-bath till the commotion ceased. He then continued the distillation till the mixture became yellow. As no crystals appeared in the liquor remaining in the retort after standing two days, he repeated the distillation as before, with the addition of eight ounces of nitric acid, and continued the operation till the yellow colour, which had disappeared on the addition of the nitric acid, returned. The liquor in the retort contained a white powder, and when cold, was observed to be thick. Eight ounces of water were added to dilute this liquor, which was then filtered, by which the white powder was separated; which being eluted and dried, weighed 74 drachms. The filtrated solution was evaporated to the consistency of a syrup, and, again subjected to distillation, with four ounces of nitric acid as before; after which, the liquor, when cold, was observed to contain many small, colourless, sour crystals, together with some white powder. This powder being separated, the liquor was again distilled with more nitric acid, and a genus belonging to the order of anseres. The bill is straight; and the superior mandible much shorter than the inferior, which is truncated at the point. The species are two, viz. the nigra and fulva, both natives of America. The fulva is perpetually flying and skimming, in and out of which it scoops small fish with its lower mandible; in stormy seasons it frequents the shores in search of shell-fish, See Plate Nat. Hist. fig. 348.
as before; by which means the liquor was rendered capable of yielding crystals again; and by one distillation more, with more nitric acid, the whole of the liquor was converted into a volatile nature; he therefore called it the acid of sugar of milk. It was afterwards called saccacic acid by the French chemists. Fourcroy has lately given it the name of mucous acid, because it is obtained by treating gum arabic, and other mucilaginous substances, with nitric acid.

Mr. Hermstadt, of Berlin, had made similar experiments on sugar of milk at the same time with Scheele, and with similar results; but he concluded that the white powder which he obtained was nothing else than an oxalte of lime with excess of acid, as indeed Scheele himself did at first. After he became acquainted with Scheele's conclusions, he published his opinions on the subject; but his proofs are very far from establishing it, or even rendering its truth probable. He acknowledges himself, that he has not been able to decompose this supposed acetate; and that he possesses properties distinct from the oxalic acid; but he ascribes this difference to the time which it contains; yet all the time which he could discover in 240 grains of this salt was only 20 grains; and if he employed it as a carbonat (as it probably was), these 20 must be reduced to 11. Now Moreau has shewn, that oxalic acid, containing the same quantity of lime, exhibits very different properties. Besides, this acid, whatever it is, when united with lime, is separated by the oxalic, and must therefore be different from it; as it would be absurd to suppose that an acid could displace itself. The saccacic acid must therefore be considered as a distinct acid, since it possesses properties distinct from the oxalic acid.

1. Saccacic acid may be obtained by the following process: Upon one part of granular oxalic acid, or other similar gum, previously put into a retort, pour two parts of nitric acid. Apply a stream of cold water until the whole takes a containing a little nitrous gas and carbonic acid gas comes over; then allow the mixture to cool. A white powder gradually precipitates, which may easily be separated by filtration. This powder is saccacic acid.

2. Saccacic acid, thus obtained, is under the form of a white gritty powder, with a slightly acid taste.

SALT, or saccacic acid, as in the form of a white powder, or in the form of crystals. SALT is a natural and a mineral acid, which is contained in a great variety of plants.

The solution has an acid taste, and reddens the infusion of turnsole. Its specific gravity, at the temperature of 33.7, is 1.005. The compounds which it forms with carbon, alkali, and metallic oxides are denominated saccates.

SACERON. See CROCEUS. SAGAPENUM, guna resinus. See PHARMACY.

SAGATHEE, in commerce, a slight kind of woolly stuff, tender, or ratteen, sometimes mixed with a little silk. SAGE. See SALVIA.

SAGNE, a Russian long measure, five inches of which make a verst. The sagne is equal to seven English feet.

SAGENILE. See RUTHILE.

SAGINA, perfoliata, a genus of the terebinth family, in the terebrata class of plants, and in the natural method ranking under the 22d order, caryophyllales. The calyx is triphialous; the petals four; the capsule is unilocular, quadrivalved and polyspermous.

There are 5 species.

SAGITTA, in astronomy, the arrow or dart, a constellation of the northern hemisphere, near the eagle. See ASTRONOMY.

SAGITTA, in trigonomotry, the same with the versed sine of an arch.

SAGITTARIA, overhand, a genus of the polyandria order, in the monoece class of plants, and in the natural method ranking under the fifth order, tripetalaeodae. The male calyx is triphialous; the corolla triphialous; the filament generally about 14; the female calyx is triphialous; the corolla triphialous; many pistils; and many naked seeds. There are five species, of which the most remarkable is the sagittalia, growing naturally in the parts of England. The root is composed of many strong fibres, which strike into the mud; the footstalks of the leaves are in length proportionable to the depth of the water in which they grow; so they are sometimes almost a yard long; they are thick and furcous; the leaves, which float upon the water, are shaped like the point of an arrow, the two cars at their base spreading wide and slender, and are very sharp-pointed. There is always a link at the lower part of the root, growing in the solid earth beneath the mud. This bulb consists of a considerable part of the food of the Chinese; and upon that account they cultivate it. Horses, goats, and swine, eat it; cows are not fond of it.

SAGITTIARUS, the archer, in astronomy, the ninth sign of the zodiac. See ASTRONOMY.

SAGO, a simple brought from the East Indies, of considerable use in diet as a restorative. It is produced from the pitch of a kind of palm which grows in the East Indies, called the cypsa cirrhata. See CYCAS, STARCH, &c.

SAIL, in navigation. See Ship-building. SAIL. If a man agrees for the purchase of goods, he shall pay for them before he carries or by the same term of a credit is expressly agreed upon.

If one man says the price of an article is 100l. and the other says I will give you 100l. but does pay not immediately, it is at the option of the seller whether he shall have it or no, except a day was given for the payment.

If a man upon the sale of goods, warrants them to be good, the law annexes to this contract a tacit warranty, that if they are not so, he shall make compensation to the purchaser; yet if the vendor knew the goods to be unsound, and has used any art to disguise them, or if in any respect they differ from what he represents them to be to the purchaser, he shall be answerable for their goodness, though no general warranty will extend to those defects that are obvious to the senses.

If two persons come to a warehouse, and one buys, and the other to procure him credit, promises the seller, if he does not pay him, I will; this is a collateral undertaking, and void without writing, by the statutes of frauds; but if he says, let him have the goods, I will be your pay-master, this is an absolute undertaking as for himself, and he shall be intended to be the real buyer, and the other to act only as his servant. 2 T. R. 73.

After earnest is given, the vendor cannot sell the goods to another without a default in the vendor; and therefore if the vendor does not come and pay, and take the goods, the vendor ought to give him notice for that purpose; and then if he does not come and pay, and take away the goods in convenient time, his agreement is dissolved, and he is at liberty to sell them to any other person.

An earnest only binds the bargain, and gives the party a right to demand; but demand without payment of money is void. See arRENT, CONTRACT, &c.

SAL, see STARCH.

SALIANT, in fortification, denotes projecting. There are two kinds of angles: the one salient, which are those that present their point outward; the other re-entering, which have their points inward. Both of these kinds we have in bastions and star-work.

SALIENT. See HERALDRY.

SALIC, or SALIQUE LAW, the law salic, an antient and fundamental law of the kingdom of France, usually supposed to have been made by Pharamond, or at least by Clovis, in virtue of which males are only to inherit.

Du Halain, after a critical examination, declares it to have been an expedient of Philip II., and says, that the daughter of Lewis Huitin from inheriting the crown. Father Daniel, on the other hand, maintains that it is quoted by authors more antient than Philip the Long, and that Clovis himself is the author of it, and that it is partly related to a particular regard to the crown of France; it only imports, in general, that in sale land no part of the inheritance shall fall to any female, but the whole to the male sex. By sale lands, or inheritances, were antiently denoted, among us, all lands, by whatever tenure held, whether noble or base, from the succession to which women were excluded by the salic law: for they were by it admitted to inherit nothing but moveable and purchases wherever there were any males.

SALICURIA, a genus of the class and order monoece polyandria. The male is an anem; and the female, solitary; calyx four-lobed, stripe. There is one species, a tree of Japan.

SALICORNA, jointed glasswort, or saltwort, a genus of the monegovia order, in the monoece class of plants, and in the natural method ranking under the 22d order, holocaraceae. The calyx is ventricose at the base, a little swelling out and entire: there are no petals, but one seed. There are nine species, of which the most remarkable are:

1. The fruticosa, with obtuse points, grows
plentifully in most of the salt marshes which are overflowed by the tides in many parts of England. It is an annual plant, with thick, succulent, jointed stalks, which trail upon the ground. 2. The perennis, with a shrubby branching stalk, grows naturally in Shapely Island. They are perennial, and produce their flowers in the same manner as the former.

The inhabitants near the sea-coasts where these plants grow, cut them up toward the latter end of summer, when they are fully grown; and after having dried them in the sun, they burn them for their ashes, which are used in making of glass and soap. These herbs are by the country people called help, and promiscuously gathered for use.

SALIX. The fluid secreted in the mouth, which flows in considerable quantity during a repast, is known by the name of saliva. All the properties of this liquor which had been observed by philosophers before the middle of the 18th century have been collected by Haller; but since that time several additional facts have been related by Fourcroy, Du Tennetar, and Brugnatelli, and a very numerous set of experiments have been made by Mr. Siebold, 1797, in his Treatise on the Salivary System.

Saliva is a limpid fluid like water; but much more viscid: it has neither smell nor taste. Its specific gravity, according to Haller, is 1.0167; according to Siebold, 1.080. When agitated, it froths like all other adhesive liquids; indeed it is usually mixed with air, and has the appearance of froth.

It neither mixes readily with water nor oil; but by a mortar it may be so mixed with water as to pass through a filtre. It has a great affinity for oxygen, absorbs it readily from the air, and gives it out again to other bodies. Hence the reason why gold or silver, triturated with saliva in a mortar, is oxidized, as Du Tennetar has observed; and why the killing of mercury by oils is much facilitated by spitting into the mixture. Hence also, in all probability, the reason that saliva is so readily transferred to sores of the skin. Dogs, and several other animals, have constantly recourse to this remedy, and with much advantage.

When boiled in water, a few flakes of albumen are putrid. When evaporated, it swells exceedingly, and leaves behind it a thin brown-coloured crust; but if the evaporation is conducted slowly, small cubic crystals of muriat of soda, (common salt) are formed; and when the evaporation is completed, there remains behind a substance which resembles vegetable gluten, and which takes fire on burning coal, exhaling the odour of prussic acid, and of burning feathers. The viscidity of saliva, the affinity which it has of absorbing oxygen, and of being inspissated, and this glutinous residuum, announce the presence of animal mucilage as a component part.

When saliva is distilled in a rotort, it froths very much. 100 parts yield 50 parts of water nearly pure, then a little carbonat of ammonium, some oil, and an acid, which perhaps is the prussic. The residuum amounts to about 1.50 parts, and is composed of muriat of soda, phlegm and phosphat of lime.

When saliva is exposed to the air, it absorbs a considerable portion of it, a slight pellicle appears on its surface, it becomes muddly, and deposits some flakes, exhaling at the same time a strong ammoniacal odour.

Soon after it putrices, and becomes exceedingly acid.

The acids and alcohol inspissates saliva; the alkalies disengage ammomia; oxalic acid precipitates lime; and the nitrats of lead, mercury, and silver, precipitate phosphoric and muriatic acids.

From these facts, it follows that saliva, besides water, which constitutes at least four-fifths of its bulk, contains the following ingredients:

1. Muriat of soda.
2. Muriat of lime.
5. Phosphat of ammonium.

But it cannot be doubted that, like all the other animal fluids, it is liable to many changes from disease, &c. Brugnatelli found the saliva of a patient, labouring under an oblique vertebral disease, impregnated with oxalic acid.

The concretions which sometimes form in the salivary ducts, &c. and the tartar or bony crust which so often attaches itself to the teeth, are composed of phosphat of lime.

Such are the properties of human saliva. The saliva of the goat as analysed by Delachoner in 1789. He collected 12 ounces of it in the space of 24 hours by puncturing the salivary duct. Its colour was greenish-yellow; its feel soapy; it had a weak disagreeable smell, and a saline taste. Boiling water and alcohol coagulated it in part; as did the acids. When sulphuric acid was used, sulphat of soda was obtained. It perished in about 14 days; and when allowed to evaporate spontaneously, it left a black residue like earth. When distilled, it yielded an inodorous watery liquid, crystals of carbonat of ammonia, a thick black empyreumatic oil, carbureted hydrogen, and carbonic acid; and a charcoal remained.

It is rather surprising that no experiments have been hitherto made on the saliva of dogs; though the hydrophobia has been usually ascribed to the infusion of the saliva of that animal.
The salmon, this fish is prepared in different methods for sale, being sold both fresh and salted, as well as smoked, pickled, &c. &c.

3. Salmo fario, common trout. The trout is an inhabitant of cold and clear streams and lakes in most parts of Europe, and admits of considerable variety as to the tinge of its ground-colour and spots. Its general length is from six to fourteen inches, and its greatest length from ten to sixteen inches, and its colour yellowish-grey, darker or browner on the back, and marked on the sides by several rather distinct, round, bright red spots, each surrounded by a tinge of pale red. The general colour of the body is a purplish grey; the red spots much larger, more or less mixed with black, and the belly of a white or silvery cast; the fins are a pale purplish brown; the tail is furnished with several darker spots; the head is rather larger in proportion than that of the salmon, the scales small, and the lateral line straight. The female fish is of a brighter and more beautiful appearance than the male.

Mr. Pennant informs us that in the lake Llyn Padarn, near Caernarvon, the Wakes are trout marked with red and black spots as large as sixpences; and others unspotted and of a reddish hue, sometimes weighing near ten pounds; but these latter are said to be harder fish.

In general the trout prefer clear, cold, and bright-running waters, with a stony or gravelly bottom. It swims with rapidity, and, like the salmon, springs occasionally to a very considerable height in order to surmount any obstacle in its course. It lives on young small fishes, shell-fish, and aquatic insects, and is particularly delighted with May-flies (ephemeris), as well as with phryganea, gnats, and their larvae. It generally spawns in September, or in the colder parts of Europe, in October, and at those times gets around the roots of trees, stones, &c. in order to deposit its eggs, which are observed to be far less numerous than those of other river-fish. Yet the trout, asBloch observes, is a fish that adapts itself to the most various situations. It is, moreover, no doubt, to the circumstance of most of the venomous kind of fishes avoiding waters of so cold a nature as those which trout delight to inhabit; and their increase would be still greater were they not themselves of a voracious disposition, frequently preying even on each other.

The merit of the trout as an article of food is too well known to require particular notice. In this respect, however, as in other fishes, those are most esteemed which are natives of the clearest waters.

The stomach of this fish is uncommonly strong and thick; but this circumstance is observed to be no where so remarkable as in those found in some of the Irish lakes, and particularly in those of the county of Galway. These are called gillmore trout; on the most accurate examination, however, it does not appear that they are specifically different from the common trout; but by living much on shell-fish, and swallowing small stones at the same time, their stomachs acquire a much greater degree of thickness, and a kind of muscular appearance, so as to resemble a sort of gizzard.

Mr. Pennant observes, that it is a matter of surprise that the trout, though so common a fish, should appear to be unnoticed by the ancients, except Antonius, who is supposed to

...
have intended it by the name of salar. He mentions it, however, merely on account of its beauty, and without any thing relative to its merit as a food.

4. Salmo salar is, according to ancient belief, the least of the British species of this genus, and is frequently seen in the river Wye, in the upper part of the Severn, and in the rivers that run into it, in the north of England, and in Wales. It is by several anglists termed the fry of the salmon; but Mr. Pennant disposed of this opinion for the following reasons: first, it is well known that the salmon-fry never continue in fresh water the whole year, but, as they appear on the first escape from the spawn, all vanish on the first vertal flood that happens, which sweeps them into the sea, and leaves scarcely one behind; secondly, the growth of salmon-fry is so quick and so considerable as suddenly to exceed the bulk of the largest salmon; for example, the fry that have quitted the fresh water in spring, not larger than gudgeons, return into it again a foot or more in length; thirdly, the salmon obtains a considerable bulk before it begins to ascend the stream; on the contrary, are found both male and female of the common size, and are readily distinguished by being furnished with either the hard or soft roe; fourthly, they are found in the fresh waters all times of the year, and even at seasons when the salmon-fry have gained a considerable size. It is well known that at Shrewsbury (where they are called Samons), they are found in such quantities in the month of September, that a skilled angler, in a coracle, will take with a fry from twenty to thirty dozen in a day. They spawn in November and December, at which time those of the Severn push up towards the head of that river, quitting the smaller brooks, and return into them again when they have done spawning. They have a general resemblance to the trout, and must therefore be described comparatively.

The head is proportionally narrower, and the mouth smaller; the body deeper; the length seldom more than six or seven inches, or at most about eight and a half; the pectoral fins have generally but one large black spot, or occasionally a single small one attached to it; whereas the pectoral fins of the trout are more numerous marked; the spurious or fat fin on the back is never tipped with red, nor is the edge of the anal fin white; the spots on the body are fewer, and not so bright; the body is also marked from back to sides with six or seven large bluish bars; but this Mr. Pennant allows to be a certain character, as the same is sometimes observed in young trout; lastly, the tail of the salmon is much more forked than that of the trout. The salmon is very frequent in the rivers of Scotland, where it is called the parr. It is also common in the Wye, and is there known by the title of skirling or lairping.

5. Salmo salvelinus, salvelin trout. Length about twelve inches; shape resembling that of the salmon, but rather more slender; colour of the back dark-brownish green; of the sides, the back part pretty much olive, moderately distant, small, round, red spots, which are sometimes surrounded with a pale margin; belly red or orange-colour; pectoral, ventral, and anal fins the same, but with the two first rays white; dorsal and caudal fin blueish brown; adipose fin small, pale, and filiponed, scales rather small than large; lateral line straight; tail moderately bifurcated; both jaws of equal length; irides silvery. Native of mountainous lakes in several parts of Germany, and of several of the rivers in Silesia, and (of this species is the red chair of the English) in some of the lakes of our own country, as those of Westmoreland, &c. As in others of this genus, those which inhabit the clearest and coldest waters are observed to be of the mildest colours. It is a fish of great delicacy of flavour, and much esteemed as a food.

6. Salmo cephalus, smelt. Of this species there appear to be two varieties: one not exceeding the length of three or four inches; the other arriving at the general length of six, eight, or nine inches, and sometimes even to twelve or thirteen. The larger variety seems to be so frequently seen about the British coasts, and which is distinguished by Dr. Bloch under the name of cephala- licus, or sea-smelt. These fishes are found about our coasts throughout the whole year, and rarely go any great distance from the shores, except when they ascend rivers either at or some time before the spawning-season. It is observed by Mr. Pennant that in the river Thames and in the Dee, they are taken in great abundance in November, December, and January; but in other rivers not till February, spawning in the months of March and April. The smelt is a very elegant fish; its form beautifully taper; the skin thin, and the whole body, but particularly the head, semi-transparent; the colour of the back is of a bluish green, with a cast of blue, beneath which it is variegated with blue, and then succeeds the beautiful silvery gloss of the abdomen; the scales are small, and easily rubbed off; the eyes are silvery; the under jaw longer than the upper; in front of the upper are four large teeth, those in the sides of the jaws being small; the tail is forked. This fish is an inhabitant of the European seas; it has generally a peculiar odour, which in those of British growth is commonly peculiarly odorous. It is said a cucumber, but by some to that of a violet.

7. Salmo Greenlandicus, Greenland salmon. Length about seven inches, which it very much exceeds; shape elongated, contracting somewhat in the tail, and the sides; the dorsal fin placed in the middle of the back; fins rather large for the size of the fish; scales small; tail forked; colour pale-green, with a tinge of brown above; abdomen and sides silvery; in the male fish, just above the lateral line, is a rough fascia, beset with minute pyramidal scales standing upright like the pile of a shag. The use of this fish is highly singular, since it is affirmed that while the fish is swimming, and even when very near, on shore, two, three, or even as many as ten will be there, as if glued together, by means of this pile, insomuch that if one is taken, the rest are also taken up at the same time. This species swarms off the coasts of Greenland, Iceland, and Newfound-land, and is said to be one of the chief supports of the Greenlanders, and a sort of dinner at their most delicate feasts. The inhabitants of Iceland are said to dry a great many of these, and use them as a winter food for their cattle, whose flesh is apt to acquire an only flavour in consequence. This fish lives at sea the greatest part of the year; but in April, May, June, and July, comes in incredible shoals into the bays, where immense multitudes are taken in nets, from fifty to a hundred; when fresh they are by some said to leave the smell of a cucumber, though others affirm that the scent is highly unpleasant. They feed on small crabs and other marine insects, as well as on small herring, on which they are also observed to deposit their eggs.

8. Salmo thymallus, grayling salmon. This elegant species grows to the length of about eighteen inches, and is an inhabitant of the clearer and colder kind of rivers in many parts of Europe and Asia, particularly such as flow through mountainous countries. In England it is found in the rivers of Derbyshire; in some of those of the North; in the Tame near Ludlow; in the Lug and other streams near Leominster; and in the river near Chirchch in Haupstaire. In Lolland it is said to be very common, where the natives make use of its intestines instead of rennet, in preparing the cheese which they make from the milk of the reindeer.

This species of the grayling resembles that of the trout, but is much more slender; its colour is a beautiful silvery grey, with numerous longitudinal deeper stripes, disposed according to the rows of scales, which are of a moderately large size; the head, lower fins, and tail, are of a brownish or rosy cast; the dorsal fin, which is deeper and broader than in the rest of the genus, is of a pale violet-colour, crossed by several dusky bars; the adipose fin is very small, and the tail forked. The white fish, very beautiful, and recorded by Mr. Pennant was taken at Ludlow, and measured above half a yard in length, its weight being four pounds eight ounces; the general size of the British specimens being far short of this measure.

The grayling, says Mr. Pennant, is a voracious fish, rising freely to the fly, and will very eagerly take a bait: it is a very swift swimmer, appearing like the transient passage of a shadow, from whence perhaps is derived its name. It is said to be a fish of very quick growth, feeding on water-insects, the smaller kind of testaceae, and the root of other fishes, as well as on the smaller fishes themselves; its stomach is so transverse that large objects cannot be swallowed. It spawns in April and May, the full-grown ova being nearly of the size of peas. The grayling is much esteemed for the delicacy of its flesh, which is white, firm, and of a fine flavour, and is considered as in the highest season in the depth of winter.

SALON, or SALON, in architecture, a very lofty spacious hall, vaulted at top, and sometimes comprising two stories or ranges of windows.

SALO, or SALP. See STARCH.

SALPA, a genus of insects of the order mollusca. Body long, narrow, gelatinous, tubular, and open at each extremity; intestines obliquely placed. The animals of this genus are of a white, transparent hue; and often adhere together; they swim with great facility, and possess the power of contracting and opening at pleasure. There are two divisions: A is furnished with an appendage or tube which differs in different species; B without the terminal appendage.

SALSOULA, salvwort, kali, &c. a genus of
the class and order pentadactyla dignus, and in the natural method ranking under the 12th order, holocercus. The calyx is pentaphylly; there is no corolla; the capsule is monospermous, with a screwed seel. The species are 31, of which the principal are:

1. Salvia kalt grows naturally in the salt marshes of various parts of England. It is an annual plant, which rises above five or six inches high, sending out many side branches, which spread on every side, with short awl-shaped leaves, which are fleshy, and terminate in acute spines.

2. Salvia roscacea grows naturally in Tartary. This is an annual plant, whose stalks are herbaceous, and seldom rise more than five or six inches high.

3. Salvia soda rises with herbaceous stalks near three feet high, spreading wide. The leaves on the principal stalk, and those on the lower part of the branches, are long, slender, and have no spines; those on the upper part of the stalk and branches are longer and thicker. All the sorts of glass-ware are sometimes promiscuously used for making soda or mineral alkali, but this species is esteemed best. The manner of making it is as follows: Having dug a trench near the sea-shore, they plant laths across it, on which they lay the herbs in heaps, and, having made a fire below, the liquor which runs out of the herbs drops to the bottom, which at length thickening, becomes soda, which is partly of alkali, partly of an ash-colour, very sharp and corrosive, and of a saltish taste. This, when thoroughly hardened, becomes like a stone, and in that state is transported to different countries for the making of glass, soap, &c.

4. Salvia tragus grows naturally on the sandy shores of the south of France, Spain, and Italy. This is also an annual plant, which sends out many diffused stalks, with linear leaves an inch long, ending with sharp spines.

5. Salvia verniculata grows naturally in Spain. This has shrubby perennial stalks, which rise three or four feet high, sending out many side branches, with fleshy, oval, acute-pointed leaves, and appear in clusters from the side of the branches; they are hoary, and have stiff prickles. See Soda.

SALT, common. The preparation of that kind of salt which is used for culinary and economical purposes (sulphate of soda) depends upon the well-known fact, that the salt contained in the sea-water, or brine-springs, being a fixed body, will not rise with the vapour of the water. All, therefore, that is wanted, is to expose any water containing salt to evaporation. The salt commonly known by the name of brine-salt is obtained from the water of the sea by evaporation. This evaporation is in some places performed by the heat of the sun, the water being let into shallow basins, in order to expose as large a surface as possible. This method is practiced in the southern provinces of France, and on a very large scale near Aveiro in Portugal. In the northern countries, where the heat of the sun is not sufficiently great, artificial fires are employed. In some salt-works these two methods are united; and in England, and countries where salt-rock is plentiful, that substance is dissolved in salt-water, and then evaporated. In very cold countries another method is employed to separate the salt from sea-water. The water is exposed in trenches on the sea-shore, where it forms a thin stratum, that the cold of the atmosphere acts powerfully in condensing it. As the water is brine, and that part consists of more water, the fluid which remains is consequently more concentrated. The operation is then completed by means of artificial heat.

The most convenient works for making salt from brine by boiling are constructed in the following manner: The salt-pan, or boiling-house, is erected near the sea-shore, and is furnished with a furnace and one or two large pans, which are commonly made of iron plates, joined together with nails, and the joints filled with a strong cement; and the bottom of the pans is prevented from breaking down, by being supported by strong iron bars.

The salt-pan being filled with sea-water, a strong fire of pit-coal is lighted in the furnace; and, then, for a pan which contains about 1400 gallons, the salt-boiler takes the white of three eggs, and incorporates them with the same amount of sea-water, which he pours into the salt-pan, while the water contained therein is only lukewarm, and mixes this with the rest by stirring it about with a rake. In many places they use instead of eggs, the blood of sheep or oxen to clarify the sea-water: and in Scotland they do not give themselves the trouble to clarify it at all. As the water heats, there arises a black frothy scum upon it, which is to be taken off with wooden skimmers. After this the water appears perfectly clear, and by boiling it briskly about four hours, a pan loaded in the common way, that is, about fifteen inches deep, will begin to form crystals upon its surface. The pan is then filled up a second time with fresh sea-water; and about the time when it is half-filled, the scratch-pans are taken out and emptied of a white powder, seeming a kind of curculious earth, which consists of mixture of sea-water, during its boiling, before the salt begins to shoot. When these have been emptied, they are again put into their places, where they are afterwards filled again. This process may be repeated, and by the boiling liquor, does not subside till it comes to the corners of the pan, where the motion of the mass is smaller, and it there falls into these pans placed on purpose to receive it.

The second filling of the pan is boiled down after clarifying in the same manner as the first, and so a third and a fourth; but in the evaporation of the fourth, when the crystals begin to form themselves, they stick the fire, and stay behind the liquor simmering; and in this heat they keep it all the while that the salt is granulating, which is nine or ten hours. The granules, or crystals, all fall to the bottom of the pan; and when the water is almost all evaporated, and the salt lies nearly dry at the bottom, they rake it all together into a long heap on one side of the pan, where it lies a while to drain from the brine, and then is put into barrows, and carried to the storehouse, and delivered in the form of blocks. In this manner the whole process is usually performed in 24 hours, the salt being commonly drawn out every morning. This is the method in most of our salt-works; but in some they fill the pan seven times before they boil up the salt, and so take it out but once in two days, or five times in a fortnight. In the common way of four boilings, from a pan of the usual size, containing 1500 gallons, they may draw from from fifteen to not much more of water every day, each bushel weighing fifty-six pounds.

When the salt is carried into the storehouse, it is put into bracs, which are partitions, like stalls for horses, lined on three sides, and the bottom with boards, and having a sliding-board on the foreside to draw up on occasion. The bottoms are made shelving, being highest at the back, and gradually inclining toward the front by this means the brine remaining among the salt, easily separates and runs from it, and the salt in three or four days becomes sufficiently dry; in some places they use cribs and barrows, which are long and close wicker-baskets, for this purpose; and in some places wooden troughs, with holes in the bottom. The same liquor which remains from the making of salt is what is called bittern, from which Epsom salt or magnesia is often extracted.

Much of the salt obtained from the brine of salt-springs, pits, &c. is white salt. White salt is prepared from sea-water, or any other kind of salt-water, first heightened into a strong brine by the heat of the sun, the evaporation of the air. It may also be prepared from a strong brine, or lixivium, drawn from earths, stones, or sands, strongly impregnated with common salt. Refined rock-salt is that obtained by dissolving fossil or rock-salt in sea-water, and afterwards boiling the solution.

A great quantity of rock-salt is used at Northwich, in order to strengthen their brine-springs; and a much greater quantity is sent coastwise to Liverpool, and other places, where it is either used for strengthening brine-springs or sea-water; much of this rock-salt was formerly exported to Holland, and is still sent to Ireland for the same purposes.

The Northwich rock-salt is never used at our tables in its crude state: and its application to the pickling or curing of flesh or fish, or preserving any provisions, without its being reduced into a refined state, by boiling it without its being dissolved in water, and boiled down in what is called white-salt, is prohibited under a penalty of £5, for every pound of rock-salt so applied. The pure transparent masses, however, of rock-salt, might probably be used by us with our food, without any sort of danger or inconvenience; at least we know that rock-salt is so used, without being refined, both in Poland and in Spain.

The quantity of rock-salt which may be dissolved in a definite quantity, suppose a pint of 16 avoirdupois ounces of water, is differently estimated by different authors. Broom is of opinion that 16 ounces of water will not dissolve quite five ounces of rock-salt; Spielmann thinks that they will dissolve 65 ounces; Newman agrees with Spielmann; Eller says, that seven ounces of fossil rock-salt dissolve in 16 ounces of water; lastly, Hoffman says that 16 ounces of water will not dissolve above six ounces of common salt. It is not wholly improbable, that different sorts of rock-salt may differ somewhat with respect to their solubility in water.
If it is admitted, that 16 ounces of water
to dissolve six ounces of salt and no more,
then we may be certain, that no brine-spring in
any part of the world, can yield six ounces of
salt from a pint of its water. For brine-
springs are, ordinarily, nothing but water in
which fossil salt has been dissolved; but a pint
of the strongest brine cannot contain so
much salt as is contained in a pint of water,
which has been subjected to six ounces of
salt; for a pint of water, in which six ounces
of salt have been dissolved, is increased a little
in bulk; it will do more than fill a pint-
measure, and the salt left in the surplus will
shew how much the salt contained in a pint
of the strongest brine falls short of six ounces.

Of or we may consider the matter in the fol-
lowing manner, which will perhaps be more
intelligible; 16 ounces of water, impregnated
with six ounces of salt, constitute a saturated
brine, weighing 22 ounces; if therefore we
would know how much salt is contained in 16
ounces of such brine, by the rule of propor-
tion we may argue, that if 22 ounces of brine
contain 16 ounces of salt, 16 ounces of
brine will contain \( \frac{16}{22} \times 16 \) ounces of salt. Hence
we may infer, that the strongest brine-springs
will not yield much above one quarter of their
weight of salt.

There are a great many brine-springs in
Cheshire, Worcestershire, Staffordshire,
Hampshire, and in other parts of Great Brit-
ain; some of which are sufficiently rich in
salt to be wrought with profit, others not.
From what has been before advanced, the
reader will readily comprehend that 16 tons
of the strongest brine consist of 12 tons of
water, and of four tons of salt; and, that, in
order to obtain these four tons of salt, the
12 tons of water must be, by some means or
other, evaporated, so as to leave the salt in a
concrete form. Suppose there should be a
brine, which in 16 tons should contain 12 tons
of salt, and only one ton of salt; yet it may
chance, that such a weak brine may be
wrought with more profit than the strongest;
for the proportion of brine to salt, depends as
much upon the price of the salt used in boiling it, as upon the
quantity of salt which it yields. Thus the sea-
water, which surrounds the coasts of Great Britain, may hold salt even more than one-
third, or less than one-fifth part of com-
mon salt; but fuel is so cheap at Newcastle,
that they can evaporate thirty or forty tons
of water, in order to obtain one ton of salt,
and yet gain as much clear profit as those do,
who, in countries less favourably situated for
fuel, boil down the strongest brine.

The advantage resulting from strengthen-
ing weak brine or sea-water, by means of
rock-salt, is very obvious. Suppose that the
sea-water at Liverpool, where large quanti-
ties of rock-salt are refined, would yield one
ton of salt from 48 tons of water; then must
a quantity of fuel sufficient to evaporate 47
tons of water be used, in order to obtain one
ton of salt. But if as much rock-salt is put into
the forty-eight tons of sea-water; as is occasion-
edly dissolved in it, then will the sea-water re-
solve a brine fully saturated, each 16 tons
of which will give four tons of salt, and the
whole of which will be produced by the evaporation
of 47 tons of water will be 12 tons of salt.

SALTS. The word salt was originally con-
ceived to muriat of soda, or common salt, a
substance which has been known, and is
commonly used, from the remotest ages. It
was afterwards generally used by chemists, and
employed by them in a very extensive and
not entirely inconstant sense. Every body which
is capable of dissolving common salt in water,
and not combustible, has been called a salt.

Salts, were considered by the older che-
mists as a class of bodies intermediate be-
tween earths and water. Many disputes arose about what bodies ought to be con-
sidecred under this class, and what ought to
be excluded from it. Acids and alkalies
were allowed by all to be salts; but the dif-
culty was to determine concerning earths
and metals; for several of the earths possess
all the properties which have been ascribed to
alkalis; and the metals are capable of enter-
ning into combinations which possess saline
properties.

In process of time, however, the term salt
was restricted to those classes of bodies, viz.
acids, alkalies, and the compounds which
acids form with alkalies, earths, and metallic
oxides. The first two of these classes were
usually called simply salts, and the bodies
belonging to the third class were called compounds or neutral
salts. This last appellation originated from an
opinion entertained by chemists that acids
and alkalies, of which they are composed,
were of a dissimilar nature, and that they con-
tinued one another; so that the resulting
compounds possessed neither the properties
of acids nor of alkalies, but properties inter-
mediate between the two.

Chiefly by restricting the term salt still more, by tacitly excluding acids and
alkalies from the class of salts altogether. At
present, then, it denotes only the compounds
formed by the combination of acids with
alkalies, earths, and metallic oxides.

No part of chemistry has been cultivated
with more zeal than the salts, especially for
those last 40 years. During that time the
number of saline bodies has been enormously
increased, and a very great number have been determined with precision.

Still, however, this wide and important
region is far from being completely explored.

Chemists have agreed to denominate the
salts of each other by names. The earth, alkali, and metallic oxide, combined
with that acid, is called the base of the salt.

Thus common salt being a compound of
muriatic acid and soda, is called a muriat; and
soda, is called the base of common salt.

Now since there are 32 acids and 37 bases, it would appear, at first sight, that there are 1824
salts; but of the 45 metallic oxides at pres-
ent known, there are a considerable number
which cannot combine with many of the
acids. This is the case also with silica, and
perhaps with some of the other earths. We
must therefore subtract all these from the
full number 1824. To compensate, however,
this deficiency, at least in part, there are se-
veral acids capable of combining with two
bases at once. Thus the tannic acid com-
bines at once with potas and soda. Such
combinations are called triple salts, and they increase the number of salts considerably.

There are some salts, too, which are capable
of combining with an additional dose of their
acid, and others which combine with an addi-
tional dose of their base. The French
chemists denote the first of these combinations by adding to the usual name of the salt the
phrase with excess of acid, or by prefixing it
to the word acidoism; they denote the sec-
dard by prefixing the phrase with excess of
base. This method of naming has the merit
of being precise, but it is exceedingly
labouriously tedious.

The ingenious method of naming saline combinations proposed by Dr. Pearson ought certainly
to be preferred. It is equally precise, if not
more so, and far more convenient in every
respect. It consists in prefixing to the usual
name of the salt, the preposition super, to de-
ote an excess of acid, and the preposition
sub to denote an excess of base. Thus
superplut of potass denotes the salt in its state of
perfect neutralization, without any excess either
crider of the sulphuric acid or of the potass;
supersubplut of potass is the same salt with an
excess of acid; and subsubplut of potass is the
same salt with excess of base.

These three great kinds must increase the number of
salts that we can possibly name; but the
precise number of salts is not known, as many
of them remain still unexamined by chemists. Probably they are not much fewer
than 2000. Some idea may be formed of the
number of saline combinations which have been
made, by recollecting that 40 years ago not
more than 30 salts in all were known.

Of these 2000, however, a considerable
number may be considered as still unknown,
that they have been merely formed without
being examined. Of those which are known,
the greater number have not been applied to
any use, and therefore do not deserve a very
particular description.

As the different genres of salts are denom-
inated from their acids, it is evident that
there are as many genera as there are acids.
The terminations of the names of these ge-
nera differ according to the nature of the
acids which constitute them. When that acid
contains a maximum of oxygen, the termina-
tion of the genus is -ite; when it does not
contain a maximum of oxygen, the termina-
tion of the genus is -ic.

Thus the salts which contain sulphurous acid are called sulphates;
those which contain sulphuric acid are
called sulphides. The formation of some con-
sideration, because the salts differ very
much, according as the acid is saturated with
oxygen or not. The -ates are seldom perma-
ent; when exposed to the air, they usually
convert oxygen, and are converted into -ates.

Every particular species of salt is distin-
guished by subjoining to the generic term
the name of its base. Thus the salt composed
of sulphuric acid and soda is called sulphat
of soda.

Triple salts are distinguished by sub-
joining the name of the salt, and these terms
connected by hyphens. Thus the compound of tar-
tratic acid, potas, and soda, is called trarut of
potassium-the-soda.

The salts then naturally divide themselves
into two grand classes; the first of which
comprehends the alkaline and earthy salts,
which derive their most important characters
from their acids; the second comprehends the
metalline salts, whose bases on the con-
trary stamp their most important properties.

Salts, or the combinations of alkalies with acids which exist in our mineral kingdom, constitute the following genera and species:

Genus I. Potass.

sp. 1. Nitrat of potass.
S A L

Genus II. Soda.


Genus III. Ammonia.


Genus I. Salts of potash.

Sp. 1. Nitrat of potassa. This salt is found native, mixed with nitrat of lime, muriat of potash, and other impurities, encrusting the surface of the earth in different parts of India, the Cape of Good Hope, Peru, Spain, Molletta, &c. It is most commonly in fine cubic crystals. Sometimes, though rarely, massive, or in six-sided prisms.

Its primitive form is a rectangular octahedron. It occurs sometimes in that form, but more frequently the apexes of the pyramids are truncated. But its most usual variety is a six-sided prism, terminated by six-sided pyramids. A specimen of native nitrate from Molletta, analysed by Klaproth, contained

44.55 nitrat of potash
23.43 sulphat of lime
30.40 carbonat of lime
0.20 muriat of potass

100.0

Genus II. Salts of soda.

Sp. 1. Carbonat of soda. This salt is found in Egypt on the surface of the earth, and on the margin of certain lakes which become dry during the summer. It has often the appearance of a rough dusty powder, of a grey colour and alkaline taste. It occurs in China, where it is called Kien; near Tripoli, where it is denominated trons; and likewise in Hungary, Syria, Persia, and India.

It is said sometimes to have been observed in crystals. The primitive form is a rhombohedral octahedron; but the pyramids are usually truncated.

A specimen of this salt from Egypt was found by Klaproth to consist of

32.60 dry carbonat of soda
20.0 dry sulphat of soda
13.0 dry muriat of soda
31.6 water

100.0

A specimen of fibrous carbonat from the interior of Africa, yielded the same chemist

37.0 soda
38.0 carbonic acid
22.5 water
2.5 sulphat of soda

100.0

Sp. 2. Sulphat of soda. This salt is found in Austria, Hungary, Styria, Switzerland, and Siberia; always in the neighbourhood of a mineral spring. It occurs usually in the state of powder, sometimes massive, and even crystallized. Colour greyish, or yellowish white.

A specimen of the monogynia order, in the tetragyna class of plants. The calyx is quadripartite; the corolla is monospermous; and the seed covered with an anulus or loose coat. There are three species, herbs of China.

SALVAGE MONEY, a reward allowed by the civil and statute law for the saving of ships or goods from the danger of the seas, pirates, or enemies.

Where any ship is in danger of being stranded, or driven on shore, justices of the peace are to command the constables to assemble as many persons as are necessary to preserve it; and on its being preserved by their means, the persons assisting therein shall in thirty days after be paid a reasonable reward for the salvage, otherwise the ship or goods shall remain in the custody of the officers of the customs as a security for the same.

SALVIA, sage, a genus of the monogynia order, in the digynia class of plants, and in the natural method ranking under the 43d order, daisieae. The calyx is quinquepartite; the corolla quinquepartite; the berry trisperminous. The species are only five, and the most remarkable are,

1. The officinal, or common large sage, which is cultivated in gardens, of which there are the following varieties: 1. The common sage. 2. The wormwood sage. 3. The green sage with a variegated leaf. 4. The red sage. 5. The red sage with a variegated leaf. These are accidental variations, and therefore are not enumerated as species. The common sage grows naturally in the southern parts of Europe, but is here cultivated in gardens for its leaves, and the variety with red or blackish leaves is the most common in the British gardens; and the wormwood sage is in greater plenty here than the common green-leaved sage, which is lost in few gardens.

2. The tomentosa, generally titled balassic sage by the gardeners. The stalks of this do not grow so upright as those of the common sage; they are hairy, and divide into several branches; the flowers are of a pale blue, about the size of those of the common sort. This sage is preferred to all the others for making tea.

3. The auriculata, common sage of virtue, which is also well known in the gardens and markets. The leaves of this are narrower than those of the common sort; they are hoary, and some of them are indented on their edges towards the base, which indentures have the appearance of ears.

4. The pomerina, with spear-shaped oval leaves, grows naturally in Crete.

5. and 6. The cocinea and formosa, are beautiful hot-house plants, with scarlet flowers.

All the sorts of sage may be propagated by seeds, if they can be procured; but, as some of them do not perfect their seeds in this country, and most of the sorts, but especially the common kinds for use, are easily propagated by slips, it is not worth while to raise them from seeds.

SAMARA, a genus of the monogynia order, in the tetragyna class of plants. The calyx is quadripartite; the corolla is monospermous; and the seed covered with an anulus or loose coat. There are three species, herds of China.

SAMARITANS, an antient sect among the Jews, still subsisting in some parts of the Levant, under the same name.

SAMBUCUS, elder, a genus of the trigyna order, in the pentadactyle class of plants, and in the natural method ranking under the 43d order, daisieae. The calyx is quinquepartite; the corolla quinquepartite; the berry trisperminous. The species are only five, and the most remarkable are,

1. The nigra, or common black elder, with a tree-stem, branching numerously into a large spreading head, twenty or thirty feet high, and large five-parted umbels of white flowers towards the ends of the branches, succeeded by bunches of black and other different-coloured berries, in the varieties; which are, common black-berried elder-tree, white-berried elder, green-berried elder, laciniated elder, and the foliages much laciniate, so as to resemble parsley-leaves, gold-striped-leaved elder, silver-striped elder, silver-dusted elder.

2. The racemos, racemose red-berried elder. This is a resident of the mountainous parts of the south of Europe, and is retained in our gardens as a flowering shrub, having
peculiar singularity in its oval-clustered flowers and berries.

3. The Canadensis, or Canada shrubby elder.

SAMIERS, the Arabian name of a hot wind, peculiar to the desert of Arabia. It blows over the desert in the months of July and August from the north-west quarter, and sometimes it accompanies with all its violence to the very gates of Bagdad, but never affects any body within the walls. Some years it does not blow at all, and in others it appears six, eight, or ten times, but seldom continues more than a few minutes at a time. It often passes with the apparent quickness of lightning. The Arabian and Persians, who are acquainted with the appearance of the sky, or near the time this wind rises, have warning of its approach by a thick haze, which appears like a cloud of dust arising out of the horizon; and they immediately upon this appearance throw themselves with their faces to the ground, and continue in that position till the wind is passed, which frequently happens almost instantaneously; but if, on the contrary, they are not careful or brisk enough to take this precaution, which is sometimes the case, they are certain to feel the full force of the wind, it is instant death.

The above method is the only one which they take to avoid the effects of this fatal blast; and when it is over, they get up and look round; and if they see any one lying motionless, they take hold of an arm or leg, pull and jerk it with some force; and if the limb thus agitated separates from the body, it is a certain sign that the other arm or leg will follow. If, on the contrary, the arm or leg does not come away, it is a sure sign there is life remaining, although to every outward appearance the person is dead; and in that case they immediately cover him or her with clothes, and administer some warm diluting liquor to cause a perspiration, which is certainly but slowly brought about.

The Arabs themselves can say little or nothing of the sandhur; but the stories current among them are, that it always leaves behind it a very strong sulphureous smell, and that the air at these times is quite clear, except about the horizon, in the north-west quarter, before observed, which was then warming it self, to support vegetables, &c. For earth alone, we find it, liable to coalesce, and gather into a hard coherent mass. Common sand is, therefore, a very good addition, by way of manure, to soil upon which it lies, and makes them more open and loose. The best sand for the farmer's use is that which is washed by rains from roads or hills, or that which is taken from the beds of rivers; the common sand that is dug in pits never answers so well. However, if mixed with dung, it is much better than laid on alone; and a very fine manure is made by covering the bottom of sheep-folds with several loads of sand and dry weeds, which are to be taken away, and laid on cold stiff lands, impregnated as they are with the dung and the urine of the sheep.

The sea-sand, used as manure in different parts of the kingdom, is of three kinds: that about Plymouth, and on other of the southern coasts, is of a blue-grey colour, like ashes, which is probably owing to the shells or mussels, and other fish of that or the like colour, being brought by the waves in abundance and in quantity. Westward, near the Land's-end, the sea-sand is very white, and about the isles of Scilly it is very glistening, with small particles of fale; on the coasts of the North Sea the sand is yellowish, brown, or reddish, and contains to great a quantity of fragments of cockleshells, that it seems to be chiefly composed of them. That sea-sand is accounted best which is of a reddish colour; the next in value to this is the bluish; and the white is the worst of all. Sea-sand is best kept up the water, or from sand-banks which are covered by every tide. The small-grained sand is most sudden in its operation, and is therefore best for the tenant who is only to take three or four crops; but the coarse or larger-grained sand is much better for the landlord, as the good it does lasts many years. See HUSBANDRY.

SAND-BAGS, in the art of war, are bags filled with earth or sand, holding each about a cubic foot. Their use is to raise parapets in haste, or to repair what is beaten down.

SAND-REEL, See AMMODYTES.

SANDARACH, in natural history, a very beautiful native fossil, though too often confounded with the common fictitious red sand, which under the name of red sand is much more extensively used. Though with respect to colour it has the advantage of cinnamon while in the mass, it is vastly inferior to it when both are reduced to powders. It is moderately hard, and remarkably brittle; and when exposed to a moderate heat, melts and flows like oil. If set on fire, it burns very briskly.

It is found in Saxony and Bohemia, in the copper and silver mines, and is sold to the merchants with the red sand, at a double price; but its virtues or qualities in medicine are no more ascertained at this time than those of the yellow orent.
There is only one species, viz. the indicum, a tree of Africa and the East Indies.

SANGUIFICATION. See Physiology.

SANGUINARIA, blood-root, is a genus of the monogynia order, in the polystachia class of plants, and in the natural method ranking under the 43d order, umbelicate. This plant has a peculiar sap or blood, which is known as tinctura sanguinis. This tincture is used in medicine, particularly for fevers, and is known as tinctura sanguinis.

SANDIUM, in natural history, the name of a genus of fossils of the class of the scallop, but neither of the rhomboidal nor common kinds, nor any other way distinguishable by its external figure, being made up of several flat plates.

SANTALUM, a genus of the monogynia order, in the octandria class of plants, and in the natural method ranking with those of which the order is doubtful. The calyx is superior; the corolla monopetalous; the stamens placed in the tube; the stigma is simple; the fruit a berry.

The santalum, sanders or sandal wood, grows to the size of a walnut-tree. Its leaves are entire, oval, and placed opposite to each other. Its wood is white in the circumference, and yellow in the centre, when the tree is old. It is said to be a substitute for the timber of the oak, which is inferior to it. In the Hindoos, Persians, and Turks, anoint their bodies. It is likewise burnt in their houses, and yields a fragrant and wholesome smell. The greatest quantity of this wood, to which a sharp and strong perfume is ascribed, remains in India. The red sanders, though in less estimation, and less generally used, is sent by preference to Europe. This is the produce of a different tree, which is common on the coast of Coreomand. Some travellers found it with the wood of Calicut, which is used in dyeing.

The santalum album, or white sanders, is brought from the East Indies in billets about the size of man's hands, leaves, and wood, of a white-ashen, or yellowish colour. It is that part of the yellow sanders wood which lies next the bark. Great part of it, as met with in the shops, has no smell or taste, nor any sensible quality that can recommend it to the physician.

The santalum flavum, or yellow sanders, is the interior part of the wood of the same tree which furnishes the former, is of a pale yellowish colour, of a pleasant smell, and a bitterish aromatic taste, accompanied with an agreeable kind of pungency. This elegant wood might undoubtedly be applied to valuable medical purposes, though at present very rarely used. Distilled with water, it becomes a most delicious and agreeable beverage, in the cold into the consistence of a balsam. Digested in pure spirit, it imparts a rich yellow tincture; which being comminuted to distillation, the spirit arises without bringing over any thing considerable of the flavour of the sanders. The residue contains the virtues of six times its weight of the wood. Hoffmann looks upon this extract as a medicine of similar virtues to ambergris; and recommends it as an excellent restorative in great debilities.

SANTOLINA, lavender-cotton, a genus of the order of polygonum aquales, in the symphytina class of plants, and in the natural method ranking under the 43d order, umbelicate. The umbels are close together, almost in a round head; the fruit is scarious; the flowers of the disk abortive. There are three species. The European is found in many parts of both Scotland and England. This plant was long celebrated for its healing virtues both internal and external; but it is now totally disregarded.

SAPIUM, in natural history, the name of a genus of forest plants, of the class of the monogynia, but neither of the rhomboidal nor common kinds, nor any other way distinguishable by its external figure, being made up of several flat plates.

SAP, or SAPF, in the art of war, is the digging up of the earth of which the garrison, in order to open a covered passage into the moat. It is only a deep trench, covered at top with boards, hurdles, earth, sand-bags, &c. and is usually begun five or six fathoms from the lowest angle of the garrison. See FORTIFICATION.

SAP-COLOURS, a name given to various expressed juices of a viscid nature, which are inspissated by slow evaporation for the use of medicine. See sap green, gamboge, &c.

SAPINDUS, the soapberry tree, a genus of the trigynia order, in the octandria class of plants, and in the natural method ranking under the 23d order, tribulata. The calyx is tetraphyllous; the petals four; the capsules are fleshy, coniate, and ventricose.

The species are 13. of which the most noted are, the saponaria, spinus, trifoliata, and clinemia. The saponaria, with winged leaves, is cultivated as a美化 in the gardens of the West ladies, where it rises with a wood, and grows from 20 to 30 feet high, sending out many branches with winged leaves composed of several pairs of spear-shaped lobes. The flowers are produced all the year round, and at the end of the branches; they are small and white, and make no great appearance. These are succeeded by oval berries as large as mudding cherries, sometimes single, at others, two, three, or four are joined together; these have a sapaneous skin or cover, which closes a very smooth roundish nut of the same form, of a shining black when ripe. The skin or pulp which surrounds the nuts is used to make a soap. The inner part is washed down in fine pulp; but it is very apt to burn and destroy it if often used, being of a very acrid nature.

These plants are propagated by seeds, and kept in the stove.

SAPONARIA, soapwort, a genus of the digynia order, in the decandria class of plants, and in the natural method ranking under the 22d order, carpoxylyl. The calyx is monophyllous and naked; there are five unguiliferous petals; the capsule is oboval and unilocular.

There are nine species, the officinale, vaccaria, carotica, portulaca, illyrica, occynoides, orientalis, huta, and belladonatia. The officinale, which is a British plant, has a creeping
not, so that in a short time it would fill a large space of ground. The stalks are above two feet high, and of a purplish colour. The flowers are white and have five petals, the leaves opposite; they sustain four, five, or more purple flowers each, which have generally two small leaves placed under them. The stalk is also terminated by a loose bunch of small flowers. They are succeeded by oval capsules, with one cell, filled with small seeds. The decoctions of this plant are used to cleanse and scour woollen cloths: the poor people in some countries use it instead of soap for washing; from which use it had its name.

SAPPHIRE, a genus of precious stones, of a blue colour, and the hardest of all except the ruby and diamond. They are found in the same countries with the ruby; also in Bohemia, Alsace, Siberia, and Auvergne. M. de Peyron mentions one found at Augurge, which appeared quite green or blue according to the position in which it was viewed. Cronsstedt, however, informs us, that the blue flower spars are frequently met with under the same name of sapphires; and it is certain from Pliny, b. 37. chap. 9. that the sapphire of the ancients was our lapis lazuli. They are seldom found of a deep-blue colour throughout, or free from some tinge of green; and when they are but slightly tinged, they are named white sapphires. The late unfortunate King of France had one with a stripe of fine yellow topaz in the middle. Some are found half green and half red, and are foliated like the ruby. The fine hard sapphires, called by the jewellers oriental, are of the same nature with the ruby and topaz, excepting the mere circumstance of colour. They are commonly in two oblong hexagon pyramids, joined at their base, and pointed at top; sometimes also in hexagonal columns.

The specific gravity of these precious stones, according to Bergman, is from 3.650 to 3.940. According to others, the specific gravity of all sapphires is 3.994; that of the Brasilian 3.1307; and of those from Puy in Auvergne, 4.0709. When powdered, they are fusible with borax or microcosmic salt, into a transparent glass; and the sapphire, when treated with them, is called magnesia alba. They are said to lose their colour by fire, and to become so hard and transparent as sometimes to pass for diamonds; but Mr. Achard found this to be a mistake, and that the true sapphires are not in the least altered either in colour, hardness, or weight, by the most intense fire. Those of Puy in Auvergne, however, though by their colour and hardness they seem to approach the oriental sapphires, lose both their colour and transparency in the fire, becoming black, and even vitrifying; which plainly shows them to be of a different kind. See Corundum.

SARABANDE, a dance said to be originally derived from the Saracens. According to some authors, it had its appellation from a comedian named Sarabandi, who first introduced it in France. The tune of the sarabande is written in 2 or 3, and its character is both expressive and majestic. One of its distinguishing features is the lengthening the second note of the measure, which at once gives a gravity and consequence to the movement.

SARACA, a genus of the hexandria order, in the diaphysal class of plants. There is no calyx; the corolla is funnel-shaped and quadridi; the filaments are on each side the throat of the corolla; the legumen is pedicellated. There is one species, a tree of the East Indies.

SARCASM, in rhetoric, a keen bitter expression, which has the true point of satire, by which the orator woofs and invades his enemy: such was that of the Jews to our Saviour, "He saved others, himself he cannot save.

SARCOCELE. See Surgery.

SARCOCOLL, a vegetable substance that possesses the following properties:

1. Solid, semi-transparent bodies; usually having a tinge of yellow; taste sweet, but having an impression of bitterness. Dissolves in the mouth like sugar.

2. Equally soluble in water and alcohol; solution yellow. The watery solution has the appearance of mucilage, and may be used for the same purposes.

3. Cannot be digested by the action of alcohol.

4. When heated, softens, but does not melt. It emits a slight smell of clove. When strongly heated, it blackens, and assumes the consistence of tar, emitting a white smoke having an acrid smell.

In a strong fire it scarcely leaves any residue.

These properties shew that sarccoll is a substance intermediate between sugar and gum, possessing some of the properties of each, but certainly approaching nearer to sugar than to gum. How far the combination of sugar and the bitter principle would resemble sarccoll, has not been tried. The following three species may be referred to sarccoll.

1. Common sarccoll. This substance is usually sold in the state of oblong globules from the size of a pea to that of a particle of sand. It is colorless; but sulphur or liquor aloes has imparted to it a semitransparenrency and much of the appearance of gum arabic. But some of the grains are reddish-brown. Its smell is peculiar, and not unlike that of aniseed. When carefully examined, and treated with alcohol, it may be detected: the first, and by far the most abundant, is pure sarccoll; the second consists of small woody fibres, and a soft yellowish-white substance, not unlike the covering of the seeds of some of the crucifom plants; the third is a reddish-brown substance apparently earthy; and the fourth is only detected when the sarccoll is dissolved in water or alcohol. It then appears in soft transparent tumulous masses like jelly.

The pure sarccoll amounts to 0.8 of the whole. When the sarccoll is dissolved in alcohol or water, and obtained again by evaporation, it loses its smell. It then assumes the form of semitransparent brittle brown cakes very like gum.

Sarccoll exudes spontaneously from the penna sarccolla; a shrub which is said by botanical writers to be indigenous in the north-eastern parts of Africa. The disease under which it is known concerning the way in which it exudes is known as "sarsollia".

SARDONYX, a precious stone consisting of a mixture of the chalcedony and carnelian, sometimes in strata, but at other times blended together. It is found 1. Stripped with the skin, which may be cut in cameo as well as the onyx. 2. White with red deutetical figures, greatly resembling the mocha-stone; but with this difference, that the figures of one, are of a red colour, in the other black. There is no real difference, excepting in the circumstance of hardness, between the onyx, carnelian, chalcedony, sardonyx and agate, notwithstanding the different names attributed upon them. Mongers informs us, that the yellow, or orange-coloured agates, with a wary or undulating surface, are now commonly called sardonyx.

SARMENTOSA. See Surmontum, a long shoot like that of a vine, the name of the 11th class in Linnaeus's Fragments of a Natural Method, consisting of plants which have climbing stems and branches, that, like the vine, attach themselves to the bodies in their neighbourhood for the purpose of support. See Botany.

SARTHRA, a genus of the trigynia order, in the pentandria class of plants, and in the natural method ranking under the 20th order, and the 2nd class; the genus is pentapetalous; the capsule unilocular, trivalved, and coloured. There is one species, an annual of Virginia.

SARPLAR of wool, a quantity of wool, once called a pocket or half-sack; a sack containing 80 tod; a tod two stone; and a stone 14 pounds. In Scotland it is called sarpilath, and contains 80 stone.

SARRACENIA, side-saddle plant, a genus of the monogynia class, in the polyandria class of plants, and in the natural method ranking under the 54th order, miscellaneous. The corolla is pentapetalous; the calyx is double, and triphylous below, pentaphylous above; the capsule quinquelocular; the style has a stigma of the form of a shield. There are five species, herbs of North America.

SARSAVRILLA. See Smilax.

SASH, a mark of distinction, which in the British service is generally made of crimson silk for the officers, and of crimson mixed with white cotton for the sergeants. It is worn in the same shape, but of course undistinguishable from that worn by the soldiers of the line, and is sewed on the shoulder. Sashes were originally invented for the convenience and ease of wounded officers, &c. by means of which, in case any of them were so badly wounded as to render them incapable of remaining at their posts, they might be carried off with the assistance of two men. They are now reduced to a very small size, and of course unfit for the original purpose. Both the sash and gorget, indeed, must be considered as mere marks of distinction, to point out officers on duty. In some instances they are worn together; in others, the gorget is in laid aside, and the sash only worn. The British cavalry tie the sash on the right, the infantry on the left, side. The sashes for the imperial army are made of crimson and gold, for the Prussian army black silk and silver, and for the Portuguese crimson silk with blue tassels. The modern French have their sashes made of three colours, viz, white, pink, and light-blue, to correspond with the national flag.
SAT

SASSAFRAS, the wood of an American tree. See Laurels. It is said to be warm, aromatic, and frequently employed as an infusion, in the way of tea, is a very pleasant drink: its oil is very fragrant, and possesses most of the virtues of the wood.

SATELLITE. See Astronomy.

SATRAPA, or SATRAPS, in Persian antiquity, described, ordered, and more commonly by the governor of a province.

SATURATION, like most other technical terms introduced into chemistry before the science had acquired much precision, has been used with a great deal of latitude, being sometimes taken in one sense and sometimes in another. But in order to be understood, it is necessary to use the word with some degree of precision.

If we make the attempt, we shall find that water will not dissolve any quantity of salt that we please. At the temperature of 0° F., it dissolves only 0.354 parts of its weight of salt; and if more salt than this is added, it remains in the water undisolved. When water has dissolved as much salt as possible, it is said to be saturated with salt, and that sense is at least analogous to the original meaning of the word. Whenever, then, a substance A refuses to combine with an additional quantity of another body B, we may say that it is saturated with B. It takes place whenever the affinity of the water and salt, is balanced by the cohesion of the particles of the salt, and therefore indicates that these two forces are equal.

In the same manner, water, after having absorbed a certain quantity of carbonic acid gas, refuses to absorb any more. We may indeed pass carbonic acid gas through water in this state, but it makes its escape unaltered. Water which refuses to absorb carbonic acid gas is saturated with that acid.

This saturation takes place when the affinity between the gas and the water is balanced by the elasticity of the gas, and indicates of course that these two forces are equal.

In the two instances the saturation is occasioned by opposite causes. The salt refuses to dissolve in the water when the cohesion of its particles equals its affinity for the water; the carbonic acid gas, when the elasticity of its particles equals its affinity for water. In the first case, it is the attractive force of cohesion which opposes further solution; in the second case, it is the repulsive force of elasticity. Hence the different method which must be followed to diminish these forces, and enable the water to dissolve a greater proportion of these respective bodies. Heat, by diminishing the force of cohesion, enables water to dissolve a greater proportion of the saline bodies. Accordingly we find that in most cases hot water dissolves more salt than cold water. Common salt is almost the only exception to this general law. On the other hand, cold, by diminishing the elasticity, or at least the expansibility of gasous bodies, enables water to dissolve a greater proportion of these bodies. Thus the colder the water is, the greater a proportion of carbonic acid is dissolved; the point of freezing of water limits this increase of solubility, because at that point the cohesive force of the particles of water becomes so great as to cause them to cohere, to the exclusion of those bodies with which they were formerly combined. Hence the reason, that most bodies separate from water when it freezes. But they generally retard the freezing considerably, by opposing with all the strength of their affinity the cohesion of the water; this is, that the freezing point of water, when it holds bodies in solution, is lower than the freezing point of pure water. A table of the freezing points of different saline solutions would be a pretty accurate indication of the affinity of the different salts for water: for the affinity of each salt is of course proportional to the degree of cold at which it separates from the water, that is, to the freezing point of the solution. In this sense of the word saturation, which is certainly the only one that it ought to bear, it may be said with propriety that there are certain bodies which cannot be saturated by others. Thus water is capable of combining with any quantity whatsoever of sulphuric acid, nitric acid, and alcohol; and all bodies seem capable of combining with almost any quantity whatsoever of water. Several of the metals, too, are capable of combining with any quantity of water which they hold in solution. In general, it may be said that those bodies called solvents are capable of combining in any quantity with the substances which they hold in solution. Thus water may be added in any quantity, however great, to the acids, and to the greater number of salts.

If we take a given quantity of sulphuric acid diluted with water, and add to it slowly the solution of soda by little at a time, and continue the mixture to the point of saturation, we shall find that for a considerable time it will exhibit the properties of an acid, reddening vegetable, and having a taste perceptibly sour; but these acid properties gradually diminish after every additional of the alkaline solution, and at last disappear altogether. If we still continue to add the soda, the mixture gradually acquires alkaline properties, converting vegetable blues to green, and manifesting a urine like of a new kind of vegetable. These properties become stronger and stronger the greater the quantity of the soda which is added. Thus it appears that when sulphuric acid and soda are mixed together, the properties either of one or the other predominate according to the proportions of each; but that there are certain proportions, according to which when they are combined, they mutually destroy or disguise the properties of each other, so that neither predominates, or rather, so that both disappear.

When substances thus mutually disguise each other's properties, they are said to neutralize one another. This property is common to a great number of substances; it manifests itself most strongly, and was first observed, in the acids, alkalies, and earths. Hence the salts which are combinations of these different bodies received long ago the name of neutral salts. When bodies are combined in the proper proportion which produces neutralization, they are often said to be saturated; but in this case the term is used improperly. It would be much better to confine the word to properties, and to introduce the term neutralization to denote the state in which the peculiar, properties of the component parts mutually disappear; for very frequently neutralization and saturation by no means coincide. Thus in tartrate of potash the acid and alkali neutralize each other; yet it cannot be said that the potash is saturated; for it is still capable of combining with more tartarious acid, and of forming superparticite of potash, a compound in which the ingredients do not neutralize each other; for the salt has manifestly a preponderance of the properties of the acid.

SATUREIA, SAVOURY, a genus of the gymnospedia order, in the didynamia class of plants, and in the natural method ranking under the 42d order, verticillate. The segments of the corolla are nearly equal; the stamina standing asunder. There are eight species; the most notable are: 1. The bot-tens, or summer savoury, is an annual plant, which grows naturally in the south of France and Italy, but is cultivated in this country both for the kitchen and medicinal uses. 2. The montana, or winter savoury, a perennial plant, grows naturally in the south of France and Italy, but is cultivated in gardens both for culinary and medicinal purposes. Both kinds are propagated by seeds. Summer savoury is a very warm and aromatic herb, and affords in distillation with water a subtle essential oil, of a penetrating smell, and very hot acid taste. It yields little of its virtues by infusion to aqueous liquors; rectified spirit extracts the whole of its taste and smell, and elevates nothing in distillation.

SATURN. See Astronomy.

SATYR, or SATIRE. See Poetry.

SATYRIUM, a genus of the diandria order, in the gynandria class of plants; and in the natural method ranking under the 42d order, verticillate. The nectarium is scrofula, or inflamed double behind the flower. There are 21 species.

SAUCISSON, in fortification, a mass of large branches of trees bound together; and differing only from a fascine, as this is composed of small branches of twigs.

SAU. See ZUMBEUS.

SAVIOUR, Order of St. a religious order in the Romish church, founded by St. Bridget, about the year 1345; and so called from its being pretended that our Saviour himself appointed to the foundess its constitutions and rules. According to the constitutions, this order is principally founded for religious women who pay a particular honour to the holy virgin, but there are some monks of the order, to administer the sacraments, and spiritual assistance to the nuns. The number of nuns is fixed at sixty in each monastery; and that of the religious priests at thirteen, according to the number of the apostles, of whom St. Paul was the thirteenth. There are also four deacons, representing the four doctors of the church, St. Ambrose, St. Augustine, St. Gregory, and St. Jerome; and eight lay-brothers; who altogether make up the number of the thirteen apostles, and the seventy-two disciples of Jesus Christ. The nuns are not admitted till eighteen years of age, nor the friars before twenty-five; and they at least perform a year's novitiate.

SAUNDERS. See SANTALUM.

SAURURUS, a genus of the tetragnaria order, in the heptandra class of plants; and in the natural method ranking under the second order, pipiperata. The calyx is a calyx, with unifolious scales; there is no corolla;
there are four genuine, and four monomorphous berries. There is one species, a herb of Vitex.  

SAUVAGESIA, a genus of the Monogynia order, in the pentadita class of plants; and in the natural method ranking with those of the Grecian type, the Delphinium of the corolla is pentametabolous and fringed; the calyx is ovate; the nectar is nectariferous; the thalamus the same, having its leaves placed alternately with the petals; the capsicum unilocular. There is one species, a native of St. Domingo; and  

SAW, an instrument which serves to cut into pieces several solid matters; as wood, stone, ivory, etc. The best saws are of tempered steel ground bright and smooth; those of iron are only hammer-hardened: hence, the first, besides their lower stiffer, are likewise found smoother than the last. They are known to be well hammered by the stiff bending of the blade; and to be well and evenly ground, by their bending equally in a bow. The edge in which the teeth is always thicker than the back, because the back is to follow the edge. The teeth are cut and sharpened with a triangular file, the blade of the saw being first fixed in a whet stone, and have been in the teeth are set, that is, turned out of the right line, that they may make the kerf or fissure the wider, that the back may follow the better. The teeth are always set for coarse cutting if they are hard; because the ranker the teeth are set, the more stuff is lost in the kerf. The saws by which marble and other stones are cut, have no teeth; these are generally very large, and are stretched out and held even by a frame. The lapidaries, too, have their saws, as well as the workmen in mosaic; but of all mechanisms, none have so many saws as the joiners, and these are as follows: The pit-saw, which is a large two-handed saw, used to saw timber in pits; this is chiefly used by the sawyers. The whip-saw, which is also two-handed, used in sawing such large pieces of stone, as saws will not easily reach. The hand-saw, which is made for a single man's use, of which there are various kinds; as the bow, or frame saw, which is furnished with checks; by the twisted cords which pass from the ends of these checks, and the tongue in the middle of them, the upper ends are drawn closer together, and the lower set further apart. The tenon-saw, which being very thin, has a back to keep it from bending. The compass-saw, which is very small, and its teeth usually not set; its use is to cut a round, or any other compass-kerf: hence the edge is made broad, and the back thin, that it may have a compass to turn in.  

SAWING. In early periods, the trunks of trees were split with wedges into as many and as thin pieces as possible; and if it was necessary to have them still thinner, they were heaved on both sides to the proper size. This simple and wasteful manner of making boards has been still continued in some places, to the present time. Peter the Great of Russia endeavoured to put a stop to it, by forbidding heave boards to be transported across the river Neva. The saw, however, though so convenient and beneficial, has not been able to banish entirely the practice of splitting timber used in building, or in making furniture and utensils, for we do not speak here of fire-wood; and, in fact, it must be allowed that this method is attended with peculiar advantages, which at all events, one can never possess. The wood-splitters perform their work more expeditiously than sawyers, and split timber is much stronger than that which has been sawn; for the sinew, or a portion of the wood, and  

SAW, two-footed tools. The piece of wood which is to be sawn through is secured by cramps. The saw with which the grain is at work has a perfect resemblance to our frame-saw. It consists of a square frame, having in the middle a blade, the teeth of which are set alternately on the plane of the frame. The piece of wood which is to be saw  

Saw extends beyond the end of the bench, and one of the workmen appears standing, and the other sitting on the ground. The saws, in which the blade is fastened, have the same form as that given to them at present. In the bench are seen holes, in which the cramps that hold the timber are stuck. They are shaped like the figure 7; and the ends of them reach below the boards that form the top of it.  

The most beneficial and ingenious improvement of this instrument was, without doubt, the invention of saw-mills, which are driven either by water or by the wind. Mills of this kind have been in use as early as the fourteenth century, in Germany, on the small river Roer or Ruier; for though Ausonius speaks properly of water-mills for cutting stone, and not timber, it cannot be doubted that they were used as mills for manufacturing deals, or that both kinds were erected at the same time. The art, however, of cutting marble with a saw is very old. Pliny co-jectures that it was invented by Carus; at least, he knew no building incrusted with marble of greater antiquity than the palace of king Mausolus, at Halicarnassus. This edifice is celebrated by Vitruvius, for the beauty of its marble; and Pliny gives an account of a sieve used for cutting it; for it is the sand properly, say, and not the saw, which produces that effect. The latter presses down the former, and rubs it against the marble; and the coarser the sand is, the longer will be the time required to polish the marble which has been cut by it. Stones of the soup-rock kind, which are indeed softer than marble, and which would require less force than wood, were sawn at an early period. For the far harder and glassy kinds of stone were sawn then also; for we are told of the discovery of a building which was encrusted with cut agate, carnelian, lapis lazuli, and amethysts. We have, however, found records of any of the Greek or Roman writers of a mill for sawing wood; and as the writers of modern times speak of saw-mills as new and uncommon, it would seem that the oldest construction of them has been forgotten; or, that some important improvement has made them appear entirely new.  

Becker says, with his usual confidence, that saws were invented in the 17th century. In this he erred, for when the infant Henry sent settlers to the island of Madeira, which was discovered in 1420, and caused European fruits of every kind to be carried thither, he ordered saw-mills to be erected also, for the purpose of sawing into deals the various species of excellent timber with which the island abounded, and which were afterwards transported to Portugal. About the year 1450, the city of Breslau had a saw-mill, which was raised on the rent of three marks; and in 1490 the magistrates of Erfurt purchased a forest, in which they caused a saw-mill to be erected, and they rented another mill in the neighbourhood besides.
Norway, which is covered with forests, had the first saw-mill about the year 1530. The mode of making the timber was called the new art; and because the exportation of deals was by these means increased, that circumstance gave occasion to the deal-trade, introduced by Christen III. in the year 1545. Soon after Henry VIII. of England, having taken possession of the island of Jersey from Mary queen of England to the court of Rome, having seen a saw-mill in the neighborhood of Lyons, the writer of his travels thought it worthy of a particular description. In the sixteenth century, however, there were mills with different saw-blades, by which a plank could be cut into several deals at the same time. The first saw-mill was erected in Holland at Saardam, in the year 1560; and the invention of it is ascribed to Cornelis Cornelissen. Perhaps he was the first person who built a saw-mill at that place, which is a village of great trade, and has still a great many saw-mills, though the number of them is being daily less, for within the last thirty years a hundred have been given up. The first mill of this kind in Sweden was erected in the year 1633. At present, that kingdom possesses the largest perhaps ever constructed in Europe, at Linkoping, and twelve feet broad, drives at the same time seventy-two saws.

In England saw-mills had at first the same fate that printing had in Turkey, the ribbon-loom in the dominions of the church, and the crane at Strasburgh. When attempts were made to introduce them, they were violently opposed, because it was apprehended that the sawyers would be deprived by them of their means of getting a subsistence. For this reason, it was found necessary to abandon a saw-mill erected by a Dutchman near London, in 1603; and in the year 1700, when Hooghten laid before the nation the advantages of such a mill, he expressed his apprehension that it might excite the rage of the people and have dangerous consequences. It was the case in 1676 or 1678, when an opulent timber-merchant, by the desire and approbation of the Society of Arts, caused a saw-mill, driven by wind, to be erected at Limehouse, under the direction of James Stanfield, who had learned, in Holland and Norway, the art of constructing and manning machines of that kind. A mob assembled, and pulled the mill to pieces; but the damage was made good by the nation, and some of the rioters were punished. A new mill was afterwards erected, which was suffered to work without molestation, and which gave occasion to the erection of others. It happens, however, that this was still the case in the kingdom of England; for one driven also by wind had been built at Leith, in Scotland, some years before.

The mechanism of a sawing-mill may be reduced to three principal things: the first, that the saw is drawn up and down as long as is necessary, and returned in the same manner, by water to the wheel; the second, that the piece of timber to be cut into boards is advanced by an uniform motion to receive the strokes of the saw; for here the wood is to meet the saw, and not the saw to follow the wood, therefore the motion of the wood and that of the saw ought immediately to depend on the one on the other: the third, that when the saw has cut through the whole length of the piece, the whole machine stops itself, as is done by a brake, if not having an obstacle to surmount, the force of the water should turn the wheel with too great rapidity, and break some part of the machine.

The upper part of Plate Saw-mill, &c. represents the circular saw-mill introduced by Mr. Goeree, in England, in 1555. For giving it a place, we have erected it at Orundoor-wharf, Westminster-bridge. ABD, fig. 1, is a strong bench, similar to those used by carpenters. In the middle of this, is an opening through which the saw F comes. The saws I, figs. 1 and 2, is a circular plate of steel, with teeth like those of a large pit-saw on its circumference, and a round hole in the middle of it, through which the spindle E, fig. 2, of the saw passes. The saws are fastened to it, by a lever C fixed to the spindle E, and another, f, which slips on the spindle, and is pressed against the saw by a nut b, screwed on the end of the spindle, so as to hold the saw tight between the flanges, when the eccentric part is taken off to be sharpened, and another put in its place in a very short time. The ends of the spindle are brought to points, which work in small holes in the wooden eagle, fig. 3, which is seen at d, f; the other screw is put through a piece of wood P, supported by the two uprights GG, and can be raised or lowered at pleasure by wedges, so as to bring the plane of the saw exact in right angle with the surface of the bench: the saw is turned round with a great velocity by a strap passing round the rigant H and the whee I, which receives its motion from a horse-wheel.

The piece of wood to be sawed is guided by a straight bar K, which is always made to move parallel to the plane of the saw by two iron coupling-rods h, so that it can be set at any distance from the saw, according to the width of the piece to be cut, and held there by screws.

The machine before us is chiefly used for ripping up three-inch deal planks. The bar K is set the proper distance from the saw, and screwed fast. The workman takes the plank, and laying its edge against the bar K,above it, endways against the saw, which, as it turns, cuts the wood with surprising quickness.

SANIFRAGA, sawfrage, a genus of the digynia order, in the decandria class of plants; and in the natural method ranking under the 13th order, succulentes. The calyx is quinqupartite; the corolla pentapetalous; the capsule bistratiisecta, unicorial, and polypermumous.

There are 50 species, of which the most remarkable are 1. The granulata, or white sawfrage, which grows naturally in the meadows in many parts of England. The roots of this plant are like grains of corn, of a reddish colour without: there is a variety of this with double flowers, which is very ornamental. The leaves are tongue-shaped, gathered into heads, rounded at their points, and have catillagious and sawed borders. The stalk rises two feet and a half high, branching out near the ground, forming a natural pyramid to the top. The flowers have five white wedge-shaped petals, and ten stamens, placed circularly the length of the tube, terminated by roundish purple summits. When these plants are strong, they produce very large pyramids of flowers. 2. The un-yes, or none-say, grows naturally on the Alps, and also in great plenty on a mountain of Ireland, called Mangerton, in the county of Kerry, in that island. The roots of this are perennials. The opposite leaf grows naturally on the Alps, Pyrenees, and Helvetic mountains: it is also found pretty plentifully growing on Ingeborough hill, in Yorkshire; Snowdon, in Wales; and some other places, from there what plant, with stalks trading upon the ground. The flowers are produced at the end of the branches, of a deep blue.

SAY, or Save, in commerce, a kind of serge, or woven stuff, much used abroad for the making of the said variety of cloths: with us it is used for aprons by several sorts of artificers, being usually dyed green.

SCABBARD, to, to punish with the scabbard of a bayonet. Soldiers are sometimes scabbarded, under the sanction of the captain of companies, for slight offenses committed among themselves. A court-martial is held in the serjeant's room or tent, to ascertain the culprit's guilt; it having been previously led to him to abide by the judgment of his comrades, in this manner, or to be tried by a regimental court-martial.

The word scabbard has been sometimes used in a figurative sense, to distinguish those persons who have obtained rank and promotion in the army without seeing much hard service, or in the service of companies, or slight officers.

SCABIOSA, scabiosa, a genus of the monogynia order, in the tetricandria class of plants; and in the natural method ranking under the 15th order, succulentes. The common calyx is polyphyllous; the proper one is double, superior; the receptacle is paleaceous or naked. There are 42 species. The most remarkable are 1. The renunci, or scabious, grows naturally in many places of Britain. The flowers are produced upon naked footstalks at the ends of the branches; they are of a purple colour, and have a faint scent. 2. The sucissa, or devil's bit, grows naturally in woods and moist places. This has a short tap-root, the end of which appears as if it was bitten or cut off, whence the plant has taken its name. Both these have long been recommended as aperient, sudorific, and expectorant; but the present practice has no dependence on them.

SCAVOLA, a genus of the monogynia order, in the pentandria class of plants. The corolla is monopetalous; the tube slit longitudinally; the border quinqupartite and lateral. The fruit is a prism inferior and monoomalous; the nucleus bicolar. There are three species.

SCALE. See Anatomy, Ear.

SCALDS, in the history of literature,
name given by the ancient inhabitants of the northern countries to their poets, in whose writings their history is recorded.

SCALE, a mathematical instrument, consisting of several lines drawn on wood, brass, silver, &c. and variously divided, according to the purposes it is intended to serve; whence it acquires various denominations, as the plain scale, diagonal scale, plotting scale, Gunter's scale, &c. See INSTRUMENTS, Mathematical.

SCALE, in music (from the Latin, scala), the denominations issued to the arrangement made by Guido, of the six syllables, ut, re, mi, fa, sol, la: also called gamut. This order of sounds, to which the French have added that of si, bears the name of scale, i.e. ladder, because it represents a kind of ladder, by means of which the voice or instrument rises to acute, and descends to grave; each of the seven syllables being, in a manner, one step of the ladder.

The word scale is also used to signify a series of sounds rising or falling from any given point; or, to the greatest possible distance, through such intermediate degrees as make the succession most agreeable and perfect, and in which we have all the harmonious divisions most commodiously divided. This scale is properly called the universal system, as including all the particular systems.

This enumeration of all the diatonic sounds of our system, ranged in order, and which we call the scale, was designated by the Greeks as a tetrachord, because, in effect, their scale was composed of only four sounds, which they repeated from tetrachord to tetrachord, as we repeat ours from octave to octave.

SCALÆNE Triangle. See Geometry.

SCALENUS, in anatomy. See Neck.

SCALES of fish. See Fish, Vol. 1, p. 924, 3d col.

SCAMMONY, in the materia medica. See Convolvulus, and Gum Resins.

SCANDALUM MAGNATUM, is the special name of a stately, and also of a worm, done to any high personage of the land, as prelates, dukes, marquises, earls, barons, and other nobles; and also the chancellor, treasurer, clerk of the privy seal, steward of the house, justice of one bench or other, and other great officers of the realm, by false news, or horrible or false messages, whereby debates and discord, betwixt them and the commons, or any scandal to their persons, might arise. 2 R. II. c. 5. This statute has given name to a writ, granted to recover damages thereupon. Cowell.—It is now clearly agreed, that though there are no express words in the statute which give an action, yet the party injured may maintain one on this principle of law; that when a statute prohibits the doing of a thing, which, if done, might be prejudicial to another, in such case he may have an action on that very statute for his damage. 2 Mod. 122.

SCANDIX, cheril, shepherd's needle, or earvus's comb, a genus of the digynia order, in the pentandria class of plants; and in the natural method ranking under the 45th order, umbellate. The corolla is radiating; the stamens united; the petals emarginated; the flrets of the disc frequently male. There are eleven species. The most remarkable is the odorata, with angular crowded seeds. It is a native of Germany; and has a very thick perennial root, composed of many fibres, of a sweet aromatic taste, like asafoetide, from which come forth many large leaves, which branch out into those of fern, whence it is named sweet fern.

SCAPEMENT, a general term for the manner of communicating the impulse of the wheels to the pendulum of a clock. Common scapements consist of a conical wheel and pallets of iron. See Clock-work.

SCAPOLITE, a mineral found at Arendal, in Norway. It is of a pearl colour, and is crystallized in long, four-sided, rectangular prisms. Faces longitudinally streaked. Its specific gravity is 3.08, and it is hard enough to scratch glass. Fracture foliated in two directions. Before the blowpipe, it froths and melts into white enamel. It is composed of 45 silica; 30 alumina; 14 iron oxide; 2 water.

SCAPULÆ. See Anatomy.

SCAPULAR. See Anatomy.

SCARABÆUS, beetle, a genus of insects of the order coleoptera. The generic character is antennae or horns claveate, with a fissile tip; legs generally toothed; body thick and compact. This genus is extremely extensive, there being nearly one hundred species. Among these the most remarkable is 1. the scarabaeus Hercules, or Hercules beetle, which sometimes measures not less than five, or even six inches in length: the wing-shells are of a smooth surface, of a blueish or brownish grey colour, sometimes nearly black, and commonly marked with several small, round, deep-black spots, of different sizes: the head and limbs are coal-black; from the upper part of the breast or thorax proceeds a horn or process of enormous length, in proportion to the body: it is sharp at the tip, where it curves slightly downwards, and is marked beneath by two or three denticulations, and furnished throughout its whole length with a fine, short, velvet-like pile, of a brownish orange-colour: from the front of the head proceeds also a strong horn, about two-thirds the length of the former, toothed on its upper face, but not furnished with any of the velvet-like pile which appears on the former. This species is a native of several parts of South America, where great numbers are said to be sometimes seen on the called mammas, rapping off the rind of the slender branches by working nimbly round them with the horns, till they cause the juice to flow, which they drink in intoxication, and thus fall senseless from the tree: however, as the learned Fabricius has well observed, seems not very probable; since the thoracic horn, being bearded on its lover surface, would undoubtedly be made bare by this operation. This species, from the large size of all its parts, affords an admirable example of the characters of the genus. It varies much in size, and it may even be doubted whether some of the smaller specimens have not been occasionally regarded by authors as distinct species. The female is destitute of both of the frontal and thoracic horn, but in other points resembles the male. See Plate Nat. Hist. fig. 352.

2. Scarabæus Goliath, the Goliath beetle, is highly remarkable both in point of size and colour; it is larger in body than the preceding, and its head and thorax, marked with longitudinal black stripes or variegations, and purple-long-wing-shafts: the head is divided in front into two forked processes: the limbs are black, and very strong. It is a native of Africa. A supposed variety sometimes occurs, in which both the thorax and wing-shafts are of a pale yellowish brown instead of rose-colour, and are marked with black variegations.

3. Scarabæus melolontha, cockchafer, is one of the most common European beetles. This insect is extremely familiar in our own Island, the larva or caterpillar inhabiting ploughed lands, and feeding on the corn, &c. This beautiful insect makes its appearance during the middle and the decline of summer. The cockchafer sometimes appears in such prodigious numbers as almost to strip the trees of their foliage, and to produce immense injury to those of the locust tribe. It appears from a paper by Mr. Molinex, printed in the Philosophical Transactions for the year 1697, that some particular districts in Ireland were overrun by this insect in a wonderful manner; and the failure of the wheat in the year 1804 has been by some attributed to the numbers of the larva of this insect which were lodged in the earth.

The larva, or caterpillar, of this insect, is said to be two, and sometimes three years, in passing from its first form into that of the perfect insect. The eggs are laid in small detached heaps beneath the surface of some cold, and the young, when first hatched, are scarcely more than the eighth of an inch in length, gradually advancing in their growth, and occasionally shifting their skins, till they arrive at the length of near two inches. At this period they begin to prepare for their change to the one, to the other, or to the pupa, selecting for the purpose some small clod of earth, in which they form an oval cavity, and, after a certain space, direct themselves of their last skin, and immediately appear in the chrysalis form, which, during the succeeding summer, when the beetle emerges from its retirement, and commits its depredations on the leaves of trees, &c. breeds, and deposits its eggs in a favourable situation, after which its life is very short duration.

4. A much more elegant insect of this kind is the scarabæus fulvus, or variegated beetle. It is nearly twice the size of the cockchafer, and of an elegant chestnut-colour, with the wing-shafts beautifully marked with white variegations. It is common in many parts of Europe, but extremely rare in England. See Plate Nat. Hist. fig. 351.

5. A species of peculiar beauty, is the golden beetle, scarabæus auratus; it is about the size of the common or black garden beetle, but of a somewhat flatter shape; and of the most brilliant, varnished, golden-green colour, with the wing-shafts varied towards the lower part by a few slight, transparent, white streaks. This beautiful species is not uncommon during the hottest part of
summer, frequenting various plants and flowers; its larva or caterpillar is commonly found in the hollows of old trees, or among the loose dry soil at their roots, and sometimes in the earth of orchards. It remains about three weeks on the plant, while it increases in size; it clings to a paper or chrysalis, out of which the insect emerges in a short time afterwards.

This may be sufficient for a general idea of the Linnaean genus scarabaeus. It may be added that the species are extremely numerous, and one of the great charms of the family is the singular appearance of the males in many kinds; that even the most romantic imagination can hardly conceive a structure of horn or process which is not exquisitely wrought in some of the tribe. See Plate Nat. Hist. fig. 353.

SCARIFICATION, in surgery, the operation of making several incisions in the skin by means of lancets, or other instruments, particularly the cupping-instrument.

SCARLET, a beautiful bright red. See Dyeing.

SCARUS, a genus of fishes of the order cichlidae. The generic character is, jaw bones, divided in the middle, crested on the edge; the teeth conical and conglomerate. There are 15 species. The most remarkable are, 1. Scarus Crenatus, Crenate scarus. General length about 12 inches; body broad, sloping, scales extremely large, lateral line running on every scale over which it passes. Native of the Mediterranean, and particularly about the coasts of Crete, but is also found in the Indian sea.

2. Scarus rivulatus, rivulated scarus. Native of the Red Sea, observed by Forskal; said to arrive at a great size; scales very small; dorsal and anal fin occasionally reunion in a channel; tail forked; supposed to feed principally on the different kinds of fish, and considered as an edible fish; but said to be sometimes productive of disagreeable symptoms from the wounds inflicted by the sharp rays of its dorsal fin.

3. Scarus purpuratus, purplish scarus, an elegant specimen, is said to be in Italy applied to the laborious ably lacerate: the purple stripes on the body terminated at their upper edges of the fin, and marked at the tip by a large lunate, marginal, black spot; distinguished and analyzed towards the base by a purple stripe; ventral fins blue: tail marked with longitudinal purple spots, and on each side by a purple stripe; shape slightly rounded; lateral line unmarked; scales lax, in the mullet. Native of the Arabian seas, observed by Forskal.

SCAVAGE, a toll or custom antiently exacted by mayors, sheriffs, and bailiffs, of cities and towns-corporate, and of merchant-strangers, for wares imported and other goods taken to scale without the liberties, which was prohibited by 19 Hen. VII. But the city of London still retains this custom.

SCAVENGERS, two officers annually chosen in every parish in London and its suburbs, by the churchwardens, constables, and other inhabitants: to hire persons called rakers, with cars, to clean the streets, and carry away the dirt and filth, with the ashes and dust from every house. For which purpose a scavenger's tax is made and levied on all houses, being allowed by the justices of the peace; but it must not exceed 4 K.

SCHELLEFFERIA, a genus of the class and order pentadactyla, of the class crustacea. The calyx is five-toothed; corolla five-petalled; capsula eight or ten celled; seeds solitary, semi-circular. There is one species, of New Zealand.

SCHEMIDELTA, a genus of the digyna order, in the order angrecacea, of the class magnoliflorae. The calyx is diphylleous; the corolla tetraphyllous; the gynoecium achenaceous. Characters: when scratching, the corolla is striped.

SCHEMUSCUS, a genus of the monogynia order, in the order angrecacea, of the class magnoliflorae. The calyx is diphylleous; the corolla monopetalous; the gynoecium stamillifera. There are two species: three-toothed seeds.

SCHEUZERIA, a genus of the tri- gynia order, in the angrecacea, of the class magnoliflorae. The calyx is diphylleous; the corolla is monopetalous; the gynoecium stamilliferous. There are two species, of South America.

SCHELUS, a gen

SCHELUS, a genus of the thistledown order, in the order angrecacea, of the class magnoliflorae. The calyx is diphylleous; the corolla is monopetalous; the gynoecium stamilliferous. There are two species, of South America.
superior; corolla five or six-cleft; stigma two; berry one-seeded. There are two species, parasites of the West Indies.

SCHLEBERRA, a genus of the digynia order, in the pentandria class of plants; and in the natural method ranking under the third of which the order consists. The calyx is quinquepartite; the corolla funnel-shaped, with the filaments in the throat, and having each a scale at the base. There is one species, of the East Indies.

SCHWANTZI, a genus of the class and order didynamia angiopteris. The calyx is four-cleft; the upper lobe very small; the lowest very large and emarginate. There is one species, of North America.

SCHWENKFELDA, a genus of the monogynia order, in the pentandria class of plants; and in the natural method ranking under those that are doubtful. The calyx is quinquelocular; the stigma parted into five; the berry quinquelocular, with a number of seeds. Of this there are two species, 1. Chioneus; 2. Aspera.

S. Hirta. The first two are natives of Guiana, the other of Jamaica. The leaves of all of them are remarkably rough, and stick to the fingers or clothes.

SCHWENKIA, a genus of the monogynia order, in the chasmatia class of plants. The corolla is almost equal, plaited at the throat, and glabrous; there are three bare stamens; the capsule bicalcarata and polyspermous. There is one species.

SCIENA, a genus of fishes of the order the cyclostomi, the generic character is, head small; dorsal fins two, seated in a furrow, into which they may occasionally withdraw; Gill-membrane six-rayed. There are two divisions in this genus, 1. with divided or humated tail; 2. with or rounded tail. There are twenty species. The most remarkable are: 1. Scena cirroa, bearded scena. Habit of that of a carp; length from one to two feet; colour pale yellow, brownish on the sides, and described as each one of many obliquely longitudinal dusky-blue lines, which assume a slightly silvery cast towards the abdomen; upper lip obtuse, and longer than the lower; teeth small; first dorsal fin beginning between the second and third, with a brown stripe: pectoral, ventral, and caudal, dusky; anal red; tail slightly humated: at the base of the gill-covers a black spot, and beneath the chin a short dusky line; native of the Mediterranean and other seas; known to the ancient Greeks and Romans, by whom it was held in considerable estimation as a food.

2. Scena laticlava, scena scena. Habit of a salmon: size considerable, growing, according to some authors, to the length of several feet: colour bluish silvery, with a dusky cast on the back: scales rather small; eyes red; and gill-covers ruffled with a red; tail slightly forked; lateral line nearly straight; native of the Mediterranean and northern seas, and often entering rivers; known to the ancients by the names of Ibraxis and Íbrus, and more recently esteemed as a food, particularly by the Romans.

SCIATICA. See Medicine.

SCILLA, the squill, in botany, a genus of the monogynia order, in the hexadendra class of plants, and in the natural method ranking under the first order, coracridae. The corolla is hexapetalous and deciduous; the filaments filiform. There are 22 species. The most remarkable is the maritime, or sea-onion, whose roots are used in medicine. Of this there are two sorts, one with a red, and the other with a white root; which are supposed to differ little from each other. From the root of the white, and the other of the red, are prepared medicinally. The roots are large, somewhat oval-shaped, composed of many coats lying over each other like onions; and at the bottom come into several parts. From the root of the white the root rise several shining leaves, which continue green all the winter, and decay in the spring. Then the flower-stalk comes out, which rises two feet high, and is naked halfway, terminating in a pyramidal thyrsus of flowers, which are white, composed of six petals, and spread open like the points of a star. This grows naturally on the seashores, and in the ditches where the salt water naturally flows with the tide, in most of the warm parts of Europe, so cannot be propagated in gardens; the frost in winter always destroying the roots, and for want of salt water they do not thrive in summer. The root is very poisonous, and its nauseous, but the acrid and aromatic性质 that it ulcerates the skin if much handled. Taken internally, it powerfully stimulates the solids, and produces urine, sweet, and expectoration. If the dose is not too large, it is not disagreeable to the taste, and has a purgative effect. The principal use of this medicine is where the primar vais are abounded with morbid matter, and the lungs are oppressed by rheumatic phenig.

SCIOPTIC, a sphere, or globe of wood, with a circular bottom, and perforation, wherein a lens is placed. It is so fitted that, like the eye of an animal, it may be turned round every way, to be used in making experiments in a darkened room. See Optics.

SCIRE, FACIAS, is a judicial writ, and properly lies after a year and a day after judgment given; whereby the sheriff is commanded to summon or give notice to the defendant, that he appear and show cause why the plaintiff should not have execution.

SCHIRKEBELI, is a juridical writ, and founded on some state of record, as judgments, recognizances, and letters patent, on which it lies to enforce the execution of, or to vacate their effect; and is a judicial writ of execution, yet it is so far in nature of an original, that the defendant may plead to it, and is in that respect considered as an action; and therefore, it is held, that a release of all actions, or a release of all executions, is a good bar to a scire facias. SeeRol. Abr.

SCRIPUS, a genus of the monogynia order, in the triandria class of plants, and in the natural method ranking under the third part of the order; the flowers are radially symmetrical, simple, and inarticulated all round. There is no corolla, and only one beardless sepal. There are 69 species, springing from the East Indies.

SCRIPHRUS. See Surgery.

SCRIBUS, SQUIREE, a genus of quadrupeds of the same class, and with the same character, is upper front-teeth curved, long, and sharp; grinders in the upper jaw five on each side, in the lower four; claws in the skeleton; tail (in most species) spreading to the sides. The animals composing this elegant genus are remarkable for the liveliness of their disposition, the severity of their motions, and the general beauty and neatness of their appearance. They inhabit woods, live entirely on vegetable food, and take up their residence in the hollows of trees, where they prepare their nests. Some specimens of the species furnishes the skin, reaching from the fore legs to the hind; by the help of which they are enabled to spring to a greater distance than the rest of the genus, and to transport themselves occasionally from tree to tree; but this momentary support in air is all that they are capable of; and though called, from this circumstance, flying squirrels, they are unable to continue that action in the manner of bats. The species of squirrels enumerated in the twelfth edition of the Systema Naturae Linnaeus amounted to no more than eleven; but such has been the spirit of research among modern naturalists, that the number is now increased to near thirty. The most noted are

1. Scurus maximus, great squirrel. Of all the species yet discovered, this is the largest, being equal in size to a cat. It is a native of Asia, and is described by Linnaeus. Mons. Somers, who informs us that it is found in the Malay country, and especially about the mountains of Cardamum, where it feeds on fruits, and is particularly fond of the fruit of the Sophora japonica, which it pierces, when ripe, in order to obtain the liquor. The fur on the whole animal is long and full; the top of the head, ears, back, and sides, are furrugious, and a small band of a crimson color is found on each ear, passing along the neck towards the sides. This animal, according to Somers, is easily tamed, and is called about the coasts of Malabar by the name of the great wood-rat.

See Plate Nat. Hist. Fig. 314.

2. Scorus vulgaris, common squirrel.

The general appearance and manners of this species are so well known that it is unnecessary to particularize them. It is a native of Asia, and is found in all the northern and temperate parts of Asia, but is observed to vary in the cast of its colours in different climates, and in the northern regions becomes grey in winter; it also varies in the size of its ears. A general measure of the European squirrel seems to be about eight inches from nose to tail, and of the tail about seven. In the spring these animals seem peculiarly active, pursuing each other among the trees, and exerting various efforts of agility. During the warm summer nights they may be also observed in a similar exercise. They seem, as Bunton observes, to dread the heat of the sun: for during the day they commonly remain concealed in their nests, making their principal excursions by night. Their habitat is so contrived as to be perfectly clean, warm, and impermeable by rain, and is furnished with moss, dried leaves, &c. and situated between the fork of two branches; it has only a small aperture near the top, which is of a conical form, so as to throw off the rain. The young are generally three or four in number, and are produced about the middle of May, or in May earlier.

The squirrel feeds on the buds and young shoots of trees, and is said to be particularly fond of those of the fir and pine; it also collects great quantities of nuts, which it deposits in the hollows of trees for its winter
food, together with beech-mast, acorns, &c. Dr. Pallas also assures us, that those of Siberia collect various kinds of fungi for this purpose. In a state of captivity, nuts form its principal food, but it will also eat a great variety of fruits and other vegetable substances, and is delighted with sugar and various sweets.

In some parts of Siberia the squirrel is found entirely white, with red eyes. About Lake Biskul it is often entirely black, or black with the belly white; and in some parts of Europe, or particularly in our own, it is occasionally found with the tail milk-white, and all the other parts of the usual colour.

3. Sciurus cinereus, grey squirrel. This species is confined to North America, in many parts of which it is extremely common, and in its general form, as well as in its way of life, resembles the European squirrel. It is a large and elegant animal, being of the size of a half-grown rabbit, and measuring about twelve inches to the tail; different individuals of the same species differ in size. The whole animal is of an elegant pale-grey, with the inside of the ears and the hinder parts of the body white. This animal is said to be found in Carolina, Pennsylvania, and other American districts; though, according to Mr. Pennant, it scarcely extends farther north than New England. Mr. Pennant also allows that it is a native of South as well as North America. In the latter it is in some years so extremely numerous as to do incredible damage to plantations, especially those of maize or Indian corn; for which reason it is one of the proscribed animals about the colonies. This species principally among trees, in the hollows of which it makes its nest, with straw, moss, &c. feeding on acorns, fircones, maize, &c. as well as on fruits of various kinds. It is said to store great quantities of provision for winter, which it deposits in holes which it prepares beneath the roots of trees, &c. It is a difficult animal to kill, changing its place on the trees with such expedition, as generally to elude the shot of the quickest marksman.

4. Sciurus striatus, the striped squirrel, is a native of the northern regions of Asia, and of several of the colder parts of North America; it has also been found, though very rarely, in some parts of Europe, and differs from the major part of the squirrel tribe in its manner of life; which rather resembles that of the dormouse, being chilled in passant to subterraneous retreats or burrows, the apartments of which are filled with various stores of acorns, nuts, grain, &c. collected for winter use. It also resembles some of the marine tribe, in being provided with cheek-pouches, for the temporary reception of food; a particular not to be found in any other species of squirrel. Its general length is about five inches and a half, and of the tail rather more. Its colour on the upper parts is a reddish brown, and on the under white; down the back a broad line runs, and on each side the body are two others; the included space between each being of a pale-yellow tinge.

These animals are, according to the observations of Dr. Pallas, extremely common in Siberia, inhabiting the maple and birch woods of that country, and generally forming their nests or burrows beneath some fallen tree; they are never known to ascend trees in the manner of other squirrels, unless suddenly surprised or pursued, when they climb with great expedition, and conceal themselves in the branches of trees, or collect their stores during the austral season, and on the setting in of winter conceal themselves in their burrows, the entrances of which they stop; and pass the greatest part of the rigorous season in sleep, and in feeding on the~stores thus collected; but if, by an unusual continuance of severe weather, their provisions happen to fail, they then sally out in quest of fresh supplies, and occasionally make their way into granaries, and even into houses. In the choice of their food they are remarkably nice, and have been observed, after filling their pouches with rye, to fling it out on meeting with wheat, and replace it with the superior grain. They are of a wild nature, and are by no means easily reconciled to a state of captivity; continuing timid, and shewing no symptoms of attachment to their owners. They are taken merely on account of their flesh, which is long or short, according to a slight or ordinary fur, have a very pleasing appearance, when properly disposed, and are said to be chiefly sold to the Chinese.

5. Sciurus vulgaris, common flying squirrel. This highly antiquated animal is the only flying squirrel yet discovered in Europe, where it is extremely rare, being found chiefly in the most northern regions, as in Finland, Lapland, &c. It also occurs in the interior districts of India and most parts of Asia; it is far more common, and abounds in the birch and pine woods of Siberia in particular. It appears to have been confounded by authors with the Virginia flying squirrel (S. vulpes), but is a totally distinct species. Its colour on the upper parts is an elegant pale or whitish grey, and on the under parts milk-white. Its general size is inferior to that of a common squirrel, measuring about three inches and a quarter in length, which is shorter than the body, thickly furred of a slightly flattened form, and rounded at the extremity. The flying squirrel generally resides in the hollows of trees towards the part projected; preys on the various mosses. It is a solitary animal, and is only seen in pairs during the breeding-season. It rarely makes its appearance by day, emerging only at the commencement of twilight, when it may be seen climbing about the trees, and darting with great velocity from one to the other. The colour of its upper part so much resembles that of the pale silvery bark of the birch-trees which it frequents, that it is no easy matter to distinguish it, while engaged in climbing about during its evening exercise. It feeds chiefly on the young shoots, buds, and catkins of the birch, as well as on the bark of the trees; in winter it congregates in its nest, coming out only in mild weather; but does not become torpid during that season.

This animal readily springs to the distance of twenty fathoms or more, and by this motion conveys itself from the top of one tree to the middle part of that to which it directs its flight, which is always slightly downwards. It thaws from the top of a tree, immediately begins to climb it with great activity, sometimes elevating, and sometimes depressing its tail. If thrown from the top of a tree, it immediately spreads its membranes, and, balancing itself, endeavouring to raise the extremity of the tail. The young are produced about the beginning of or before the middle of May, and are two, three, and sometimes four, in number; they are as first born, and nearly void of hair, and the parent feeds them by covering them with her flying membrane; leaving her nest only at the approach of evening, and carefully concealing the young with the moss of the nest.

SCLERANTHUS, a genus of the monotypic order, in the dicotyledon class of plants; and in the natural method ranking with those that are doubtful. The calyx is quinquepartite; the corolla bilabiate; the filaments are barren; the capsules free, and joined together, involucrately, with one seed. Of this there is one species, viz. aromatica, a native of Guiana.

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gular but distinct spots of pale brown. Their feelers are thick and fihly, notwithstanding an old English saying, that "a fly's legs, and the legs of a fly, differ much in weight and size; some weighing 37 ounces, others not 22; the length of the largest to the tip of the tail, 25 inches; the breadth, three feet five inches; the bill is seven inches long; the head, neck, and convicts of the wings are of a pale brown; the middle of each feather black; the breast and belly white, marked with narrow oblong black lines; the back is white, spotted with a few black streaks; the quills and feathers are black, but the inner webs spotted with white; the tail is white, tinged with red, and beautifully barred with black; the legs are long, strong, and of a blueish grey colour; the bottoms of the toes flat and broad, to enable it to walk on the soft mud, in search of food.

2. The phoxopus, or whimbrel, is much less frequent on our shores than the curlew; but its haunts, food, and general appearance, are much the same. It is observed to visit the neighbourhood of Spalding (where it is called the curlew knot) in vast flocks in April, but continues there no longer than May, and is seen there any other time of the year; it seems to be peculiar to this place, and its breeding-place. The specific difference in the size, this never exceeding the weight of twelve ounces.

3. The ructica, or woodcock, during summer inhabits Norway, Sweden, Poland Prussia, the march of Brandenburg, and the northern parts of Europe; they all retire from those countries in the beginning of winter, as soon as the frosts commence, which force them into milder climates, where the ground is open, and adapted to their manner of feeding. They live on worms and insects, which they search for with their long bills in soft grounds and moist woods. Woodcocks generally arrive here in flocks, taking advantage of the night or a mist; they soon separate; but, before they return to their native haunts, they pair. They feed and fly by night, beginning their flight in the evening, and returning the same way through the same glades to their day retreat. They leave England the latter end of February, or beginning of March; not but they have been known to continue here accidentally.

4. The gallenago, or common snipe, is well known. Its usual weight is about four ounces. The jack snipe (which is by some thought a different species) does not weigh above half as much.

5. The calidris, or red-shank.

6. The gullis, or green-glass.

7. The aegocephala, or godrot.

SCOLOPENRIDA, CENTPEDEA, a genus of insects of the order apitera: the generic character is, antennae setaceous; body depressed; legs numerous, equalling the number of segments of the body on each side, feelers two, setaceous. The larger species of the genus scolopendra, found only in the hotter regions of the globe, are insects of a formidible appearance, and possess the power of inflicting severe pain and inflammation by their bite. Of these one of the most conspicuous is the scolopendra morsitans, a native of many parts of Asia, Africa, and South America. Its length is sometimes not far short of ten inches; its colour is yellowish brown, the legs and under parts of the body being much paler; the head is armed on each side with two large claws. The genera have the same strong or horny nature as those of the aranea avicularia, but placed in a different direction, the two fangs meeting horizontally when in action; these fangs are furnished with the inside, near the tip, with an oblong slit, through which, during the act of wounding, an acrimonious or poisonous fluid is discharged; the eyes are several in number: on each side the head, and are placed in a small oval group; the legs are on each side the body, and the tail is terminated by a pair of processes, which perfectly resemble the rest of the legs, except that they are larger, andpec the first joints strongly spined or articulated on the inside. These horrible insects are said to be chiefly found in woods, but, like the small European species, they are occasionally seen in houses, and are said to be so common in some particular situations, that it would be quite obliged to place the feet of their beds in vessels of water, in order to prevent their attacks during the night.

2. Scolopendra Plumeri, or Plumer's scolopendra, is a species of a similar genera, or length through the former, sometimes measuring a foot and a half. According to the description and figure of Scolip, the body consists of thirty-two joints, exclusive of the head and tail.

3. Scolopendra galera, or common insect, and is met with in similar situations with the onius asellus and armadillo; it is an animal of swift motion, and is furnished with fifteen legs on each side; its colour is a polished chestnut-brown, somewhat paler beneath, and its usual length an inch and a half. See Plate Niti. Hist. fig. 335.

4. Scolopendra electricis, like the former, an inhabitant of damp situations, and not unfrequently makes its appearance in houses; its general length is about an inch and a half, and its diameter scarcely more than the tenth of an inch, being of an extremely light and slender form, the colour is dusky brown, with the legs yellowish; these are about seventy on each side. The motions of this insect are tortuous and undulatory, seldom continuing long in the same direction; it is possessed of a high degree of phlegm and splendour, which however seems to be only exerted when the animal is pressed or suddenly disturbed, when it discribes a beautiful serpentine line, so powerful as not to be obliterated by two canes on the same table. It is also tenacious of life, remaining seemingly uninjured for a great many days in the closest confinement.

5. Scolopendra subterrana so much resembles the former, that it might be equally confounded with it; it is however of a still more slender form, and of a much paler colour, viz. a light yellow brown; it is found in damp places, and often under ground; it is not peculiar of any phosphoric splendour, nor is it capable of surviving many hours in a state of confinement, unless placed in a very moist situation.

The scolopendra are oviparous animals, and the young, at their first exression, are furnished only with a few feet on each side; acquiring after a certain period, the legitimate number peculiar to their species, of which there are eleven.

SCOLOPIA, a genus of the tetrandria class and order. The calyx is inferior, three or four-parted; corolla three or four-petalled, hermaphrodite, six-seeded; seeds arillate. There is one species, a shrub of Santa Cruz.

SCOLYTHUS, a genus of the class and order tetrads monogyonia. The calyx is two-cleft; corolla one-seeded. There is one species, a shrub of Santa Cruz.

SCOLYMUS, a genus of the polygonia class and order tetrads monogyonia. The calyx is two-cleft; corolla one-seeded.

S. COMBER, Scomber, a genus of fishes of the order thunnacei; the generic character is, body oblong, smooth, sometimes carinated by the lateral line; fins (in most species) above and below, towards the tail. Curlews are frequent in this species, of which the most remarkable are:

1. Scomber scombrus, common marek. This beautiful fish is a native of the European and American seas, generally appearing in shoals, round particular coasts. Its great resort, however, seems to be within the Arctic circle, where it resides in innumerable masses, grows to a larger size than elsewhere, and is considered as one of their favourite food, consisting chiefly of marine insects, in far greater plenty than in warmer latitudes. During the severity of the northern winter it is often observed to lie imbedded in the soft mud, beneath the icy ice of surrounding the polar coasts, being thus sufficiently protected from the effects of frost; and, on the return of spring, is generally believed to migrate in enormous shoals, of many miles in length and breadth, and to visit the coasts of more temperate climates in order to deposit its spawn. Its route has been supposed nearly similar to that of the herring, passing between Iceland and Norway, and proceeding towards the northern part of our own island, where it part throws itself off into the Baltic, while the grand column passes downwards, and enters the Mediterranean through the straits of Gibraltar.

This long migration of the mackerel, as well as of the herring, seems at present to be greatly called in question; and it is thought more probable that the shoals which appear in such abundance round the more temperate European coasts, in reality reside during the winter at no very great distance, numbering themselves in the soft bottom, and remaining in a state of torpidity; from which they are awakened by the warmth of the returning spring, and gradually recover their former activity. At their first appearance their eyes are observed to appear remarkably dim, as covered with a kind of film, which passes off as the season advances, and they appear in their full perfection of colour and vigour.

The shape of the mackerel is highly elegant, and it is justly considered as one of the most beautiful of the European species. Its calyx is a simple cup of food is universally established, and it is one of those fishes which have maintained their reputation through a long succession of ages; having been highly esteemed by the ancients, who prepared from it the particular cautery or sauce known...
The use of the score is indispensable in composition; to the conductor of any performance it is also highly requisite, in order to his knowing whether each performer follows his part, and to enable him to supply any accidental omission with the piano-forte, organ, or other instrument, at which he is not present.

SCORPAEN, a genus of fishes of the order Scorpaenidae, and of the family of the scorpiæna, is distinguished by a peculiar form of the mouth, the head and body being abruptly truncated in front, of vast size, and armed with various protuberances and spines. Among the most common of the European species is the scorpiæna, which is frequently seen in considerable numbers in various parts of the Mediterranean, where it chiefly frequents the shallow areas, lying in ambush among the rocks, despite the many stories of its supposed appearance, its rather formidable structure, and its great size. It is a large fish, with many rows of small sharp teeth; the eyes large; the gill-covers armed with strong spines intermixed with ctenii; the body covered with large, dusky scales, spotted with black on the back, and beneath the tail, with a redish cast; the dorsal fin is furnished with strong spiny rays, the fish, when caught, erects, and this fin is disposed in such a way as to lengthen the body, forming a perpendicular direction; both jaws are armed with numerous small teeth; and the upper jaw is furnished with three cirri, viz., one on each side, and one in the middle. The general colour of this fish is a tawny brown, but when it is moving with much pace. It is a native of the Indian seas, and measures twelve or fifteen inches in length. See Plate Nat. Hist., fig. 357.

4. Scorpiæna scrofa, flying scorpiæna, a fish of this family of peculiar structure, length ten or twelve inches; colour brownish-yellow, variegated by various shades of the same colour; skin dense and tough; head depressed, and furnished with strong teeth on different parts of the mouth; the head is not, however, without some exception, the broader and more robust of the two; it is furnished with a pair of soft spines, situated on the rump of the fish; the body is covered with large, dusky scales, spotted with black on the back, and beneath the tail, with a redish cast; the dorsal fin is furnished with strong spiny rays, the fish, when caught, erects, and this fin is disposed in such a way as to lengthen the body, forming a perpendicular direction; both jaws are armed with numerous small teeth; and the upper jaw is furnished with three cirri, viz., one on each side, and one in the middle. The general colour of this fish is a tawny brown, but when it is moving with much pace. It is a native of the Indian seas, and measures twelve or fifteen inches in length. See Plate Nat. Hist., fig. 357.

5. Scorpiæna diadactyla, diadactyl scorpiæna. General length about a foot; form extremely grotesque; general colour dusky brown, varied above by transverse yellow streaks, and beneath by roundish spots of the same colour; skin dense and tough; head depressed, and furnished with strong teeth on different parts of the mouth; the head is not, however, without some exception, the broader and more robust of the two; it is furnished with a pair of soft spines, situated on the rump of the fish; the body is covered with large, dusky scales, spotted with black on the back, and beneath the tail, with a redish cast; the dorsal fin is furnished with strong spiny rays, the fish, when caught, erects, and this fin is disposed in such a way as to lengthen the body, forming a perpendicular direction; both jaws are armed with numerous small teeth; and the upper jaw is furnished with three cirri, viz., one on each side, and one in the middle. The general colour of this fish is a tawny brown, but when it is moving with much pace. It is a native of the Indian seas, and measures twelve or fifteen inches in length. See Plate Nat. Hist., fig. 357.

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3. The largest and by far the most formidable of the genus is the scorpion of Lannes, or great African scorpion. This species is of so large a size as often to measure from four inches from the head to the beginning of the tail, and four inches if measured from the tip of the claspers to that of the tail. Its colour is a dark brown, inclining to yellow beneath, and in the interstices of the joints and the tips of the spines it is a reddish cast. This species is found in many parts of Africa, where it is held in great dread; the effect of its sting producing very severe symptoms, and sometimes even proving fatal.

The poison of the scorpion is evacuated through two very small oblong foramina situated on each side of the tip of the sting. It is well known that a diversity of opinion has subsisted among authors relative to this particular. The celebrated Rea, assisted by the best microscopes he could procure, was not able to detect any orifice, though he was well convinced of the existence of such, from observing a minute drop of poison exuding from near the tip. Others have denied the existence of any foramen; but Vallisner and Lewenhock have properly described two foramina, viz. one on each side; so that the sting of the scorpion can with greater facility discharge its poisonous fluid than that of any other insect. A third foramen is said to have been sometimes observed.

The part in scorpions which is situated beneath the breast, bearing the appearance of two minute combs, has been fixed upon by Linnaeus as the criterion of the species; the number of teeth, however, varying occasionally in the same species, renders this character uncertain. The use of these organs remains as yet uninvestigated.

Scorpions are venomous insects, producing a very considerable number of young at once; there are at first entirely white, but acquire their dusky colour in the space of a few days. They are observed to cast their skin once in two years, in the manner of spiders. There are 10 species.

SCORPIEO. See Astronomy.

SCORPION, in the ancient art of war, an engine chiefly used in the defence of the walls of fortified places, by throwing arrows, firebricks, or great stones.

Marcellinus describes the scorpion as consisting of two beams bound together by ropes. From the middle of the two, rose a third beam, so disposed, as to be pulled up and let down at pleasure; and on the top of this were fastened iron hooks, where a sling was hung, either of iron or hemp; and under the third beam lay a piece of hair-cloth full of chalk, tied with cords. It had its same scorpion, when the long beam or tiller was erected, it had a sharp top in manner of a sting.

To use the engine, a round stone was put into the sling; and four persons on each side, loosen the beams bound by the ropes, draw back the whole beam to the hook; then the engineer, standing on an eminence, gave a stroke with a hammer on the cord to which the beam was fastened with its hook, which set it at liberty; so that hitting against the soft hair-cloth, it struck out the stone with a great noise.

SCORPIURUS, CATERILLAR, in botany, a genus of the decamorphia order, in the dipteral class of plants; and in the natural method ranking under the 32d order, papilionaceae. The legumin is contracted by incisions on the inside between every two seeds, and revolved round. There are four species; the most remarkable of which is the voninius, a native of Italy and Spain. It is an annual plant, with trailing herbaceous stalks, which at each joint have a spatulate-shaped leaf with a long foot-stalk. From the wings of the leaves there is formed a footstalk of the flowers, which sustain at the top one yellow butterfly-flower, succeeded by a thick twisted pod having the size and appearance of a large catterpillar, whence it had this title. This has long been used for medicinal purposes. It is grown on account of its odd shape than for any great beauty.

SCORZA, a mineral of a green-coloured sand, the specific gravity of which is 3.35. It is found in Transylvania, and is composed of 43.9% silica, 21.00 alumina, 14.00 lime, 16.50 oxide of iron, 0.25 oxide of manganese.

SCORZONERA, Viper's Grass; a genus of the polygonum aquilis order, in the syngenesia class of plants; and in the natural method ranking under the 49th order, composite. The receptacle is naked; the pappus planum; the calyx indurated, with scales imbricated on their margins. There are 29 species; the most remarkable is the hispanica, or common scorzonera, which is cultivated in the gardens of this country, both for culinary and medicinal purposes. The root is carrot-shaped, about the thickness of a finger, covered with a dark-brown skin, is white within, and has a milky juice. The stalk rises three feet high, is smooth, and branching at the top. The flowers are of a bright yellow colour.

SCOTLAND. By 5 Anne c. 8, the union of England and Scotland was effected, and the twenty-five articles of union agreed to by the parliaments of both nations, were ratified and confirmed as follows: viz. the accession to the monarch of Great Britain, shall be the same as was before settled with regard to that of England. The united kingdoms shall be represented by one parliament. There shall be a communication of all rights and privileges between the subjects of both kingdoms, except where it is otherwise agreed. When England raises 2,000,000, by land-tax, Scotland shall raise 48,000l.; the standards of the coin, of weights and measures, shall be reduced to those of England, throughout the united kingdoms. The laws relating to the trade, customs, and the excise, shall be the same in Scotland as in England; but all the other laws of Scotland shall remain in force, though alterable by the parliament of Great Britain; and particularly laws relating to private right are not to be altered, but for the evident utility of the people of Scotland. Sixteen peers are to be chosen to represent the peerage of Scotland in parliament, and forty-five members to sit in the house of commons.

The sixteen peers of Scotland shall have all privileges of parliament, and all peers of Scotland shall be Great Britain, ranking next after those of the same degree at the time of the union, and shall have all privileges of peers, except sitting in the house of lords, and voting on the trial of a peer.

It was formerly resolved by the houses of lords, that a peer of Scotland, claiming and having a right to sit in the British house of peers had no right to vote in the election of the sixteen Scotch peers; but it seems now settled, that a Scotch peer, made a peer of Great Britain, has a right to vote in the election of the sixteen Scotch peers; and that if any of the sixteen Scotch peers are created peers of Great Britain, they thereby cease to sit as representatives of the Scotch peerage, and new Scotch peers must be elected in their room.


SCRIBING, in joinery, &c. is a term used when one side of a piece of stuff is to be fitted to another that is irregular. In order to make these join close all the way they scribe them; they are to be scribed close to the other they intend to scribe to, and opening their compasses to the widest distance these two pieces stand from each other, they bear the point of one of the legs against the side they intend to scribe to, and with the other point draw a line on the stuff to be scribed. Thus they form a line on the irregular piece parallel to the edge of the regular one; and if the stuff is cut exactly to the line, when these pieces are put together they will seem a joint.

SCRIPTURE. All profane scoffing at the holy scripture, or exposing any part thereof to contempt or ridicule, is punishable by fine and imprisonment. 1 Ham. 7.

SCHOPHULARIA, See Medicine.

SCHOPHYLUS, Figwort; a genus of the angiosperma order, in the dianthus class of plants; and in the natural method ranking under the 49th order, composite. The calyx is quinquedent; the corolla almost globular, seven to a flower, very crispate bilocular. There are 22 species, of which the most remarkable are: 1. Nodosus, or the common figwort, which grows in woods and hedges. The leaves have a slight smell and bitter taste. A decoction of them is said to cure hogs of the measles. An omission made in the root was formerly used to cure the piles and scrophulous sores, but is at present out of practice. 2. Aquatica, water-figwort, or butterwort. It grows on the sides of rivulets and other wet places, and has a pellitory smell, though not so strong as the preceding. The leaves are used in medicine as a corrector of senna, and against the side against. 3. Scoroma, or basin-leafed figwort. It grows on the banks of rivulets, &c. in Cornwall. 4. Verpalis, or yellow figwort. It grows in hedges in Surrey.

SCLEROT. See Anatomy.

SCHRUNK, weight equal to the third part of a drachm, or to twenty grains. See Weight.

SCULPTURE. Sculpture is an art, in which, by means of taking away, or adding to, matter, all sorts of figures are formed, either
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In clay or wax, wood, marble or other stones, or metal.

The art of sculpture, in its most extensive sense, comprehends not only carving in wood, stone, or marble, but also engraving in all its kinds, and casting in bronze, or lead, wax, and plaster of Paris, as well as modeling in clay, wax, or stucco.

All these are branches of sculpture (of which we shall occasionally make mention); but as they are ranged in their respective practice, under different denominations, we propose to give a history of the first branch (and chiefly of carving in stone and marble, which is at present peculiarly considered as the sculptor's art), and of its necessary preliminary, modeling in clay or wax.

Powers of sculpture. Sculpture is not only able, in common with other imitative arts, to express the forms of visible objects and the conceptions of the mind, but it possesses this superior distinction, that by means of its various branches, it is eminently capable of transmitting the most durable records of men's actions to distant ages. Were it not for this art, we should at the present moment be ignorant of every event which has distinguished the course of time in the long history of human existence; at least, our only knowledge would be gathered from tradition, whose fallacy and inaccuracy are every hour evinced. Without this art, we could form no conjecture of the permanency or variation of human forms, much less of human passions and taste; nor is it to be forgotten, that the first communication of the laws of God was made to the Israelites by the means of sculpture.

The art of sculpture, like its sister, painting, is initiatory, not for the gratification of the eye only, but also of the intellect. It is capable of expressing all forms that fall under our inspection, and of conveying more direct expressions of beauty than are to be found, either by ordinary observation, or are generally united in one body, and which are therefore called ideal forms.

Sculpture, in its confined and proper sense (in which we here propose to treat of it), divides itself into modeling of heads, and of statues, or groups: and these productions may be classed generally, like those of painting, under the respective terms, historical, allegorical, portraiture, &c. See Painting.

Bas-relief has been already described (see RELIEVO). Works of sculpture have been invented for the purpose of representing subjects of history or fancy, and may be regarded as a species of painting in stone. They are chiefly used to adorn the pediments, friezes, and panels of buildings, as well as the pedestals of statues, &c.

Statues are defined to be figures in full or imitated relief. They are of various descriptions or statues. They have chiefly been employed for the purposes of religious worship, as among the heathen nations and the Roman-catholics; and for the commemoration of heroic characters, or of men distinguished by any remarkable achievements.

Groups are an assemblage and union of statues, and are generally employed to the same purposes as single statues.

Of the methods of study. The studies necessary for the young sculptor, towards the attainment of his art, are so similar to those of the artist, that (with the obvious exceptions arising from the difference of materials employed in the two arts), that very little remains here to be enlarged on, under the head of studies. The principal acquisitions to which the student must direct his endeavours, are, a knowledge of composition, form (including anatomy), and expression; to which, as in painting, must be added the difficult study of grace. These are generally inured to, under the articles painting, design, drawing, and expression. See Drawing, Expression, and Painting.

The method of study most recommended to young sculptors, is, to begin with copying, and end with rivaling, the forms of the Greek statues.

"Vos exemplaria Graecae Nocturna versate manus, versate diurna!" says Da Frennoy: nor can it be questioned that the sculptors are generally speaking, direct guides to nature. But it should not pass unnoticed, that although the forms of the Greek sculpture are, in general, not only more beautiful, but more appropriately so than any other; yet in some instances they have been executed by modern sculptors, as in the forms of infants by Pimpane. See Statues, antique.

The method of execution in the Greek statues and other works of sculpture, seems to have been extremely different from that which is generally in use among modern artists. In the ancient statues, the artist frequently found striking proofs of the freedom and boldness that accompanied each stroke of the chisel, and which resulted from the artist's being perfectly sure of the accuracy of the method which he pursued. Even in the most minute parts of the figure, no indication of timorousness or diffidence appears; nothing that can induce us to believe, that the artist feared he might have occasion to correct his strokes. It is difficult to find, even in the second-rate productions of the Greek artists, any mark of a false stroke or a random touch. This firmness and precision of the chisel stroke is evidently to be ascribed from a more determined and perfect set of rules, than those of which we are masters.

Besides studying, therefore, in the productions of the Grecian masters, their choice and expression of select nature, whether beautiful, sublime, or graceful, together with that serenity and simplicity which pervade all their works, the artist will do well to investigate the manual and mechanical part of their operations, as this may lead to the improvement of his mode of progress.

It is certain that the ancients, almost always formed their first models in wax; to this modern artists have substituted clay, which they prefer on account of its yielding nature, and its sticking in some measure to every thing it touches. We must not, however, imagine from hence, that the method of forming models of wet clay, was either unknown or neglected among the Greeks; on the contrary, the art of this kind was so much admired, that in the Villa Albani. These clay models were then turned by their mails, to render certain parts more delicate and lively; hence arose the phrase, ad unguem factus homo, "an accomplished man." It was the opinion of count Caylus, that the ancients did not use models in forming their statues. But to dispute this, it is only necessary to mention an engraving on a stone, in the cabinet of Horsch, which represents Prometheus engraving the figure of a man, with a plummet in his hand, to measure the proportions of his model.

As soon as the artist has rendered himself familiarly acquainted with the beauties of the Grecian statues, and formed his taste on the admirable models they exhibit, he may then proceed with advantage and success to the imitation of nature. The ideas he has already formed of the perfection of nature, by observing her dispersed beauties, and combined and collect catholic in the compositions of the ancient artists, will enable him to acquire with facility, and to employ with advantage, the detached and partial ideas of beauty which will be exhibited to his view in a survey of nature in her actual state. When he discovers these partial beauties, he will be capable of combining them with those perfect forms of beauty, with which he is already acquainted. In a word, by having all the models of ancient artists already mentioned, he will form an accurate judgment of the powers of his art, and will draw rules from his own mind.

There are, however, two ways of imitating nature. In the one, a single object occupies the artist, who endeavours to represent it with precision and truth; in the other, certain lines and features are taken from a variety of objects, and combined and blended into one regular whole. All kinds of copies belonging to the first kind of imitation blend the productions of this sort must necessarily be executed in a confined and servile manner, with high finishing, and little or no invention. But the second kind, called imitation, is made directly to the investigation and discovery of true beauty, of that beauty whose perfect idea is only to be found within the mind.

Of the different modes of process in sculpture. Works of sculpture are performed, either by hollowing or engraving, as in metals, agates, and other precious stones, and in marbles of every description; or by working in relief, as in bas-reliefs in the materials just mentioned, or in metal, clay, wax, marble, or stone.

The excavation of precious stones forms a particular branch of art called intaglio, which, together with the working them in relief, when the term cameo is applied to them, belongs to the art of seal-engraving. See Engraving.

The excavation of metals constitutes the art of engraving, in its various branches, or the art which is comprehended in the term engraving, comprising projecting, casting in bronze, &c.

Of the last only, viz. casting in bronze, we take this opportunity of observing, in addition to the account given under the head
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bromes, that a highly improved method has lately been put in practice by professor Zander, an eminent sculptor at Vienna, in the case of emperors Joseph II. The student may find an accurate detail of Zander's mode of process, in the "Academic Annals of Painting," published by the royal academy of London.

We proceed, as before proposed, to the other more immediate and proper parts of the sculptor's art.

The process of hollowing hard stone or marble, will need no particular description; especially as it is now wholly in disuse, except for the forming of letters in monumental or other inscriptions.

In working in relief, the process is necessarily different, according to the materials in which the work is performed.

As not only the beginning of sculpture was in clay, for the purpose of forming statues, but as models are still made in clay or wax, for every work undertaken by the sculptor, we shall first consider the method of modelling figures in clay or wax.

Few tools are necessary for modelling in clay. The clay being placed on a stand or easel, the artist begins to work with his hands, and puts the whole into form by the same means. The most expert practitioners of this art seldom use any other tool than their fingers, except in such small or sharp parts of their work, as the fingers cannot reach. For these occasions, they are provided with three or four small tools of wood, about seven or eight inches in length, which are rounded at one end, and at the other flat and shaped into a sort of claws. These tools are called by the French bouchons. In some of these the claws are smooth, for the purpose of smoothing the surface of the model; and in others are made with teeth, to rake or scratch the clay, which is the first process of the tool on the work, and in which state many parts of the model are frequently let by artists, to give an appearance of freedom and skill to their work.

If clay could be made to preserve its original moisture, it would undoubtedly be the finest substance for the models of the sculptor; but when it is placed either in the fire, or is exposed in a dry air, its parts are more or less hard and brittle in the air, its solid parts grow more compact, and the work shrinks, or loses a part of its dimensions. This diminution in size will be of no consequence, if it affected the whole equally, so as to preserve its proportions. But this is not always the case: for the smaller parts of the figure drying sooner than the larger; and thus losing more of their dimensions in the same space of time, than the latter do; the symmetry and proportions of the work inevitably suffer.

This inconvenience, however, is obviated by forming the model first in clay, and moulding it in plaster of Paris before it begins to dry, and the taking a plaster cast from that mould, and the repairing it carefully from the original work; by which means you have the exact counterpart of the model in its most perfect state; and you have, besides, your clay model to work from.

In order to model in wax, you must prepare the wax in the following manner: to a pound of wax add half a pound of scannomy (some mix turpentine also), and melt the whole together with oil of olives; putting more or less of it as you would have your modelling wax harder or softer, also some of your blue sable mixed with this composition, to give it a reddish colour, in imitation of flesh.

In modelling in wax, the artist sometimes uses his fingers, and sometimes tools of the same sort as those described for modelling in clay. It is at first most difficult to model in wax than in clay, but practice will render it familiar and easy.

Of the use of the model. Whatever considerable work is undertaken by the sculptor, whether has-relief, or statue, &c. it is always requisite to form a previous model, of the same size as the intended work; and the model being perfected, according to the method before described, whether in clay, or in wax, or a cast in plaster of Paris, becomes the rule, whereby the artist guides himself in the conduct of his work, and the standard from which he takes all its measurements. In order to render the place handled more correctly by it, he puts over the head of the model an immoveable circle, divided into degrees, with a moveable rule fastened in the centre of the circle, and likewise divide the division of the circle, and thereby the rule hangs a line with a lead, which directs him in taking all the points, which are to be transferred from the model to the marble; and from the top of the marble is hung the lead on that line is hung from the model; by the correspondence of which two lines, the points are ascertained in the marble.

Many eminent sculptors prefer measures taken by the compasses to the method just described; for this reason, that the model is moved but so little from its level, the points are no longer the same.

This method, however, offers the best means, by which models in judgement may be attained; but it is manifest, that enough yet remains to exercise and display the genius and skill of the artist. For, first, as it is impossible, by the means of a straight edge, tangent to this curve of a curve, to derive a certain rule to guide him, as often as the line which he is to describe deviates from the direction of the plumb-line. It is also evident, that in order to determine exactly the proportion, which the various parts of the figure ought to bear to each other, considered in their mutual relation and connections. This defect, indeed, may be partly supplied by intersecting the plumb-lines by horizontal ones; but even this resource has its inconveniences; since the squares formed by transversal lines that are at a distance from the figure (though they are exactly equal), yet represent the parts of the figure as greater or smaller, according as they are more or less removed from our point of view.

Of sculpture in wood. A sculptor in wood should first take care to choose wood of the best quality, and the most proper for the work which he intends to execute. If he undertakes a large work, requiring strength and solidly, he ought to choose the hardest wood, as oak, elm, beech, or chestnut; but for works of moderate size, pear or apple-tree serve very well. As even these latter woods are still of considerable hardness, if the work consists only of delicate ornaments, the artist will find it preferable to take some more tender wood, provided it is at the same time fine-grained, and hard. The French sculptor, for instance, the Bouchardier tree, which is excellent for this purpose, as the chisel cuts it more neatly and easily than any other wood.

The ancients made statues out of almost every different kind of wood. At Sicyon the statue of Apollo was of box; the statue of Diana at Ephesus, was of cedar. As these two sorts of wood are extremely hard and enduring; and as cedar, in particular, is of such a nature, that, according to Pliny, it ought never to come to an end; the ancients preserved them for the lasting of their divinities.

In the temple built on mount Cyllene in honour of Mercury, Paternice relates, that there was a statue of that god made of cedron wood, eight feet in height. This wood was also much esteemed.

The cypress likewise, being a wood not apt to spoil, nor to be damaged by worms, was also used for statues; as were the palm-tree, olive, and ebony, of which latter, according to Pliny, there was another statue of Diana at Ephesus.

Several other kinds of wood were equally employed for this purpose, even the vine, of which the same author says, there were statues of Jupiter, Juno, and Diana.

Fulclum speaks of a French artist at Florence, of the name of Jann, who executed several statues in wood, in a style of finishing equal to marble, and particularly one of St. Beatus, which Bassini considered as a marvelous production.

The beauty of sculpture in wood consists in the tender manner of cutting the wood, free from all appearance of hardness or dryness.

For any work of large dimensions, even though it consists of a single figure, it is better to join together several smaller pieces of wood than to make the whole of a single large piece; which is more able to warp and spring from the shrinking or swells of the grain, that always dry at heart, although it appears perfectly dry on the outside.

No wood can be properly fit for works of this kind, that was not been cut at least ten years before it is used.

The tools used for sculpture in wood, are the same as those of the joiner or cabinet-maker.

Of sculpture in stone and marble. For sculpture in marble and other stone, the artist must make use of tools of good steel, well tempered, and of strength proportioned to the hardness of the material.

The first thing to be done, is to saw out from a larger block of marble, a block proportioned to the size of the work which is undertaken. After this, the sculptor shapes the gross masses of the forms he designs to represent, by knocking off the superfluous matter with a strong mallet or bed, and a strong steel tool called a point. When the block is thus hewn out agreeably to the measure previously taken for the performance of the work, the sculptor brings it closer to the intended form by means of a finer point; and sometimes of a tool called a dog's tooth, having two points, but less sharp than the single one.
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After this he uses the gradine, which is a flat cutting tool, with three teeth, but is not so strong as the point.

Having advanced his work with the gradine, he uses the chisel to take off the ridges left by the former tool. He is delicate in the use of this instrument, and, giving softness and tenderness to the figure, till at length, by taking a rasp, which is a sort of file, he brings his work into a proper state for being polished.

Raspes are of several kinds, some straight, some curved, and some harder or softer than others.

When the sculptor has thus far finished his work with the chisel and rasp, he procures, whatever certain parts or particular works require polishing, he uses pumice-stone to make all the parts smooth and even. He then goes over them with tripoli, and when he would give a still higher gloss, he rubs them with leather and straw-ashes.

Besides the tools already mentioned, sculptors use also the pick, which is a small hammer pointed at one end, and at the other formed with teeth made of good steel and squared, to render them the stronger. This serves to break up a block of marble, and dig them with a hole of equal dimensions, which cannot be done with cutting tools. The chisel is driven with the maltel or beetle, and its points bruise the marble and reduce it to powder. Water is thrown into the hole from time to time, and this water that is made, to bring out the dust of the marble, and to prevent the tool from heating, which would destroy its temper; for the free-stone dust on which tools are edged, is only moistened with water to prevent the iron from heating and taking off the temper of the tool by being rubbed dry; and the trepanns are wetted for the same reason.

The sculptor uses the bouchard to bore or pierce such parts of his work as the chisel cannot reach, in danger of spoiling or breaking them. In using it, he passes it through a piece of leather, which leather covers the hole made by the bouchard, and prevents the water from spurring up in his face.

The other tools necessary for sculpture on marble or stone, are the rounded, which is a sort of rounded chisel; the bouget, which is a chisel-squared and pointed; and various compasses to take the requisite measures.

The process of sculpture in stone is the same as in marble, excepting that the material being less hard than marble, the tools used are not so strong, and some of them are of a different form, as the rasp, the hand-saw, the tipe, the straight chisel with three teeth, the rounded, and the grater.

If the work is executed in free-stone, tools are employed which are made on purpose, as the free-stone is apt to scale, and does not work so nicely like marble. Sculptors in stone have commonly a bowl in which they keep a powder composed of plaster of Paris, mixed with the same stone in which their work is executed. With this composition they fill up the small holes, and repair the defects which they meet with in the stone itself.

HISTORY OF SCULPTURE.

Adantic art.

The art of sculpture is of such immemorial antiquity, that it has been by some conceived to have had its being from eternity; but without regarding it in this exalted light, St. Augustin has attributed a date to its invention as early as the time of the Protopen, our common father Adam, who, as authors, was the inventor of letters. Sculpture, therefore, may trace its pedigree from the infancy of the world, and contend for pre-eminence with the most remote antiquities which it has been employed to celebrate. Josephus, Cteschem, and some other authors, make mention of some antediluvian sculptures in stone and brick erected at Joppa, which are imagined to have contained the systems of idolatry and celestial sciences, and to have remained unburnt for some thousands of years after the universal cataclysm.

Cham, who is supposed to be the same as Zoroaster, is spoken of by the author of the scholastic work on Geography, as having engraved the liberal arts on fourteen columns, seven of brass, and seven of brick. Socrates also mentions the same circumstance, with this variation, that they were engraved on plates of different metals (diversa metalorum laminis).

Concerning the art of sculpture immediately after the Flood, it is scarcely to be questioned that it was transmitted by Noah and his descendants. About two hundred years after the Deluge, Mercenarius Trismegistus reports of himself, that he engraved his most abstruse mysteries on stone, reforming all that had been deprived by Cham. Some of these records were in letters, some in figures and engravings characters, probably not unlike to those contained in the stupendous obelisks erected by Misra, the first Egyptian Pharaoh, about four hundred years (according to Kirschen) before Moses.

The first mention that is made of the art of sculpture in the writings of Moses, is in the book of Genesis, where we are informed that when Jacob, in obedience to the divine command, was returning from Padan, he carried his wife Rachel along with her the pharama, or idols, of her father's house. These must certainly have been very small images, since Rachel found it so easy to conceal them from her father, notwithstanding his anxious search; but we are ignorant in what form they were made, or of what materials they were composed. The first persons mentioned in the Bible as artists, are Aboliah and Benjama, who, according to some, covered the mercy-seats, and wrought the ornaments of the pectoral to be worn by the high priest.

As Chaldea, therefore, was the first people of the earth after the Flood, and as it appears from various accounts that the art of engraving upon bricks baked in the sun was there carried to a considerable degree of perfection at a very early period, it appears probable that the Chaldeans derived the rudiments of the art of sculpture immediately from their antediluvian ancestors.

The origin of idolatrous worship is generally thought to be derived from images first made to preserve the memory of the dead, and, in process of time, converted by the flatterers of great men into objects of adoration. This also affords presumptive evidence that the Chaldeans were the first who practised the art of sculpturing, and stone into the figures of men and other animals; for the Chaldeans were unquestionably the first idolaters, and their early progress in sculpture is confirmed by the several testimonies of Berosus, Alexander, Polybius, and Pliny.

Against this conclusion some plausible arguments have been urged on the authority of a theory established by a French writer, who maintains that in the year of the world 1490, about 200 years after the Deluge, the Scythians under Brooma, a descendant of Magog, extended their conquests over the greater part of Asia; and that Brooma was not only the civilizer of India, and the author of the Brahminical doctrines, but also diffused the principles of the Scythian mythology over Egypt, Phenicia, Greece, and the continent of Asia.

Leaving the consideration of this question, as too extensive for our present purpose, we proceed to trace the progress of the art of sculpture through some other nations of antiquity, till we bring it to Greece, where it was carried to the highest perfection to which it has yet attained.

Phoenicia, in the immediate vicinity of Chaldea, must necessarily have very early acquired a knowledge of sculpture. The Phoenicians possessed both a character and situation highly favourable to the cultivation of this art. They beheld the most beautiful models in their own persons, and their industrious character qualified them to attain perfection in every art for which they had a taste. But as their situation raised a spirit of commerce, it is at all times questionable whether commerce induced them to cultivate the arts. Their temples shone with statues and columns of gold, and a profusion of emeralds were everywhere scattered; but the beauties of art do not consist in finery or ostentation of wealth. The temples of the Phoenicians have been unfortunately destroyed; many Carthaginian models indeed are still preserved, ten of which were deposited in the cabinet of the grand duke of Florence. But though their architects were a colony of Phenicians, we should probably deduce from their works a very unfair estimate of the merit of their ancestors.

Very high pretensions to antiquity of every kind are made by the Persians; but we do not and that they ever made any distinguished figure in either of the arts of sculpture or painting. They were indeed sensible to the charms of beauty, but they did not study to imitate them. Their dress, which consisted of long flowing robes, concealing the whole person, prevented them from attending to the beauties of form. Their religion too, which taught them to worship the divinity in the emblem of fire, and that it was impious to represent him under a human form, seemed almost to prohibit the exercise of this art, by taking away the strongest incentives to art during the reigne of superstition; and as it was not customary among them to raise statues to great men, it was impossible that statuary could flourish in Persia.
The Persian, however, represented in their bas-reliefs many symbolic expressions of the powers of the Divinity, as well as of their religious ceremonies or heroic achievements. The bas-reliefs on the palace of Persopolis and the bulls of the Brahmans, are arranged in horizontal and perpendicular lines, answering the double purpose of description and architectural decoration. The style of drawing in these bas-reliefs resembles that of later hieroglyphics, except in the dresses of the figures, which are different from those either of the Egyptians or Hindoos. The Persians are represented with long beards and ringlets, caps, full tunics, with regular folds and large sleeves. The Medes, in the same ruins of Persopolis, have close tunics. The drapery in these bas-reliefs is superior to that of the Egyptians, as bearing a greater resemblance to nature.

In Hindostan and Egypt the art of sculpture has been exercised in a similar manner in the shaping or adorning large rude masses of the hardest materials, and the works of these two nations may not improperly be considered together. The reader will find some account of their sculpture under the article ANTIQUITIES.

In India, bas-reliefs have been found in great numbers in the caves of Ellora and Elephants: the subjects are religious. The drawing of the figures bears a strong resemblance to the Egyptian style, but they are less correct in their forms, the heads being generally very large, and the limbs disproportionate to the bodies. It may be questioned, from the greater simplicity of execution, whether the Egyptian hieroglyphics are not also more ancient than the Hindoos; the ground in the former being level with the highest relievo, and in the latter cut down to the lowest outline of the figure.

The character and style of design among the Egyptians have been more fully noticed by writers, because the first progress of the art among that people is conceived to elucidate that of most other antient nations.

In the Egyptian idols, composed of parts of different animals, each part appears to have been separately studied; for it is not to be supposed that a people of such rude manners as the Egyptians would communicate to their works that refinement and beauty which the elegance of Greekian manners inspired. On the other hand, there are many of the Tuscan statues which bear so close a resemblance to those of Greece, that antiquarians have thought it probable that they were conveyed from that country or Magna Grecia into Etruria, about the time of the Roman conquest, when Italy was adorned with the spoils of Greece.

Among the monuments of Etrurian art, two different styles have also been observed. In the first the lines were straight, the attitude stiff, and the shape of the head without beauty. The general form of the figure is likewise too slender: the head is oval, the chin peaked, the eyes flat, and looking obtuse.

All these are evidently the defects of an art in a state of infancy, and some of them are equally conspicuous in the early statues of all nations. The style of the Etrurian sculpture is so similar to that of the Egyptians, that one is almost induced to suppose...
that there had once been a communication between these two nations; but the introduction of this style by Dedaus is generally credited.

Winckelmann supposes that the second epoch of sculpture in Etruria commenced in Etruria about the time at which it had its greatest perfection in Greece, in the age of Phidas; but this conjecture is not supported by any proofs. To describe the second style of sculpture among the Etruscans, is almost the same as to describe the style of the modern restorers of the art in Tuscany. The joints are strongly marked, the muscles raised, the bones distinguishable, but the whole appearance is harsh, particularly in the representation of ordinary life. The statues of the gods are designed with more delicacy. In forming them the artists were anxious to show that they could exercise their power without that violent distention of the muscles which they conceived necessary in the exertions of beings merely human; but in general their attitudes are unnatural, and the actions strained. If a statue, for instance, holds any thing with its fore fingers, the rest are stretched out in a stiff position.

Greek. The earliest examples of Grecian sculpture remind us still more of the Egyptian, in the principles of design, than those of any other nation. The face of the human figure has the same kind of oval, the eyes are described by the same curves, the eye full, and the body and limbs represented nearly in the same general forms. The works of the early Greeks may, however, be justly considered as being marked out in the proportions of their figures, and superior in the drawing of the body and limbs. It is probable that sculpture preceded the use of letters in Greece, as in other nations; but the small bronze figures with inscriptions on them in Cadiunan letters, are such weak and barbarous resemblances of the human form, that it is needless to trace its origin in any more remote period.

The Greeks began very early to study the proportions of the human form. Vitrivius informs us that "as the height of the human figure was six times the length of the foot, that was made the rule of proportion for the Doric column." Their knowledge, therefore, in this point of art, was by no means insufficient to their architectural proportions.

Whether Greece received the principles of the arts from Egypt and Phœnicia, or, as they asserted, were the original inventors of them, it is certain that the native genius of the Grecians, combined with other particularly favourable circumstances, very soon raised sculpture from a state of barbarism. In the earliest era of sculpture in Greece, schools of design were established in the island of Zeeina, at Corinth, and at Sicyn. This last city was styled the mother of the arts, as Diapason and Selphides, and their disciples also, had flourished there; and after seven generations, Aristotle, the brother of Canaceus, likewise a sculptor of eminence, presided over the same establishment with undiminished fame. The school of Zeeina travelled its origin to Dedaus, of fabulous renown; and Sicyn, said to have produced two statues of Juno; one for her temple at Samos, and the other for that at Argos.

From these auspicious drawings of the art of sculpture, three distinct schools arose; one of which was peculiar to Ionia; the other were in Greece, at Athens, and at Sicyn, each of them shining with nearly equal splendour for several ages. At the head of the first Grecian artists, stands Myron, whose statues in bronze at Athens were admired in the sixteenth Olympiad. A Discothek, made by Myron, is particularly noticed by Quinctilian.

Phidas, whose name is better known in the present day than that of any other sculptor, was the disciple of Echias and Agesilaus, the probable contemporaries of Myron, and who flourished in the sixteenth Olympiad. We collect from Quinctilian, that he excelled in imparting a celestial dignity to his figures of the deities, two of which are celebrated in this respect, the Minerva at Athens, and Jupiter Olympius at Elis. Many of his most beautiful works were in ivory, frequently less than the natural size. He cast likewise in bronze.

In the same age lived Polycletus, whose works were distinguished by exquisite grace and most correct finishing; the latter quality was the effect of his singular diligence. To judge of the human figure he is said to have given more than human form, but founded in expressing the majestic character of the gods.

The works of Egesias were of a sublime style, but hard manner.

Of the school of Phidas, the most distinguished sculptors were Alcmenes of Athens, and Agorasitus of the island of Paros. Their rival skill was exerted in finishing a statue of Venus; and the palm was adjudged by the Athenians to their own citizen.

Polycleitus of Sicyn, the competitor with Phidas in an understanding of more grandeur and consequence than his general works. He was employed by the inhabitants of Argos to make a colossal statue of Juno, composed of gold and ivory, in order to emulate, rather than to imitate, the Olympic Jupiter of Phidas.

Two figures in bronze by Polycleitus representing the canopher or nymph bearing in baskets the symbols of Ceres to a sacrifice, were taken from the Thebians by Verres. They were esteemed beyond any bronze figures existing at that time. Such was the skill of this eminent master, that he completed so perfect a human figure that it served as a model to his successors, and was admired by Lyssippus as the acme of his art.

While Phidas in gold and ivory, and Polycleitus in bronze, engrossed to themselves every excellence, Scopas acquired a scarcely inferior celebrity for his statues in marble. The group of Niobe and her children is attributed by Piny to Scopas or Praxiteles, he does not decide which.

The last sculptor (of whose works we have any knowledge) ceasal with Phidas, was Ctesilaus, who, jointly with him and Polycleitus, designed, one of the three Amazons designed to decorate the temple of Diana at Ephesus, and the statue of Pericles, commended by Piny, who allows to Ctesilaus the felicity of giving to his heroes a still more airy air than they possessed.

The names of Policles, Cephisodorus, Leochares, and Hippodotus, are preserved from oblivion by Piny, but none of their works remain. Leochares was one of the four artists employed in adorning the miliarium built by the celebrated Artemisia, queen of Caria, to the memory of her husband.

Menestratus, Socrates, Philiscus, Lyais, Memenides, and many others, are also spoken of with praise by various writers; but we have unfortunately no other remaining testimonies of their merits.

Of the first style of the Grecian sculptors, so remarkable for simplicity and gracefulness, the era was circumscribed to the limits of fifty years, during which period the art had arrived at its meridian of beauty. The succeeding age introduces Praxiteles, who may be called the father of the second manner, and whose works were discriminated by their flowing outline and delicate finishing. The elevation of Thelus by Eupemnonius above the other states of Greece, produced a complete change in her whole system; but as soon as the Athenians recovered their former splendour, the arts, which had ever accompanied the vicissitudes of her fortunes, revived with an unabated splendour. The works of Praxiteles are celebrated by historians and poets. His Venus of Guidius in marble, attracted them no less admiration than the Medicean Venus has done in the modern world; and his giant statue of a bull, immortalized in the trunk of the tree against which he leans) Samocetus, is still among the most prodigious productions of sculpture.

Not long after Praxiteles had signified himself in Italy, and particularly in Rome, Lyssippus appeared, whose great merit consisted in following nature more scrupulously than any of his immediate predecessors. If, as Pliny reports, his works were so numerous as to amount to not less than fifteen; the works of Praxiteles, we have the more cause to regret that they were all of bronze, and are irretrievably destroyed. He flourished under the reign of Alexander.

To Aganderus, Polydoronus, and Athenodorus, is ascribed (by Pliny) the celebrated group of the Laocoon and his sons, and the art has been frequently busied in endeavouring to discriminate the particular portion of each artist; but conviction has hitherto been produced. Abbé Winckelmann conjectures that Aganderus was the father of the other two artists, and that he himself finished the statue of Laocoon, leaving the children to be wrought by his son Polycrates (or Juliaus apellis). No authentic document remains by which the time in which these artists flourished can be ascertained.

Neither do we know the precise date of Apollonius and Taurinus, the authors of a less celebrated group representing Daedalus tied to the horns of a bull (in order to be precipitated into the sea) by Zeilus and Amphion, the sons of Antiope. This work is generally supposed to have been executed by the rival group of Laocoon. In an inscription on it, now obliterated, was traced the name of another artist, Menecrates. This vast mass of sculpture is said to have been formed out of a single block, in the island of Rhodes. It has suffered greatly in the course of time.

Greece, after the death of Alexander the Great, lapsing into a state of dependence little short of slavery, the arts were for a time wholly neglected; and when they were revived (after the amnesties, had they not found refuge in Asia, under the patronage of the Seleucides, Men of talents also in every profession.
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Winckelmann has assigned four different styles to this art among the Greeks. The antient style, which continued until the time of Phidias; the grand style, formed by that celebrated statues; the beautiful, introduced by Praxiteles, Apelles, and Lyssippus; and the imitative style practised by those artists who copied the works of the antient masters. The most authentic monuments of the antient style have been already described. The statues formed in this style were not distinguished by beauty of shape, nor by proportion, but bore a close resemblance to those of the Egyptians and Etruscans. The eyes were long and flat; the section of the mouth not horizontal; the chin was pointed; the curls of the hair were ranged in little rings, and it was impossible to inspect the head to distinguish the sex.

The character of the antient style was energetic, but harsh; it was animated, but without gracefulness; and the violence of the expression deprived the whole figure of beauty. The great group of Hercules, which was erected by Phidias, Polycletus, Scopas, Alcamenes, Myron, and other illustrious artists. It is probable, from some passages of antient writers, that in this style were preserved some characteristics of antient manners, such as straight lines, the squares, and angles. The antient masters, such as Polycletus, being the legislators of proportion, says Winckelmann, and of consequence thinking they had a right to distribute the parts of the human body, have undoubtedly sacrificed some degree of the form of beauty to grandeur which is harsh, in comparison of the flowing lines and graceful forms of their successors. The most considerable monuments of the grand style, are the statues of Niobe and her daughters; and a figure of Pallas, to be seen in Villa Albani; which, however, must, not be confounded with that preserved according to the first style, and also found in the same place; the head of which possesses all the characters of dignified beauty, at the same time exhibiting the rigidity of the antient style. Elegy and ebullition have not, in the opinion of Winckelmann, that austerity of appearance which marks the age of the last-mentioned statue of Pallas. They are particularly characterised by grandeur and simplicity.

The third style was the graceful or beautiful. Lyssippus was, perhaps, the artist who introduced this style. Being more conversant than his predecessors with the flowing and beautiful lines of nature, he avoided the square forms which the masters of the second style had too frequently admitted. He was of opinion that the art ought rather to please than to astonish, and that the aim of the artist should be to raise admiration by giving delight. The artists who cultivated this style did not, however, neglect to study the sublime works of their predecessors. They knew that grace is consistent with the most dignified beauty; and they made use of the same features which those forms are enhanced by dignity. Grace is inspired into all the movements and attitudes of their statues. It appears in the delicate turn of the hair, and even in the adjusting of the drapery.

The last, or imitative style, is of an inferior degree of excellence to that which has just been mentioned. The great reputation of Praxiteles and Apelles raised an ardent emulation in their successors, who, desiring to surpass such illustrious masters, were satisfied with imitating their works. Every species of beauty of form appears to have been well known to the antients; and great as the ravages of time have been amongst the works of art, specimens are still preserved in which can be distinguished dignified beauty, attractive beauty, and a beauty peculiar to tender age. A specimen of dignified beauty, which Thoma says, was the most excellent model of infant beauty which antiquity has transmitted to us, is a satyr of a year old, which is preserved, though a little mutilated, in the Villa Albani.

Nor were the sculptors who represented these admirable productions of the human form, regardless of the drapery of their statues. They clothed their figures in the most proper stuff, which they wrought into that shape which was best calculated to give effect to their design.

The vestiment of the linen in Greece generally consisted of linen cloth, or some other light stuff, and in latter times of silk, and sometimes of woollen cloth. They had also garments embroidered with gold. In the works of sculpture, as well as in those of painting, one may discern the taste of the time by the transparency and small folds. The other light stuffs which were worn by the women, were generally of cotton, sometimes striped, and sometimes ornamented with a profusion of flowers. Silk was also employed; but whether it was known in Greece before the time of the Roman emperors, cannot easily be determined.

The vestiments of the Greeks, which deserve particular attention, are the tunic, the robe, and the mantle.

The tunic was that part of the dress which was next to the body. It may be seen in the Flora Parnese, and in the statues of the Amazons in the Capitol. The youngest of the daughters of Niobe, who throws herself into her mother's arms, is clothed only with a tunic. It was of linen, or some other light stuff, without sleeves, fixed to the shoulders by a button, so as to cover the whole breast. Some of the tunics of the goddess Ceres, and of comedians, have long straight sleeves.

The robes of women commonly consisted of two long pieces of woollen cloth, without any particular form, attached to the shoulders by a great many buttons, and sometimes by a clasp. They had straight sleeves, which came down to the wrists. The young girls, as well as the women, fastened their robe to their side by a cincture, fastened on the side in a knot; as it is still done in many parts of Italy. Sometimes these tunics were embroidered with a rose in shape, which has been particularly remarked in the two beautiful daughters of Niobe. In the younger of these, the cincture is seen passing over the shoulders.
and the back. Venus has two cineraria, the one passing over the shoulder, and the other surrounding the arm. The latter is the cestus so celebrated by the poets.

The mantle was called peplos by the Greeks, which signifies properly the mantle of Pallas. The name was afterwards applied to the mantles of the other gods, as well as to those of men. This part of the dress was not square, as some have imagined, but of a roundish form. The antients, indeed, speak in general of square mantles, but they received this shape from four tassels which were affixed to them: two of these were visible, and two were concealed under the mantle.

The mantle was brought under the right arm, and over the left shoulder; sometimes it was attached to the shoulder by two buttons, as may be seen in the beautiful statue of Lucullus at Villa Albani.

With respect to the head, women generally wore no covering but their hair; when they wished to cover their head, they used the corner of their mantle. Sometimes we meet with veils of a fine transparent texture. Old women wore a kind of bonnet upon their head, an example of which may be seen in a statue in the capitol, called the Prasina; but Wickenmann is of opinion that it is a statue of the Vestal Virgins. The covering of the feet consisted of shoes or sandals. The sandals were generally an inch thick, and composed of more than one sole of cork. Those of Pallas in Villa Albani have two soles, and other statues had no less than five.

But in no part of art are the Grecian sculptors more eminently excellent than in the general characteristic expression which they gave to their figures.

The most elevated species of tranquility and repose was studied in their figures of the gods. The father of the gods, and even inferior divinities, are represented without emotion or representation. But Jupiter is not always exhibited in this tranquil state. In a bas-relief belonging to the marquis Ron- di, he appears seated with a melancholy aspect. The Apollo, once called of the Belvedere, and representing the act of discharging from his bow the mortal shaft against the serpent Python, to express the action of a hero, the Grecian sculptors dedicated the countenance of a noble and attentive character representing his ganoes, and allowing no expression of pain to appear.

Philoctetes is introduced by the poets shedding tears, uttering complaints, and rending the air with his groans and cries; but the artist exhibits him silent, and bearing his pains with dignity; in the same manner as the Ajax of the celebrated painter Timonoma- chus was not drawn in the act of destroying the sheep which he took for the Grecian chief, but in the moments of reflection which succeeded that frenzy.

Illustrious men, and those invested with offices of dignity, are represented with a noble assurance and firm aspect. The statues of the Roman emperors (executed by Greek artists) resemble those of heroes, and are far removed from every species of inatten, in gesture, in the attitude, and action. They never appear with haughty looks, or with the splendor of royalty. None but captives are ever represented as offering any thing to them with bended knee.

The Greek works of ivory and silver were not always of a small size. The colossal bust of a man composed of these materials was twenty-six cubits high. It is indeed scarcely possible to believe that statues of such a size could entirely consist of gold and ivory. The quantity of ivory necessary to form a statue a foot broad in modern conceptions. M. de Pauc calculates, that the statue of Jupiter Olympus, which was 54 feet high, would consume the teeth of 300 elephants.

The Greeks generally heaved their marble statues so that when they afterwards worked the heads separately, and sometimes the arms. The heads of the famous group of Niope and her daughters appear to have been adapted to their bodies after being separately finished. It is proved by a large figure representing a river, which is preserved in Villa Albani, that the antients first heaved their statues roughly, before they attempted to finish any part. When the statue was received its perfect figure, they next proceeded to polish it with pumice-stone, and again carefully retouched every part with the chisel.

The amateurs, when they employed porphyry, usually made the head and extremities of marble, and then covered it with porphyry. There are four figures entirely composed of porphyry; but these are the productions of the Greeks of the middle age. They also made statues of basalt and alabaster.

The amateurs, as well as the moderns, made works in plaster; but no specimens remain except some figures in bas-relief, of which the most beautiful were found at Baiae, near Naples.

We have been thus minute in our account of the Grecian sculpture, because it is the opinion of the ablest critics, that modern artists have been more or less eminents, as they have studied with the greater or less attention the models left us by that ingenious people. Wickenmann goes so far as to contend, that the most finished works of the Grecian masters ought to be studied in preference even to the works of nature. The reason assigned by the abbe for his opinion is, that the fairest image of beauty are more easily discovered, and make a more striking and powerful impression, by their reunion in these sublime copies, than when they are scattered far and wide in the original of nature. Allowing, therefore, the study of nature the high degree of merit its so justly claims, it must nevertheless be granted, that it leads to true beauty by a much more tedious, laborious, and difficult path, than the study of the antique figures immediately to the artist's view the object of his researches, and combines in a clear and strong light the various rays of beauty that are dispersed through the wide domain of nature. By this means, the artist may be admitted, without great allowances for the peculiar creed of the writer.

Decline of Grecian sculpture.

When the restful genius of the Grecians, and the aggressive spirit of the Romans, are compared to the second thralom of the Greek states, and L. Mummius was directed to lay siege to Corinth, the capture of a city so famed as the repository of all that was most perfect in the arts, provoked the avarice of the conqueror; who, by transporting many of the most superb works of art to Rome, to grace his triumph, excited in his followers an ardour of possessing treasures of the same kind, as totally transferred the seat of the arts from Athens to the growing metropolises of the world.

Sicily, at the same period, had been ravaged by M. Sertorius, and Sparta by Mucrion and Varro; and Greece began to be exhausted of all it once boasted in art. Nor was the fate of the arts in Egypt more auspicious, whence, after the defection of Seleucus, they took refuge in the court of Attalus; but their security was short of short duration. On the death of Attalus, his territory devolved to the Romans; and the treasures of sculpture which adorned his palace, were also transferred to Rome.

Rome. After taking a view of the extinction of the arts in Greece, we may find some satisfaction in directing our minds to the introduction of them at Rome, and to the liberal encouragement which they have experienced even from their haughty and rapacious conquerors.

Petiles, a name which has been confounded with Praxiteles, was a native of Calabria; who, in a statue in the Capitol or of Roscius, the celebrated actor, as an infant lying in a cradle, and curiously, by a serpent, a situation of danger from which his nurse is said to have preserved him. Nearly about the same time, Archelaus and Evander were in great re-
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most exclusively, by Greek sculptors. Julius
Cæsar, who, in a private station, had
made an extensive collection of marbles, and
small figures in ivory and bronze; and who,
when dictator, dedicated them as a public
benefaction in the temple of Venus Genetrix;
may be said to have left the love of the arts
in the possession of the Roman.
Augustus, after he assumed the imperial
government, dispatched Memmius Regulus
to collect from every city of Greece the sta-
tues yet remaining in them. His orders were
so well observed, that the finest pieces of
sculpture were brought to Rome, with
precision by which his palaces were crow-
ed; and many were distributed in his
numerous villas. The Olympian Jupiter,
Phidias, composed of gold and ivory, was
placed on the only statue that escaped; the artists
of Greece asserting, that from the state of its
materials, it would not bear removal.
Augustus encouraged also the prevailing
mode of representing in statuary the most
distinguished characters of the age, and
placed many of their statues in public situa-
tions of eminence.
Succeeding emperors followed the ex-
ample of Augustus. We are informed by
Pausanius, that from the temple of Delphos
only, five statues were transported to Rome by
Nero, who also employed Zeuxoborus to cast
colossal statues of him in bronze 110 feet
high.
Nero, however, indulged the perverseness
of his taste in gilding, and otherwise disfigur-
ing, many of these exquisite works.
The triumphal arch built by Titus, and the
frieze in the temple of Minerva, built by Do-
mitian, give a very favourable idea of the
arts under those emperors.
In the sculpture of triumphal bas-reliefs
and trophies, the artist was particularly
eminent. The architectural plans adopted
by Trajan were of such magnitude, that men
of every kind of talents were invited to signal-
lize themselves under his munificent patro-
nage. His bridge over the Danube, his tri-
umphal arches, his monument of the column
which now bears his name, appear to have
given employment to all the powers
of human skill.
Under the auspices of Hadrian, the suc-
cessor of Trajan, the arts maintained a pro-
gressive degree of excellence. He was em-
ninently accomplished, not only as an admiral,
but was himself an artist. Every province
in Greece enjoyed his munificence; and the
temple of Jupiter at Athens, which he re-
stored, and that of Cyzicus, on the shores of
Propontis, which he built, were stupen-
dous monuments of imperial splendour. Hav-
ing for eighteen years been engaged in vi-
siting the most distant parts of the Roman
empire, he resolved to construct his villa at
Tivoli; in which, not only exact models of
the most celebrated buildings he had seen,
should be erected, but that they should be
furnished with originals, or the most copies,
of the most admirable statues. His correct
judgment in all works of art contributed more
to the absolute superiority of this collection,
thann the mere power of expending unlimited
treasures. Among these statues, erected by
Hadrian that the fashion of hav-
ing portraits in statuary was so generally ex-
tended amongst the noble and opulent citizens
of Rome. In his own villa at Tivoli were
placed, by him, these statues, not only of all his living, but of his de-
ceded, friends. Of his favourite Antonius,
in various characters, there are infinite re-
petitions. That most valued was found on
the Equiline hill, and was placed by Leo X. in
the Vatican, but it has lately been desolated
as Mercury, by the abate Visconti. Another
was found about 1770, in the Thermae Mar-
tani of Hadrian, near Ostia. It represents
Antinous in the mythological character of
Alcmane, in the labours of the collection of
the Lion J. Smith Barry, at Beaumont, in
Cheshire.
Some curiosity is excited to enquire
the names of those artists who were so con-
stantly employed, and so amply patronised,
by Hadrian. Those only of Aristeus, Papias,
and Zeno, occur on the plifths of fragments
discovered amongst the Tiburtine ruins.
We are now advancing rapidly to the de-
cline of sculpture among the Romans. Of
the two Antonines, M. Aurelius appears to
have been the greater friend of the arts. His
equestrian statue in bronze in the area of
the capitol, still defies the competition of the
modes last epoch. It includes the reigns of
Trajan, Hadrian, and the Antonines, and
terminates within that of Commodus. It was most remarkable for the
character and high-finishing of heads intended
as portraits, particularly of the imperial
busts, as of M. Aurelius, Commodus when
young, and of Lucius Verus.
A statue, said to be of that degenerate
monster Commodus, in the character of a
young Hercules, is in the Velverre; but the
superior style of the hair is a decisive proof,
according to the judicious Winckelmann, that
it is a genuine Hercules of much higher an-
tiquity.
But a far inferior state of sculpture, in
which none of its pristine elegance could be
raised, is apparent in the bas-reliefs of two
triumphal arches, erected at Rome in the
reign of Septimius Severus. The arts, how-
ever, cannot be supposed to have declined
in the sixth century, as the possession of the
artists who professed them; for many portraits
in marble, both of this emperor and his favour-
ite minister Plautinus, afford a convincing
proof, that the sculptors were many, yet
that the art was in a state of decadence.
The several authors who have pursued
this inquiry with the most ample and critical
investigation, are undecided in fixing the ex-
act period of the extinction of the arts at
Rome. Some allow no proofs of their ex-
istence later than the Gordians; and by
others they are extended to the reign of Li-
cinio Gallienus, in the 205th year of Chris-
tianity. Why the profession of the arts should,
in a great measure, cease, several causes
have been given; but the principal and most
obvious one is, that when Constantine deter-
minted to establish at Byzantium another ca-
pital of the Roman world, he pillaged the old
metropolis of its most valuable statuary, to
embellish a rival city. Those cities of Greece
also which were contiguous, supplied, of
course, an easy prey. Implied credit per-
haps is not to be given to an author of such
questionable veracity as Crusius; but from
him we learn, that Constantine had collected
the Olympic Jupiter of Phidias, the Galian
Venus of Praxiteles, and a colossal Juno, in
bronze, from her temple at Samos; not in
detail more of his catalogue. Those ac-
cording to Nicetas, were broken in pieces, or
melted down, at the surrender of the Eastern
empire, and its metropolis, in 1204, to the
French and Venetians. The four bronze
horses of the Capitol now in the church of
St Mark at Venice, were preserved from destruc-
tion, and transported in triumph.
From the reign of the first Byzantine
emperors, to the immediate successors of Theo-
dorus, we may perceive a ray of their former
fame, in the works of some Greek artists.
The historical columns of Arcadius now in no
very unequal estimation of those of Trajan
and Antonine at Rome. But from many
epigrams of the Antiquaries, it is evident that
able artists were to be found; and it may be
said to suppose, that such praise was not,
in every instance, extravagant or unmerited.
At the same time that Rome was laid waste
by the Goths, the works in bronze by the artists of Constantine were held in consider-
able estimation.
In the conclusion of his History of the De-
cline and Fall of the Roman Empire, the erudite Gibbon has given a perspicuous ac-
count of the causes to which the ruins of Rome may be ascribed.
During the fifteenth century, Petrarch and
Poggio, the celebrated Florentine rhetori-
cian and lawyer, very eloquently describe
the dilapidation by which they were sur-
rounded in their view of the imperial city.
After many centuries of injury sustained from
the Goths, the zeal of the primitive Christians,
the civil wars of her own nobility, and the
waste of materials, or the gradual decay of
time.
Poggio asserts, that six perfect statues
only remained, of all the former splendour
of the mistress of the world. Four were ex-
tant in the baths of Constantine; the others
were that now on the Monte-cavoile, and
the equestrian statue of M. Aurelius. Of
these, five were of marble; the sixth and last
is of bronze.
Poggio was the first collector of antique
sculpture, and from him the great Cosimo de
Medici acquired a passion for art, and
learned to enrich his cabinet with their pro-
ductions. His successors, with hereditary
emulation, exerted every power of wealth
and influence, to render that cabinet the
proud of Europe.
An investigation of the remains of Roman
grandeur, so long and sedulously pursued,
was rewarded by frequent discoveries of the
finest antique sculptures; and the artists of
the modern schools established at the Flo-
rence, gave the first proofs of their ingenuity
in restoring and adapting those precious frag-
ments.
Many curious particulars relative to the
discovery of antique statues in the sixteenth
century, may be found in Ficoroni, in an ac-
count by Flaminius Vaccar, printed at the
end of Nardini's Roma Antica, and in Mont-
facon. Several of these are also to be found
in Deyray's Anecdotes, from which many
parts of this account of the arts have been
selected.

Modern art of sculpture.
Of the sculptors of the modern school, the
first who are deserving of notice are Niccolo
Pilati, and his son Giovanni, whose works
in bas-relief became the principal ornaments of the cathedrals which were built in Italy in their time. They were born at Pisa, and flourished in the middle of the 13th century. To their names is to be added that of Niccolò dell'Arca.

To these succeeded Donatello, born at Florence, in 1386, whom an Italian author calls the reveiler of sculpture: and Lorenzo Ghiberti, celebrated for his admirable bas-reliefs in bronze on the gates of the Baptistery of St. John at Florence, of which Michael Angelo said, that they deserved to be the gates of Paradise. The compartments of these gates are filled with subjects taken from the Old Testament. The accompanying ornaments of fruits, flowers, &c. are of the most exquisite workmanish. The list of succeeding sculptors, in Tuscany, is very numerous. Those of the greatest celebrity are Michael Angelo Buonarroti, no less eminent in sculpture than in painting, Baccio Bandinelli; Niccolò called l'Ibrido; Gulielmo della Porta; Jacopo Sansovino; Annibale Fontana; Benvenuto Cellini; Mont Orcoli; &c. and many others.

To these is to be added the name of Propertia di Rossi distinguished as much by her misfortunes as her talents. Her history is singularly interesting, if the circumstances related to her are authentic.

Propertia di Rossi was born at Bologna, at the close of the fifteenth century. She was not only versed in sculpture, but had reached also no common excellence in music. Her first works were carvings in wood, and on peach-stones, eleven of which were in the museum of the marquis Grassi at Bologna, each representing on one side one of the apostles, and on the other several saints. In these minute attempts having gained universal applause, she then gave a public proof of her genius in a work of considerable importance, which she finished in marble, for the front of the cathedral of St. Petronius. A bust of count Guido Pepoli was likewise greatly admired, in which grace and architecture were equally familiar to her. With all these talents, and a fame unrivalled by her sex, Propertia was most unfortunate. In early life she had been married without sympathy, her affection being the sole one which her heart was totally insensible. While her health was daily yielding to despair, she undertook the bas-relief, representing the story of Joseph and Potiphar's wife, which forms the principal subject of the work above-mentioned, belonging to the church of St. Petronius. It was at once a monument of her hopeless passion, and of her admirable skill.

The juvenile talents of Michael Angelo were displayed in the imitation, first of Donatello, and next of the antique; but he soon formed his own distinct style, consistent with the character of his native genius. This style was, like his painting, invariably grand. His anatomical knowledge was at all times conspicuous, and the display of it sometimes exceeded the just bounds. His works in various cities of Italy are numerous. The principal ones are at Rome and Florence. In the former city, they are in the church of the Most Holy Name of Jesus, in the church of St. Peter in Vicinol, (which comprises the well-known statues of Moses) and the celebrated work of the Pieta, in a chapel in St. Peter's, are worthy of the highest admiration.

At Florence, his greatest work is in the crypt of St. Lorenzo, where he has placed the statues of the dukes Lorenzo and Giugliano Medici, together with four emblematic figures of Night, Day, Twilight, and Dawn. The superior genius of this great artist established the school of sculpture in Florence; and his influence a long period, little more than imitators of his style. But although they succeeded in giving to their figures an appearance of anatomical knowledge, they were far from equalling their great predecessor in the profound conception of the principles of art. They may of course all be considered as his inferiors in a line which he had marked out for them.

With the decline of the republic of Florence, the arts also sunk into decay, or took their flight to Rome, where Algarotti became the author of a new style, by studying to unite the effects of painting with those of sculpture, and thus desiring the real intent of his art; which is to imitate the forms, not the appearances, the effects, the latter being the province of painting.

By these means sculpture assumed, under the hands of Algarotti, a mannered air, which it has never since wholly lost.

One of the most extraordinary works of Algarotti, is a large bas-relief, placed over an altar in St. Peter's church; in which he has represented St. Peter and St. Paul in the air, availing by their presence the unyielding Attila, who was advancing to the attack of Rome. The principal figures in this singular work are of the highest relief; those which are supposed less to be front in mezzo-relieve; and in the others the degree of relief is proportionally diminished, until the most distant figures are only marked with a simple line. This was considered in his time as the masterpiece of the bas-relief, and Pope Innocent the Tenth rewarded the artist with a present of 30,000 Roman crowns.

To Algarotti succeeded Lorenzo Bernini, born in 1598, who, pursuing the track which Algarotti had begun, and distinguishing himself at an early age by extraordinary matu-

rity, and equalled in his own time the other rules than the indulgence of his own fancy, and sought celebrity from the flights of caprice and extravagance. His first group was Apollo and Daphne, at the moment that the nymph begins to exhibit the change from her natural form to that of the laurel-tree. The figures are remarkably light and graceful, and the fame which this work acquired for its author was of the most excessive degree.

His later works at Rome were the celebrated chair of St. Peter's church, the monument of the pope Urban the Eighth and Alexander the Seventh, the equestrian statue of Constantine, and the fountain in the Piazza Navona.

The sculptors who followed were the imitators sometimes of one, and sometimes of the other, of these two masters.

At the same period flourished Francois de la Quessoy, called Fiammingo, unrivalled in the beautiful and tender forms of his infantine style; and of the statue of Saint Simme, he proposed to imitate the simplicity of the antique; and succeeded (says Mengs) in imitating the superficial appearance, but not the essential maxims, of the antients.

Rusconi is the last sculptor worthy of particular notice, until the appearance of Antonio Canova, a Venetian, now living, and whose productions exhibit talents of a very extraordinary rank. Many accounts of his own have been found to be in the realms of modern travellers.

Of a date very little later than the revival of art at Florence, is the commencement of its cultivation in France. While Michael Angelo was disclosing his wonderful powers at Rome, under the patronage of and at the Tenth, Jean Goujon attracted the admiration of Paris, in the reign of Francis the First, and continued to receive it in that of Henry the Second. His name is frequently placed in competition with the sculptors of the Italian school. "The works of Goujon (says a French writer) recall to our view the simple and sublime beauties of the antique." His figures were however more esteemed on the continent for the elegance of their bas-reliefs than in the French school. The Fontaine des Saints Innocens, in the Rue St. Denis at Paris, is an instance of his merit in this kind; as is also the tribute, supported by Joseph Cardinal, at the Salle des Cent Suisses at the Louvre.

Girardon, born in 1628, was at once (like the preceding artist) a sculptor and architect. His works were admired for the correctness of design, and beauty of composition; and he was said by his countrymen to have produced chefs-d'oeuvres only. The magnificent mausoleum of cardinal Richelieu in the church of the Sorbonne, the equestrian statue of Louis the Fourteenth in the Place Vendome, and numerous statues and groups in the gardens of Versailles, are testimonials of his merit.

Contemporary in age and fame with Girardon, was Puget, born at Marseilles, in 1628, and denominated by Louis the Fourteenth "the inimitable." He studied from the age of 16 to 21, in Italy, where he distinguished himself equally for the quickness of his talents, and his extraordinary dexterity in them. Soon after his return to his own country, he was invited to Paris by M. Colbert, and executed there, among other works, the particularly the groups of Milo, and Andromeda rescued by Perseus, in the park of Versailles. His works are celebrated by the French for their elevated taste, correctness of drawing, nobleness of character, and the general the happy fertility of genius, his artistic disposition of drapery for the display of the form beneath it, is much admired. Puget's reputation was at its height when Bernini became eminent at Rome; and it is not more creditable to one than to the other of these sculptors, that when Louis the Fourteenth sent an invitation to Bernini to come to Paris, that artist replied, that the king of France had no occasion for his talents, while he had such a sculptor as Puget in his dominions.

The other countries on the continent having chiefly received the rudiments of art from the two already mentioned, have cultivated a similar taste in most of their works of sculpture. In France, however, have appeared worthy of high praise: and in modern days the names of Zaner in Vienna, Sergel in Stockholm, and Kosowski in Petersburg, stand high in estimation.
It is now requisite to turn our attention to England; where, although the early period of the Reformations have left memorials of the talents of our artists, the present school of sculpture is of a very recent date. From the time of the Reformation, the art of sculpture has been almost wholly in the hands of foreign artists. Cibber, Gibbons, Rysbrack, Scheemakers, Rolli and some others, were employed on all public occasions to the exclusion of native artists.

The principal works of Cibber are the statues on the front of Bedlam, some of our kings round the Royal Exchange, and others at Chatsworth and Cambridge. He was the father of the celebrated dramatic writer Colley Cibber.

Of Grinling Gibbons is a statue in bronze of James II. now in Scotland-yard, in the Roman costume. In minute ornaments, carved in wood, Gibbons has few equals. His works of that kind are frequent; some of the best are at Lord Egremont's at Petworth, Windsor, and the duke of Norfolk's at Holm Iacey. In the tower of Trinity-college, Oxford, are other striking proofs of his genius.

Rysbrack's first appearance in England was about the year 1720, when the statues of Paris, particularly Le Pâtre, Vancele, Bouchardon, and Le Gros, enjoyed the first reputation, and his many sculptures, whose invention was exhausted in the classical subject of the royal gardens. Wherever he acquired the elements of his art, he displayed talents of a masterly artist in England. His bronze statue of King William at Bristol, and his monument of bishop Hough in Worcester-cathedral, are counted among his superior works.

Some of the busts by his hand are; John Bahlol, king of Scots, at Bahol college; Alfred, at the university, finished by Wilton; Gibbs, the architect, in the Radcliffe library; Dr. R. Friend, archbishop Boulter, and probably the busts of George I. and II. at Christchurch.

Scheemakers left many valuable works; he was particularly the monument of our monarchical bard, in Westminster-abbey, procured him the greatest celebrity.

Rolli was a native of Lyons, a city which has given birth to several French sculptors; to Cassoveux, N. Coustou, and F. Amoureaux, the contemporaries of Rolli, and with some probability his fellow-scholar under Coustou. There is a want of simplicity in the works of this artist, from which the celebrated statue of Newton at Trinity-college, Cambridge, is by no means exempt. Mr. Nightingale's monument in Westminster-abbey, says Walpole, although finely thought and well executed, is more picturesque than sepulchral.

At Christchurch are fine busts of Dr. Matthew Lee, Dr. R. Frewen, and one of the Template of Phoebus.

Since the time of the foreign artists above mentioned, many eminent English sculptors have appeared, whose works are to be found in our churches and public buildings. Wilton, Nollekens, Banks, Bacon, Piazza, Wotton, and many others, are some of the most curious names of our modern school. Wilton executed some good monuments in Westminster-abbey; Nollekens has established a fane which has stood the test of a long life of constant practice, and remains undiminished.

The characteristic merits of Banks and Bacon are thus described by Mr. Hezze, in his Inquiry into the State of The Arts in England. "Banks was among those who most zealously sought the enlargement of professional knowledge in the stores of Rome. A mind ardently roused to competition with the works of excellence which he beheld, and a hand trained from infancy to a ready expression of thoughts, unfolded the capital part to his productions an air of ancient art. "Bacon's genius was of native growth; he traversed no distant regions for improvement of his art, but drew from the researches of others sufficient food for an active and ready fancy. His conceptions were quick and sparkling, his execution polished, and his whole work characteristically graceful."

The sculpture of Flaxman denotes a chaste and correct taste, founded on the most critical study of the works of Grecian art. W. V. F. Scheemacker is an able pupil of the Venetian Canova.

England also boasts her female sculptors. The Hon. Mrs. Damer, and the illustrous a test Sibbons, have shewn distinguished talents in art.

SCURVY. See Medicine, Vol. II. p. 135, col. 2.

SCUTAGE was antiently a tax imposed on such as held lands, &c. by knight's service, towards furnishing the king's army; hence scutago habenda was a writ that lay for the king, or other lord, against tenants holding by knight's service, to serve in person, or send a sufficient man in their room, or pay a certain sum, &c.

SCUTELLARIA, scull-cap, a genus of the gymnospermia order, in the cyphemimer class of plants, and in the natural method ranking under the 40th order, paramoet. The calyx is short, tubulated, has the mouth entire, and close after flowering. There are two species in Britain, the galericulata and minor. 1. Minor. The galericulata, blue scull-cap, or hooved willow-herb. It grows on the banks of rivers and lakes, is bitter, and has a garlic smell. 2. Minor, little red scull-cap, or willow-herb. The stalks are about eight inches high; the leaves are heart-shaped, oval; the flowers are purple. It grows in fields, and on the sides of lakes. There are fourteen other species.

SCUTTLES, in a ship, square holes cut in the deck, big enough to let the body of a man, seagreng to let people down into any room below upon occasion, or from one deck to another. They are generally before the main-mast, before the king in the forecast; in the gun-room, to go down to the stern-sheets; in the round-house, to go down into the captain's cabin, when forced by the enemy in a tight aloft. There are also some smaller scuttles, which have gratings over them; and all of them have covers that people may not fall down through them in the night.

Scuttle is also a name given those little windows and long holes which are cut out in cabins to let in light.

SCYLLARUS, a genus of insects, according to Fabricius, of the order aperta; but by the Linnean system it is ranked with the genera of the order venus molluscus. The generic character is, bill large, convex, sharp-edged, channelled at the sides, hooked at the point; nostrils naked, rounded at the base of the bill; tongue car- tilaginous, split at the point; feet climbing. There is but a single species, viz. the pata- nina, which inhabits New South Wales; the size of a crow, but from the length of the tail measures 26 inches long.

SEA, in a strict sense, signifies a large portion of water almost surrounded by land, as the Baltic and Mediterranean seas; but it is now usually understood for that vast body of water which encompasses the whole earth. See OCEAN.

What proportion the supericies of the sea bears to that of the land, cannot easily be given. But that the surface of our globe is equally divided between land and water, and that accordingly calculated the supericies of the sea to be 83,490,306 square miles. But it is now well known the earth is less than half a mile thick of the earth's surface. But of him believed the existence of a vast southern continent, which captain Cook has shewn to be visionary. It was this circumstance which misled him. Accordin to the theory of that great observer, it was, that hitherto made, the surface of the sea is to the land as three to one; the ocean, therefore, extends over 125,335,798 square miles, supposing the supericies of the whole globe to be 170,931,912 square miles. To ascertain the depth of the sea is still more difficult than its supericies; both on account of the numerous experiments which it would be necessary to make, and the want of proper instruments for that purpose. Beyond a certain depth the sea has hitherto been found inanesthetic; and though several ingenious methods have been contrived to obviate this difficulty, none of them has yet been able to approach. We know in general that the depth of the sea increases gradually as we leave the shore; but if this continued beyond a certain distance, the depth in the middle of the ocean would be prodigious. Indeed the numerous islands every where scattered in the sea do not seem to present the contrary, by showing us that the bottom of the water is equal like the land; and that, so far from uniformly sinking, it sometimes rises into lofty mountains. If the depth of the sea is in proportion to the elevation of the land, as has generally been supposed, its greatest depth will not exceed five or six miles; for there is no mountain six miles perpendicular above the lev- el of the sea. The sea has never been ac- tually sounded to a greater depth than a mile and sixty-six feet; every thing beyond that therefore rests entirely upon conjecture and supposition, which ought never to be admitted to doubt. The depth of the sea can be ascertained by experiment, because, when admitted, they have too often led to false conclusions. Along the coasts, where
the depth of the sea is in general well known, it has always been found proportional to the height of the shore: when the coast is high and mountainous, the sea that washes it is deep; when the coast is low, the water is shallow. Whether this proportionality holds at a distance from the shore, experiments alone can determine.

To calculate the quantity of water contained in the sea, while its depth is unknown, is impossible. But if we suppose with Buffon that it is the greatest part of a mile, the ocean, if its superincumbent waters are 128,233,759 square miles, will contain 32,038,030,75 cubic miles of water.

Let us now endeavour to compute the quantity of water which is constantly discharged into the sea. For this purpose let us take a river whose velocity and quantity of water are known, the Po, for instance, which, according to Riccioli, is 1000 feet (or 100 perches of Boulogne) broad, ten feet deep, and runs at the rate of four miles in an hour; consequently that river discharges into the sea, in an hour, 4,800,000 cubic miles of water.

A cubic mile contains 122,000,000 cubic perches; the Po therefore will take twenty-six days to discharge a cubic mile of water into the sea. Let us now suppose that it is not very far from the truth, that the quantity of water which the sea receives from the rivers in any country is proportional to the extent of that country. The Po from its origin to its mouth traverses a country 380 square miles, and the rivers which fall into it on every side rise from sources about sixty miles distant from it. The Po, therefore, and the rivers which it receives, water a country of 45,600 square miles. Now since the whole superficies of the dry land is about 42,745,253 square miles, it follows, from our supposition, that the quantity of water discharged by all the rivers in the world, in one day, is thirty-six cubic miles. If, therefore, the sea contains 32,038,030 cubic miles of water, it would take all the rivers in the world 2439 years to discharge an equal quantity.

It may seem surprising that the sea, since it is continually receiving such an immense supply of water, does not visibly increase, and at last entirely overflow the earth. But the surprise will cease, if we consider that the rivers themselves are supplied from the sea, and that they do nothing more than carry back those waters which the ocean is continually losing from it. Dr. Halley has demonstrated that the vapours raised from the sea and transported upon land are sufficient to maintain all the rivers in the world. The simplicity of this great process is astonishing: the sea not only communicates distant countries, and renders it easy to transport the commodities of one nation to another, but its waters rising in the air descend in showers to fertilise the earth and nourish the vegetable kingdom, and collecting into rivers flowing forth, give wealth and commerce along with them, and again return to the sea to repeat the same round.

As the sea covers so great a portion of the globe, we should not doubt, by exploring its bottom, discover a vast number of interesting particulars. Unfortunately, in the great part of the ocean this has hitherto been impossible. Part, however, has been examined; and the discoveries which this examination has produced enable us to form some idea at least of the whole. The ocean, as far as we can conjecture indeed beforehand, bears a great resemblance to the surface of the dry land, being, like it, full of plains, rocks, caverns, and mountains; some of which are abrupt and almost perpendicular, while others rise with a gentle declivity, and sometimes tower above the water and form islands. Neither do the materials differ which compose the bottom of the sea and the basis of the dry land. If we dig to a considerable depth in any part of the earth, we uniformly meet with rock; the same thing holds in the sea. The strata too are of the same kind, disposed in the same manner, and form indeed but one whole. The same kind of mineral and bituminous substances are also found intermixed with these strata; and it is to them probably that the sea is indebted for its bitter taste. Over these natural and original strata an arborescent vegetation has been formed, composed of different materials in different places. It consists frequently of muddy tertiary substances firmly cemented together, sometimes of shells or coral reduced to powder, and, in some places, it is generally composed of fine sand or gravel.

The ocean differs more in saltness in different climates towards the equator than nearer the poles. This seems to arise from the difference in quantity of water evaporated, in proportion to those which fall in rain. One pound of sea-water in the Baltic yields about a quarter of an ounce of salt; near Holland half an ounce; and in the British seas about two ounces. Boyle has also observed, that in places of great depth the water is saltest at the bottom. In the voyage made towards the north pole in 1773, it was found that the sea-water at the Nore contained not quite one thirty-sixth of salt; at the broad the mouth sands not quite one thirty-second; off Flamborough Head, rather more than one twenty-ninth; off Scotland, rather less than one twenty-ninth; latitude 74°, at sea, one twenty-ninth; latitude 78°, rather less than one twenty-eighth.

The cause of the saltness of the ocean has been a subject of investigation among philosophers in almost all ages, but it still remains in great obscurity. There can be little doubt that a large quantity of saline matter existed in this globe from the creation; and, at this day, we find immense beds of salt gin, or common salt, buried in the earth, particularly in Carmania; but whether these collections have been derived from the ocean, and deposited in consequence of the evaporation of its waters in certain circumstances; or whether the ocean was itself originally fresh, and received its salt from collections of saline matter situated at its bottom, or from that brought by the influx of rivers; cannot now be ascertained.

No accurate observations on the degree of saltness of sea-water exist in particular latitudes, as those made till the present century, and it is not possible, therefore, to ascertain what was the state of the sea at any considerable distance of time, nor, consequently, whether its degree of saltness increases, decreases, or is stationary. From differences among aquatic animals, however, some of which seem adapted to salt water, and some to fresh, it is probable, that both these states of water existed from the creation of the world. We find it true, that some kinds of fish thrive only in salt water, others in fresh: some in standing pools, and others in rapid currents.

That excellent philosopher and chemist, the bishop of Lundaf, has recommended a most simple and easy mode of ascertaining the saltness of the sea in any latitude; and as the language, in point of perspicuity and correctness, cannot be improved, we take the liberty of inserting it in his own words:

"As it is not every person who can make himself expert in the use of the common means of estimating the quantity of salt contained in sea-water, I will mention a method of doing which is so easy and simple, that every common sailor may understand and practise it, and which in a few minutes of time, if we suppose the temperature of the sea to be of a degree between 32° and 42°, enables me to determine the weight of the cloth above its original weight, which is the weight of the sea-water imbibed by the cloth; and the excess of the weight of the cloth after being dried, above its original weight, is the weight of the salt retained by the cloth; and by comparing this weight with the weight of the sea-water imbibed by the cloth, we obtain the proportion of salt contained in that species of sea-water."

"Whoever undertakes to ascertain the quantity of salt, contained in sea-water, either by this or any other method, would do well to observe the state of the weather preceding the time when the salt of the sea, for the quantity of salt contained in the sea near the surface may be influenced both by the antecedent moisture and the antecedent heat of the atmosphere."

Whether the sea is saltier or not at different depths, notwithstanding Mr. Boyle’s observations before quoted, has not yet been properly ascertained; but that its temperature varies considerably in proportion to the depth we have already seen. With respect to the temperature," says bishop Watson, "of the sea at different depths, it seems reasonable enough to suppose, that in summer time it will be hotter at the surface than at any considerable depth below it, and that in winter it will be colder."

"Mr. Wales describes the instrument he made use of for trying the temperature of the sea at different depths, in the following terms: ‘On the 12th of June, I tried the sea-water at different depths connected with a wooden tube of about eighteen inches long and three inches externally. It was fitted with a valve at the bottom, and another at the top, and had a contrivance for sus-
pend the thermometer exactly in the middle of it. When it was used it was fastened to the deep sea-line, just above the lead. To this they fastened a piece of wax so that the water had a free passage through it, by means of the valves which were then both open; but the instant it began to be drawn up, both the valves closed by the pressure of the water, and of course the thermometer was brought up in a body of water of the same temperature with that it was let down to. With this instrument, which is much the same with one formerly described by Mr. Boyle, in his observations about the saltness of the sea water was fetched up from different depths, and its temperature accurately noticed, in different seasons and latitudes.

August 27, 1775, south latitude 24°. 40'. The best of the air was 32°; of the water at the surface 7°—of water from the depth of 40 fathoms 68. 47°, 29'.

December 27, 1772, south latitude 58°, 21'. The best of the air was 31°—of the water at the surface 32°—of water from the depth of 160 fathoms 33°. 47°, 29'.

In the voyage to the high northern latitudes before mentioned, they made use of a bottle to bring up water from the bottom, which is thus described:—"The bottle had some corking of the vessel, three inches thick, which was wrapped up in an oiled skin, and let into a leather purse, and the whole enclosed in a well-pitched canvas bag, firmly tied to the mouth of the bottle, so that not a drop of water could penetrate to its surface. A bit of lead shaped like a cone, with its base downwards, and a cord fixed to its small end, was put into the bottle; and a piece of valve leather, with half a dozen slips of thin bladder, were strung on the cord, which, when pulled, effectually corked the bottle on the inside. We have here put down two of the experiments which were made during that voyage.

August 4, 1773, north latitude 80°. 30'. The best of the air was 32°—of the water at the surface 36°—of water fetched up from the depth of 60 fathoms under the ice 39°. 44°, 42'.

September 4, 1773, north latitude 63°. The best of the air was 66°—of the water at the surface 55°—of water from the depth of 683 fathoms 40°.

It appears from all these experiments that, when the atmosphere was hotter than the surface of the sea, the superficial water was hotter than that at a considerable distance below it.

Sea-water may be rendered fresh by freezing, which excludes or precipitates the saline particles; or by distillation, which leaves the salt in a mass at the bottom of the vessel. Upon these principles, a mode of obtaining a supply of fresh water at sea was recommended some years ago to the admiralty, by Dr. Irving. It consisted in only adapting a tin tube of suitable dimensions to the lid of the commodore's kettle, and condensing the steam in a hogshen which served as a receiver. By this mode a supply of twenty-five gallons of fresh water per hour might be obtained from the kettle of one of our ships of war.

The sea shall be open by the laws of England, to all merchants. The main sea Beneath the low-water mark, and round England, is part of England, for there the admixture is deep.

SEALT, is either in wax, impressed with a device and attached to decals, &c. or the instrument with which the wax is impressed. Sealing of a seal, is an essential part of it; for if a writing is not sealed, it cannot be a deed.

SEALER, an officer in chancery, appointed by the lord chancellor or keeper of the great seal, to seal the writs and instruments there made in his absence.

SEALING, in architecture, the fixing a piece of wood or iron in a wall with plaster, mortar, cement, lead, and other solid binding.

SEAMEN, by various statutes, sailors having served the king for a limited time, are free to use any trade or profession, in any town of the kingdom, except in Oxford or Cambridge.

By 2 Geo. II. c. 36, male adult by 2 Geo. III. c. 31, no master of any vessel shall carry to sea any seaman, his own appren
tices excepted, without first entering into an agreement with such seaman for his wages, such agreement to be made in writing, and to the receipt whereof the seaman is to sign; but such agreement shall not be enforced by a penalty of ten pounds for each master carried to sea without such agreement, to be forfeited by the master to the use of Greenwich-hospital. This agreement is to be signed by each master within three days after entering on board such ship, and is, when executed, binding on all parties.

SEAM or SEAM of CORN, IS A MEASURE OF EIGHT BUSHELs.

SEAM of GLASS, the quantity of 120 pounds, or 24 stones each five pounds weight. The seam of wood is a horse-load.

SEAMS of a ship, are places where her planks meet and join together. There is also a kind of peculiar seam in the sowing of sails, which seam of a sail is the round seam, so called from its being round like the common seams.

SEARCHER, an officer of the customs, whose business it is to search and examine all ships outward-bound, to see whether they have any prohibited or uncustomed goods on board.

SEASIN, OR SEASING, in a ship, the name of a rope by which the boat rides by the ship's side when in the harbour, &c.

SEBATS, as the sebacid acid was, strictly speaking, unknown till the late experiments of Thénard, the description of the sebacids published by former chemists cannot be admitted as exact till they are verified by a new examination. These acids of course are unknown, if we except the few facts point
ed out by Thénard. This chemist, however, has announced his intention of publishing a detailed account of them.

1. When sebacid acid is dropped into barytes water, lime water, or straw-wax water, it does not remain in solution. Hence we learn, that the sebacin of the alkaline earths are soluble in water.

2. The alkaline sebacids are likewise soluble.
are four species: the villum, orientale, cretizum, and ceratizum. The villum, or wood-rye-grass, is distinguished by a calyx with wedge-shaped scales, and by the fringe of the glume being woolly. The glumes of the orientale are large, and the two calyces are sharp, and thick, and the glumes of the cretizum are fringed on the outside. The cretizum, or common rye, has glumes with rough fringes. It is a native of the island of Cantia, was introduced into England many ages ago. It is the only species of rye cultivated in this kingdom. There are, however, two varieties, the winter and spring rye.

The winter rye, which is larger in the grain than the spring rye, is sown in autumn at the same time with wheat, and is sometimes mixed with it; but as the rye ripens sooner than the wheat, this method must be very exceptionable. The spring rye is sown along with the oats, and usually ripens as soon as the winter rye; but the grain produced is lighter, and it is therefore seldom sown except where the autumnal crop has failed.

Rye is commonly sown on poor, dry lime-ground, where it will not thrive. By continuing to sow it on such a soil for two or three years, it will at length ripen a month earlier than that which has been raised for years on strong cold ground. Rye is commonly used for bread, or bread alone or mixed with wheat. This mixture is called medlin, and was formerly a very common crop in some parts of Britain. Mr. Marshall tells us, that the farmers in Yorkshire believe that a crop of rye will not affect the yield of barley, and that a small quantity of rye sown among wheat will prevent this destructive disease. Rye is much used for bread in some parts of Sweden and Norway by the poor people. About a century ago rye bread was also much used in England; but being made of a black kind of rye, it was of the same colour, clumsy, very disgusting, and consequently not so nourishing as wheaten.

Rye is subject to a disease which the French call crest, and the English horned rye; which sometimes happens when a very hot summer succeeds a rainy spring. According to this rye produces an irregular vegetation in the middle substance between the grain and the leaf, producing an excrecence of a brownish colour, about an inch and a half long, and two tenths of an inch broad. A bread made of this kind of rye has a nauseous acrid taste, and produces spasmodic and gorging disorders.

SECEANT, in geometry, is a line that cuts another, and divides it into two parts. See TRIGONOMETRY.

SECHUM, a genus of the syngenesa order, in the monocot class of plants; and in the natural method ranking under the 34th order, caccizizacem. The male calyx is quinquedentate and monopetalous; the corolla monopetalous; the five filaments are united in an erect tube. In the female flower the pistillum is cylindrical and crest; the stigma large, petal-shaped, and pedicelled; the pericarpium ovate, plano-convex, fleshy, and unilocular, containing one seed, which is smooth, compressed, and fleshy. Of this there is only one species, viz. the caulís, or chiloche vine. This is cultivated and grows very luxuriantly in many places in Jamaica. The vines run and spread very much. The fruit is boiled, and served up at table by way of greens; and the root of the old vine is somewhat like a yam (dioscorea), and on being boiled or roasted tastes farinaceous and wholesome.

SECOND, in geometry, chronology, &c., the sixtieth part of a prime or minute, whether of a degree, or of an hour: it is denoted by two small dots, thus (\(\cdot\)).

SECOND, in music, an interval of a joint degree. There are four kinds of seconds. The diminished second, containing four commas; the minor second, consisting of five commas; the major second, consisting of nine commas; and the redundant second, composed of a whole tone and a minor semitone.

SECONDARY, in general, something that acts as second, or in subordination to another. Secondary circles of the sphere, are circles passing through some great circle; thus the meridians and hour-circles are secondary to the equinoctial.

There are also secondaries passing through the poles of the eclipse, by means of which all stars are referred to the ecliptic.

SECONDARY, an officer who is second, or next to the chief officer; as the secondaries to the prothonotaries in the courts of B. R. and C. B.

SECRETARY, an officer who by his master's orders writes letters, dispatches, and other instruments, which he renders fit for the use of his master. Of these there are several kinds: as 1. Secretaries of state, who are officers that have under their management and direction the most important affairs of the kingdom, and are obliged constantly to attend on the king; they receive and dispatch whatever comes to their hands, either from the crown, the church, the army, private grants, pardons, dispensations, &c., as likewise petitions to the sovereign, which when passed, they dispatch according to the direction of the king in council. They have authority to commit persons for treason, and other offences against the state, as conservators of the peace, and the justice of the peace throughout the kingdom. They are members of the privy and cabinet council, which is seldom or never held without one of them being present; and as the business and correspondence in all parts of this kingdom, it is managed by the secretary for the home department. With respect to foreign affairs, the business is in the foreign office. There has been lately established a secretary of state, who is the chief officer, and must not be confounded with the secretary at war. The secretaries have each two under-secretaries, and one chief clerk. To the secretaries of state belong the custody of that seal properly called the signet, and the direction of two other offices, one called the paper-office, and the other the signet-office. See PAPER-OFFICE and SIGNET-OFFICE.

2. Secretary of an embassy, a person attendant on the diplomatic dispatches relating to the negotiation. There is a great difference between the secretary of an embassy, and the ambassador's secretary; the last being a domestic or ministerial of the former, and the first a servant or minister of the prime. 3. The secretary at war, an officer of the war-office, who has two chief clerks under him, the last of which is the secretary's messenger. There are also secretaries in most of the other offices.

SECRETION, in the animal economy, the separation of some fluid mixed with the blood by means of the glands. See PHYSIOLOGY.

SECRETIONS, morbid. In different diseases to which the annual body is subject, various fluids make their appearance which did not previously exist, at least under the forms which they assume. Thus in the dropsy the cellular substance, frequently the cavities of the head, breast, and abdomen, are filled with a whitish liquid. Where any part of the skin is irritated into a blister, the interval between the cuts and cuticle is filled with a transparent fluid; and when any part of the muscles or skin is wounded, the ulcer is soon covered with a matter called pus. See PUS.

A thin sinews exudes from cancers and cutaneous sores. The liquor of the dropsy is found upon examination to agree almost exactly with the urine. The liquor of blisters is composed also of the same constituents as the serum of blood; from 200 parts has been obtained by chemical analysis:

<table>
<thead>
<tr>
<th>Substance</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Murate of soda</td>
<td>40%</td>
</tr>
<tr>
<td>Carbonate of soda</td>
<td>30%</td>
</tr>
<tr>
<td>Phosphate of lime</td>
<td>12%</td>
</tr>
<tr>
<td>Other</td>
<td>28%</td>
</tr>
</tbody>
</table>

SECTION, in geometry, denotes a side or surface appearing of a body or figure cut by another; or the place where lines, planes, &c., cut each other.

The common section of two planes is always a right line; being the line supposed to be drawn on one plane by the section of the other, or by its entrance into it.

SECTION of a building, in architecture, is the same with its profile; or a delineation of its heights and depths raised on a plan, as if the fabric was cut asunder to discover its inside.

SECTIONS, conic, in geometry. See CONIC SECTIONS.

SECTOR, in geometry, is a part of a circle, comprehended between two radii and the arc; or it is a mixed triangle, formed by two radii and the arch of a circle.

SECTOR, See INSTRUMENTS MATHEMATICAL.

SECDUNDINES. See MIDWIFERY.

SECURIDAGA, a plant belonging to the class of daphniphyllum, and to the order of oleaceae. The calyx has three leaves, which are small, deciduous, and coloured. The corolla is papilionaceous. The vexillum, consisting of two petals, is oblong, straight, and conjoined to the carina at the base. The carina is of the same length with the ala. The legumen is ovated, unilocular, monopetalous, and ending in a legulated ala. There are three species. The erectus has an upright stem; the scandens is a climbing plant, and is a native of the West Indies.

SECUTORES, in antiquity, a kind of gladiators among the Romans, who fought against the retiarii. The scutatores were armed with a sword and buckler, to keep off the net or gauze of the retiarii, and they wore a cask on their head.

SE DEFENDENDO, in law, a plea used for him that is charged with the death of another, by alleging that he was under a necessity of doing what he did in his own defense, that the other asstitted him in such a manner, that if he had not done what he did, he must have been in hazard of his own life. But here the danger must appear so great, as to be inevitable. See Homicide.

SEDITION, among civilians, is used for a malicious commotion of the people, or an assembly of a number of citizens without lawful authority, tending to disturb the peace and order of the society. This offense is of different kinds: some seditions more immediately threatening the supreme power, and the subversion of the present constitution of the state; others tending only towards the re- dress of private grievances. Among the Romans, therefore, it was variously punished, either by banishment, or by the tending threatened greater mischief. See lib. i. Cod. de Sedition, and Mat. de Crim. lib. ii. n. 5. de Leva Majestate. In the punishment, the authors and ring-leaders were justly distinguished from those who, with less wicked intentions, joined and made part of the multitude.

The same distinction holds in the law of England and in that of Scotland. Some kinds of sedition in England amount to high treason, and come within the stat. 23 Edw. III, as levying war against the king. And several seditions are mentioned in the Scotch acts of parliament as treasonable. Hayne's Crim Law of Scotland, p. 33, 34. The law of Scotland makes riots and tumultuous assemblies a species of sedition. But the law there, as well as in England, is now chiefly regulated by the riot act, made 1 Geo. I. only it is to be observed, that the proper officers in Scotland, to make the proclamation thereby enacted, are sheriffs, stewards, and bailies of regalities, or their deputies; magistrates of royal boroughs, and all other inferior magistrates; high and petty constables, and the officers of the peace, in any county, earldom, city, or town. And in that part of the island, the punishment of the offence is any thing short of death which the judges, in their discretion, may appoint.

SEDUM, orgine, a genus of the pentaphylaceous order, in the decandria class of plants; and in the natural method ranking under the 13th order, succulenta. The calyx is quincuncal; the corolla is pentatetabolous, pointed, and spreading; there are five nectariferous squamae, or scales, at the base of the gernon. The capsules are five.


All these species of sedum are hardly hardy succulent perennials, durable in root but mostly annual in stales, &c. which, rising in spring, flower in June, July, and August, in different sorts; the flowers consisting universally of five spreading petals, generally crowning the stalks numerously in cory- bone and cyrnum bunches and spikes, appearing telescopically, and are succeeded by plenty of seeds in autumn, by which they may be propagated, also abundantly by part- ing the roots, and by slips or cuttings of the stalks in summer; in all of which methods the plants are very rapid, and spread very fast into tilled banches; being all of succulent growth, they consequently delight most in dry soils, or in any dryishy earth.

As flowering plants, they are mostly employed to embellish rock-work, ruins, and other places where the hardy flowers, or those which require a more rigorous sort of soil, are planted, either the roots or cuttings of the shoots in a little mud or any moist soil at first, placing it in the crevices, where they will soon root and fix themselves, and spread about very agreeably. For economical purposes, the rosemum and rape are cultivated in Holland and Germany, to mix with lettuce in salad. The wall-pepper is so acrid, that it blister the skin when applied externally. Taken inwardly, it excites vomiting. In scarbotic cases and quinsy, it is said to be an excellent medicin under proper management. Goats eat it; cows, horses, sheep, and swine, refuse it.

SEED. See Plants, Physiology, and Genus.

SEELING, at sea, is used in the same sense as earlier with heading: when a ship lies down constantly, or steadily on one side, the seaman say, she heels; and they call it seeling when she tumbles violently and suddenly, by the sea Forsaking her, as they call it, that the waves, planting either the roots or cuttings of the shoots in a little mud or any moist soil at first, placing it in the crevices, where they will soon root and fix themselves, and spread about very agreeably. For economical purposes, the rosemum and rape are cultivated in Holland and Germany, to mix with lettuce in salad. The wall-pepper is so acrid, that it blister the skin when applied externally. Taken inwardly, it excites vomiting. In scarbotic cases and quinsy, it is said to be an excellent medicin under proper management. Goats eat it; cows, horses, sheep, and swine, refuse it.

SEGMENT of a circle. See Geome- try.

Segment of a sphere, is a part of a sphere terminated by a portion of its surface, and a plane which cuts it off, passing some where on the sphere, and cuts the surface of the sphere. The segment of the diameter of the sphere is equal to four of its great circles; or four circles of the same diameter; so the surface of any segment is equal to four circles on a diameter equal to the chord of half the arc of the segment. So that if d denotes the diameter of the sphere, or the chord of half the circumference, and c the chord of half the arc of any other segment, also a the altitude or versed sine of the same, then,

\[ 3.1416d^2 \] is the surface of the whole sphere, and

\[ 3.1416c^2 \text{ or } 3.1416d \text{ or } 3.1416m^2 \text{ the surface of the segment.} \]

For the solid content of a segment, there are two rules usually given; viz. 1. To three times the radius of the square of its base, add the square of its height, multiply the sum by \( \pi \) the product by .5236. Or, 2. From three times the diameter of the sphere, subtract twice the height of the frus- tum; multiply the remainder by the square of the height, and the product by .5236.

That is, in symbols, the solid content is either \[ \frac{3.1416 \times 3r^2 + \pi}{4} \text{ or } = \frac{3.1416 \times 3d^2}{4} \]

That is, in symbols, the solid content is either \[ \frac{3.1416 \times 3r^2 + \pi}{4} \text{ or } = \frac{3.1416 \times 3d^2}{4} \]

SEGRERIA, in botany, a plant belonging to the class of polyandria and the order of monogynya. The calyx is petaliphiolous, the sepals are four, colored, and permanent; there is no corolla. The capsule is oblong and monospermous, the large ala terminating in small lateral sze. There are two species, the Americana and 'Mouria.

SEIGNORY, dominium, in our law, is used for a manor or lordship of a seigneur, or lord of the fief or manor.

SEIGNORAGE, signifies the right, or due belonging to a seigneur, or lord; but it is particularly used for a duty belonging to the prince, for the coming of money, called also rebours; which under our ancient kings was five shillings for every pound of gold brought in the mass to be coined, and a shilling for every pound weight of silver. At present the king claims no seignorage at all, but the crown agrees, it is said to be an excellent medicin under proper management. Goats eat it; cows, horses, sheep, and swine, refuse it.

SEINIS, in law, signifies possession. Sei- is two-fold; sein in law, and sein in fact. Sein in law, when an actual possession is taken; sein in law, when something is done which the law accounts a seinin, as an enrolment.

SEIZE, SEIZE, or SEIZE, in the sc- language, is to make fast, or bind, particularly to fasten two ropes together, with rope-yarn. The seizing of a boat is a rope tied to a ring, or little chain in the foreship of the boat, by which means it is fastened to the side of the ship.

SEIZURE, in commerce, an arrest of any merchandise, movable, or other matter, either in consequence of some law, or of some express order of the sovereign. Con- tradand goods, those fraudulently entered, or landed without entering at all, or at wrong places, are subject to seizures, arranged in seizures, among us, one half goes to the informer, and the other half to the king.

SELAGO, a genus of the angiospermae order, in the dicynemia class of plants; and in the natural method ranking under the 44th or- der, aggregate. The calyx is quincuncial: the tube of the corolla capillary, with the limb nearly equal, and a single seed. There are 20 species.

SELENITIC, in chemistry. See Sul- phate of Lime.

SELENITES, in natural history, the name of a large class of fossils, the characters of which are these: they are bodies composed of slender and single visible filaments, arranged into fine, even, and thin flakes; and those disposed into regular figures in the several dif- ferent genera, approaching to a rhomboid or hexagonal column, or a rectangular parallelo- gram; filis, like those tales, but they not traversed, or occasionally placed in a perpen- dicular direction; they are flexible in a small degree, but not at all elastic; they do not ferment with acid menstrua, but readily calci- cine in the fire. Of this class there are se-
VEN orders of bodies, and under those ten genera. The solenite of the first order are those composed of horizontal plates, and approximating to a rhomboidal form; of the second order, those composed of two columns and a triangular form; of the third are those whose filaments are scarce and arranged in plates, but which, in the whole mass, appear rather of a striated than of a radiated structure, and of the fourth order, but of no determinately angular figure; of the fifth are those formed of plates perpendicularly arranged; of the sixth are those composed of confronting plates, arranged into the figure of a star; and of the seventh are those of a complex and indeterminately figure.

The structure of the solenite of all the genera of the first order is exactly alike; they are all composed of a great number of broad flake plates or in a great measure externally resembling the flakes of the foliaceous genera; these are of the length and breadth of the whole mass; the top and bottom being each only one such plate, and those between them, in like manner, each complete and single; and the body may always be easily and evenly split up into flakes by a single blow. These flakes differ, however, extremely from the talus; for they are each composed of a number of parallel threads or filaments, which are usually disposed parallel to the sides of the body, though sometimes parallel to its ends. In many of the species they are also divided by parallel lines, placed at a considerable distance from each other, and the plates in splitting often break at these lines; these lines are not of any permanent elastic, and that they readily calcine. The structure of those of the second is the same with that of the first; but that in many of the specimens of them, the filaments of which the plates are composed run in two directions, and meet in an obtuse angle; and in the middle there is generally seen in this case a straight line running the whole length of the column; and small parcels of clay insinuating themselves into the cracks, representing it, the figure of grass so naturally, as to have deceived many into a belief that there was really an ear of grass there. The other orders consist only of single genera, the structure of each of which is a distinct and generic name. See Plate Nat. Hist. fig. 359.

S. E. L. E. U. C. I. D. E., in chronology: ara of the Seleucidae, or the Syro-Maccabonian ara, is a computation of time, commencing from the establishment of the Seleucidae, a race of Greek kings, who reigned as successors of Alexander the Great, in Syria, as the Ptolemies did in Egypt. This ara we find expressed in the book of Maccabees, and on a great number of Greek medals, struck by the cities of Syria, &c. The rabbins call it the ara of contracts, and the Arabi therik dikarum, that is, the ara of the two horns. According to the best accounts, the first year of this ara falls in the year 314 before Christ, being twelve years after Alexander's death. See SEL-TAR.

SELF, the name vulgaris of Linnaeus. The stem erect, and about eight or ten inches high. The leaves grow on foot-stalks, are ovato-oblong, slightly indented, and somewhat hairy. The bracteae are heart-shaped, opposite, and fringed. The flowers are white, or purplish, grow in dense spikes, and are terminal. This plant is perennial, grows wild in meadows and pasture-grounds, and flowers in June and July. This herb is recommended as a mild restorative and vulnerary in spittages, ulcers, and other febrile complaints, and those that arise in gargarisms against aphthae and inflamations of the fauces. Its virtues do not appear to be very great; to the taste it discovers a very slight astringency or bitterishness, which is more sensible in the flower top than the leaves.

S. E. L. I. N. U. M., a genus of the digynia order, in the pentandria class of plants; and in the natural method ranking under the 45th order, umbellate. The fruit is oval, oblong, compressed, plane, and straited in the middle; the involucrum is reduced; the petals cordate and equal. There are nine species, the sylvestre, palustre, austriacum, carulofila, chabrand, samii, spinosa, sibiricum, and decanton.

SELL, in building, is of two kinds, via ground-sell, which denotes the lowest piece of timber, in a timber building, and that on which the whole superstructure is raised; and the window-sell, called also window-sell, is the bottom pli of the window.

SELLA QUINCA. See Anatomy.

S. E. L. Z. E. R. W. A. T. E. R. See Waters, MINERAL.

SEMECARPUS, a genus of the trigyna order, in the pentandria class of plants. The corolla is quinquepalata; the drupa is heart-shaped, celiolous, and monospermon. There is but one female flower.

SEMEM, a substance prepared by nature for the reproduction and conservation of the species both in animals and plants. The peculiar liquid secreted in the testes of males, and destined for the impregnation of females, is known by the name of semen. The human semen alone has hitherto been subjected to chemical analysis. Nothing is known concerning the seminal fluid of other animals. Vauquelin published an analysis of the human semen in 1783.

Semen, when newly ejected, is evidently a mixture of two different substances: the one, fluid and milky, which is supposed to be secreted by the prostate gland; the other, which is considered as the true secretion of the testes, is a thick milky substance, in which numerous white shining filaments may be discovered. It has a slight disagreeable odour, an acid irritating taste, and its specific gravity is greater than that of water. When rubbed in a mortar it becomes frothy, and of the consistence of pomatum, in consequence of its enveloping a great number of air-bubbles. It converts paper stained with the blossoms of mallows or violets to a green colour, and consequently contains an alkali.

As the liquid cools, the mucilaginous part becomes transparent, and acquires greater consistency; but in about twenty minutes after its emission, the whole becomes perfectly liquid. This liquefaction is not owing to the absorption of moisture from the air, for it loses instead of acquiring weight during its exposure to the atmosphere; nor is it owing to the action of the air, for it takes place equally in close vessels.

Semen is insoluble in water before this spontaneous liquefaction, but afterwards it dissolves readily in it. When alcohol or oxymuratic acid is poured into this solution, a number of white flakes are precipitated. Concentrated alkales facilitate this action with water. Acids readily dissolve the semen, and the solution is not decomposed by alkales; neither is the alkaline solution decomposed by acids.

Semen decomposes no ammonia from fresh semen; but in the interval of two days煮, it loses in a moist and warm atmosphere, lime separates a great quantity from it. Consequently ammonia is formed during the exposure of semen to the air.

When oxymuratic acid is poured into semen, a number of white flakes precipitate, and the acid loses its peculiar colour. These flakes are in soluble in water, and even in acids. If the quantity of acid is sufficient, the semen acquires a yellow colour. Thus it appears that semen contains a mucilaginous substance analogous to that of the tears, which combines with absorbing oxygen. M. Vauquelin obtained from 100 parts of semen six parts of this mucilage.

When semen is exposed to the air about the temperature of 60º, it becomes gravely, covered with a transparent film; and in three or four days deposits small transparent crystals, often crossing each other in such a manner as to represent the spokes of a wheel. These crystals, when viewed through a microscope, appear to be four-sided prisms, terminated by very long four-sided pyramids. They may be separated by diluting the liquid with water, and decanting it off. They have all the properties of phosphat of lime. If, after the appearance of these crystals, the semen is still allowed to remain exposed to the atmosphere, the pellicle on its surface gradually thickens, and a number of white round bodies appear on different parts of it. These bodies also are phosphat of lime, prevented from crystallizing regularly by the too rapid abstraction of moisture. M. Vauquelin found that 100 parts of semen contain three parts of phosphat of lime. If at this period the exposure to the air becomes moist, other crystals appear in the semen, which have the properties of carbonat of soda. The evaporation does not go on to complete exsiccation, unless at the temperature of 77º, and when the air is very dry. Then, if the moisture is evaporated, the semen has lost 97 per cent of its weight; the residue is semitransparent like horn, and brittle.

When semen is kept in very moist air, at the temperature of about 77º, it acquires a yellow colour, like that of the yolk of an egg; its taste becomes acid, it exaltes the odour of putrid fish, and its surface is covered with abundance of the byssus septica.

When dried semen is exposed to heat in a crucible, it melts, acquires a brown colour, and exaltes a yellow fume, having the odour of burnt horn. When the heat is raised, the matter swells, becomes black, and gives out a strong odour of ammonia. When the odour of ammonia is dispelled, if the matter is immersed with water, an alkaline solution may be obtained, which, by evaporation, yields crystals of carbonat of soda. M. Vauquelin found that 100 parts of semen contain one part of carbonat of soda. If the part of soda is increased, there will remain only a quantity of white ash, consisting of phosphat of lime.
Thesit appears that some is composed of the following ingredients:

1. Water 6
2. Mucilage 6
3. Phosphat of lime 3
4. Soda 1
5. Mucilage

Semen ed. See Botany; and Plants, physiology of. With respect to number, plants are either furnished with one seed, as sea-plant and bistor, two, as wood-rood, and the umbelliferous plants; three, as spurge, four, as the lip-flowers of Touchwoods, and rough-leaved plants of Raya, or many, as ranunculus, azalee, and poppy. The form of seeds is likewise extremely various, being either large or small, round, oval, heart-shaped, kidney-shaped, angular, prickly, rough, hairy, wrinkled, smooth, or shining, black, white, or brown. Most seeds have only one cell or internal cavity; those of leger burdock, valerian, lamb's lettuce, carilton, sebaste, and sebastian, have two. With respect to posture, seeds are either soft, membranaceous, or of a hard bony substance; as in gnowell, umbilic, and all the nuciferous plants. In point of magnitude, seeds are either very large, as in crocus, or very small, as in campyllum, amnium, ranipong, and troughatoe.

With respect to situation, they are either dispersed promiscuously through the pulp (semen nudulenta), as in water-lily; allied to a stipe or stem of the vallaria, the seed-vessel, as in the cross-shaped and spider flowers; or placed upon a placenta or receptacle within the seed-vessel, as in tobacco and thornapple.

Seeds are said to be mixed, (semen unna) which are not contained in a cover or vessel. Such are those of the lip and compound flowers, the umbelliferous and rough-leaved plants; covered seeds (semen tecta) are contained in some vessel, whether of the capsule, pod, berry, apple, or cherry kind.

A simple seed is such as bears neither crown, wing, nor downy pap; the varieties in seeds arising from these circumstances are particular enumerated under their respective heads.

In assimilating the animal and vegetable kingdoms, Linnaeus denounces seeds the eggs of plants. The fecundity of plants is frequently the most astonishing; from a single plant or stalk of Indian Turkey wheat, are produced, in one summer, 2000 seeds; of deciduous 3000; of sun-flower 4000; of poppy 32,000; of a spike of cat-tail 10,000, and upwards; a single fruit, or seed-vessel, of tobacco, contains 1000 seeds; that of white poppy 8000. Mr. Ray relates, from experiments made by himself, that 1012 tobacco-seeds are equal in weight to one grain; and that the weight of the whole quantity of seeds in a single tobacco-plant is such as must, according to the above proportion, determine their number to be 360,000. The same author estimates the annual produce of a single stalk of spinewort to be upwards of one million of seeds.

The dissemination of plants respects the different methods or vehicles by which nature has contrived to dispense their seeds for the purpose of propagation. These by naturalists are generally reckoned four:

1. Rivers and running waters. 2. The wind.
3. Animals. 4. An elastic spring, peculiar to the seeds themselves.

1. The seeds which are carried along by rivers and torrents are frequently conveyed many hundreds of leagues from their native soil, and cast upon a very different climate, to which, however, by degrees they render themselves familiar.

2. Those which are carried by the wind are either winged, as in fir-tree, trumpet-flower, tulpin-tree, birch, arbor-vitae, medowtree, and jasmine, and some umbelliferous plants, which are covered with papules, or downy crown, as in valerian, popular, reed, succulent swallow-wort, cotton-tree, and many of the compound flowers, placed with in a winged calyx or seed-vessel, as in seacap sea, pick, dock, doreosa, ast, maple, and elm-voices, logwood, and wood; or, lastly, contained within a swelling calyx or seed-vessel, as in water-cherry, cucurbit, melis, black, and black-net, hinebor, black-sea, heart-sea, and chile-sea-thistle.

3. Many birds swallow the seeds of vane-

burr, jumaper, misseto, oats, millet, and other grasses, and void them entirely. Squire's, rats, parrots, and other animals, suffer many of the seeds which they devour to escape, and thus are the seeds of many herbs and fruits, of some of which, the pears, pears, and cherries, have been hindered from passing into a degree by some of the tribes of the people.

4. The seeds which disperse themselves by an elastic force, have that force resident either in their calyx, as in oats, and the great number of fenns; in their pappus, as in canauros; or in their capsule, as in the nuciferous plants, African spire, frank, helonella, horse-tail, basil, Malabar, cut, cumber, clemeter, and male balsam-apple.

5. The semi-cylindrical parabola, in the higher geometry, a curve which is the second order, wherein the cubes of the ordinates are as the squares of the abscissas. Its equation is 

\[ ax^2 + by = cz. \]

6. The semi-diurnal. Of any of those circles which the sun appears to perform each day revolution, beneath which is shown the horizon is called the diurnal arch, and that which is below the horizon is called the nocturnal arch, the halves of which are called the semi-diurnal and the semi-nocturnal arches.

7. See the article PARABOLO.
larger. On opening the egg, the embryo cuttle is found alive. The males are very constant, accompanying their females wherever they go, facing danger in their defence, and rescuing them intrepidly at the hazard of their own lives. The tinaceous females fly about in waves with a high noise of a cuttlefish, on being dragged out of the water, resembling the grunting of a hog. When the male is pursued by the seadragon, or other ravenous fish, he shows the danger by straitening. He spits his black liquor, sometimes the quantity of a dram, by which the water becomes black as ink, under shelter of which he baffles the pursuit of his enemy. This ink, or black liquor, has been demonstrated by M. Le Cat astonished animal, and is reserved in a particular gland. In its liquid state it resembles that of the chorioid in man, and would then communicate an indelible dye; when dry, it might be taken for the product of the black liquor in negroes dried, and made a precipitate by spirit of wine. This xatho animal, in negroes as well as in the cuttle-fish, is more abundant after death than even during life. It may serve for printing, or printing paper, and is employed in the manufacture of which the Romans used it. It is said to be an ingredient in the composition of Indian ink, mixed with rice. There are five species.

3. The large, or great cuttle, with short arms and long tentacula; the lower part of the body rhomboid and piramated, the upper thick and cylindrical. They inhabit all our seas, where having blackened the water by the effusion of their ink, they abandon it with their tail leap out of the water. They are gregarious, and switl in their motions: they take their prey by means of their arms, and embracing it, bring it to their central mouth. They adhere to the rocks, when they wish to be quiescent, by means of the concave discs that are placed along their arms.

2. The octopus, with eight arms, connected by a button beneath it. This is the polypus of Pliny, which he distinguishes from the loligo and sepia by the want of the tail and tentacula. They inhabit our seas, but are most at home in the Mediterranean. In both kinds consorts are formed of different size. The Indians affirm that some have been see two fathoms broad over their centre, and each arm nine fathoms long. When the Indians navigate their little boats, they go in dread of them; and lest these animals should fling their arms over and soak them, they never sail without an ax to cut them off. When used for food they are served up red from their own liquor, which from boiling with the adder's skin, it becomes scarlet. Barthol. says, upon cutting one of them open, so great a light broke forth, that at night, upon taking away the candle, the whole house seemed to be in a blaze.

3. The medusa, or middle cuttle, with a long, slender, cylindrical body; tail frayed, pointed, and canted on each side; two long tentacula; the body almost transparent, green, but convertible into a dirty brown; containing two pouches, which are chiefly used in colouring through fear, adapting it, chameleon-like, to that of the place they are in. The eyes are large and equal; active.

4. The sepia, or small cuttle, with a short body, rounded at the bottom; has a round fin on each side and two tentacula. They are taken off Flinthsur, but chiefly inhabit the Mediterranean.

5. The official, or official cuttle, with an ovalated body, has fins along the whole of the sides, almost meeting at the bottom, and two long tentacula. This is the one, the cuttle-bone, the shape, which was formerly used as an absorbent. The bones are frequently flung on all our shores; the animal very rarely. The conquer-eds bite off their arms, or feet, but they grow again, and the fragment is preyed upon by this type. This fish emits (in common with other species), when frightened or pursued, the black liquor which the antients supposed, by darkening the circumjacent air, concealed it from the enemy; and which they sometimes made use of instead of ink.

This animal was esteemed a delicacy among them; and is eaten even at present by the Italians. Boundalter gives us two recesses, and a direction for the drying of this fish; which may be considered as necessary to this day. Atheneus also leaves us the method of making an antique cuttle-fish sausage; and we learn from Aristotle, that those animals are in highest season when pregnant.

SEPARLE, (from sepes, a hedge), the name of the 44th or 40th of Linnaeus's Fragmenta of a natural Method, consisting of a beautiful collection of woody plants, some of which, from their size and elegance, are very proper furniture for hedges. See Box.
for that purpose: to clear it from the oil, it is put into a vessel of hot soap-water, whence being taken out, wrung, and dried, it is spun on the wheel. As to the shorter wool, it is boiled for the wool, it is only carded on the long card of serjeant, and spun over the wheel, without being scoured of its oil: and here it is to be observed, that the thread for the warp is always to be spun finer, and maintain better twisted, than that for the woof.

The word lends itself in the warp and woof being spun, and the thread reeled into skeins, that of the woof is put on spools, fit for the cavity of the shuttle; and that for the warp is wound on a kind of wooden bobbins, to fit it for warping; and when warped, it is stiffened with a size, usually made of the shreds of parchments; and when dried, put into the loom, and mounted so as to be raised by four treadles, placed under the loom, which the workman makes to act successively, equally, and alternately, one after another, with his feet; and as the threads are raised, throws the shuttle. See Weaving.

The serjeant, or being taken from the loom, is carried to the fuller, who fulls or scouring, in a tumbling mill, with fuller's-earth; and after the fulling, the knots, ends, straws, &c. sticking out on either side of the surface, are taken off with a kind of plickers or iron pincers, after which it is returned into the fulling machine, where it is worked with warm water, in which soap has been dissolved; when quite cleared, it is taken out, the knots are again pulled off; it is then put on the tenter to dry; taking care, as fast as it dries, to stretch it out, both in length and breadth, till it is brought to its just dimensions; then being taken off the tenter, it is dyed, shrunk, and pressed.

SERGEANT, or SERJEANT, at law, is the highest degree taken in that profession, as that of a doctor is in the civil law. To these serjeants, as men of great learning and experience, one court is set apart for them to plead in by themselves, which is the court of common pleas, where the common law of England is observed; yet though they have this court to themselves, they are not restrained from pleading in other courts, where the judges (who cannot be elevated to that dignity till they have taken the degree of serjeant at law) and their brethren, are held in the same great respect, next to the king's attorney and solicitor general. These are made by the king's mandate, or writ.

There are also serjeants at arms, whose office is to attend on the person of the king, to arrest persons of condition offending.

SERGEANT, or SERJEANT, in war, is an inferior officer in a company of foot, or troop of dragoons, armed with a halberd, and appointed to see discipline observed, to teach the soldiers the exercise of their arms, and to order, straighten, and form, ranks, files, &c.

SERJEANTY, signifies in law a service that cannot be due from a tenant to any lord, but to the king only; and it is either grand serjeancy or petit serjeancy.

Grand serjeancy, is a tenure whereby a person holds his land of the king by such services as he is bound to do in person; as to carry the king's banner, or his lance, or to carry his sword before him at his coronation, or to do other like services; and it is called grand serjeancy, because it is a more worthy service than the service in the common tenure of sequeance.

Petit serjeancy is where a person holds his land of the king, to furnish him yearly with some small thing towards his wars, as a horse, or a man, and is in truth, no more than some service in effect, because such tenant by his tenure ought not to go nor do any thing in his proper person.

SERIES, in general, denotes a continued succession of things in the same order, and having the same relation or connection with each other; in this sense we say, a series of emperors, kings, bishops, &c.

SERIES, in mathematics, is a number of terms, whether of numbers or quantities, increasing or decreasing in a given proportion, the doctrine of which has already been given under the article PROGRESSION.

SERIES, INFINITI, is a series consisting of an infinite number of terms, that is, to the end of which it is impossible ever to come; so that let the series becarried on to any assignable number, length, or number of terms, it can be carried on further, without end or limitation.

A number actually infinite (i.e. all whose units can be assigned, and yet is without limits) is a plain contradiction to all our ideas about number; for whatever number we can conceive, or have any proper idea of, is always determined; so that we cannot, after it may be assigned, and a greater after this; and so on, without a possibility of ever coming to an end of the addition or increase of numbers assignable; which inexhaustibility, or endlessness, in the nature of numbers, is all we can distinctly understand by the infinity of number; and therefore to say that the number of any things is infinite, is not saying that we comprehend their number, but indeed the contrary; the only thing positive in this proposition being that, the number of these things is greater than any number which we can actually conceive and assign. But then, whether in things that do really exist, it can be truly said that their number is greater than any assignable number; or, which is the same thing, that in the enumeration of their units one after another, it is impossible ever to come to an end; this proposition is true, by all men, and by all nations; we have no business in this place: for all that are concerned here to know is this certain truth; that after one determinate number we can conceive a greater, and after this a greater, and so on without end. And therefore, whether the number of any number that do or can really exist all at once, can be such that it exceeds any determinable number, or not, this is true: that there are numbers which exist, or are produced successively one after another, the number may be greater than any assignable one; because, though the number of things thus produced that does actually exist at any time is finite, yet it may be increased without end. And this is the distinct and true notion of the infinity of a series; that is, of the infinity of the number of its terms, as it is expressed in the definition.

Hence, it is plain, we cannot apply to an infinite series, the common notion of a sum, viz. a collection of several particular numbers that are joined and added together one after another; for this supposes that these particular numbers are all known and determined; whereas the terms of an infinite series cannot be all separately assigned, there being no end in the enumeration of its parts, and therefore it can have no sum in sense. But again, if we consider that the idea of an infinite series is not that of a collection of something positive and determined, in so far as we conceive the series to be actually carried on; and the idea of an inexhaustible remainder still behind, or an endless addition of terms that can be made to it one after another, this is as different from the idea of a finite series as two things can be. Hence we may conceive it as a whole of its own kind, which therefore may be said to have a total value whether that is finite or not. Now in some infinite series this value is finite or limited; that is, a number is assignable beyond which the sum of no assignable number of terms of the series can ever reach; nor indeed ever be equal to it, yet it may approach to it in such a manner as to want less than any assignable difference; and this we may call the value or sum of the series; not as being a number found by the common method of addition; but as being such a limit that if it were possible to add them all one after another, the sum would be equal to this number.

Again, in other series the value has no limit; and we may express this: by saying the sum of the series is infinite; which indeed signifies no more than that it has no determinate and assignable value; and that the series may be carried such a length that its sum, so far, shall be greater than any given number. In short, in the first case we affirm there is a sum, yet not a sum taken in the common sense; in the other case we plainly deny a determinate sum to any sense.

Theorem I. In an infinite series of numbers, increasing by an equal difference or ratio (that is, an arithmetical or geometrical increasing progression) from a given number, a term may be found greater than any assignable number.

Hence, if the series increases by differences that continually increase, or by ratios that continually increase, comparing each term to the preceding, it is manifest that the same thing must be true, as if the differences or ratios continued equal.

Theorem II. In a series decreasing in finite, to a given ratio, we can find a term less than any assignable fraction.

Hence, if the terms decrease, so as the ratios of each term to the preceding do also continually decrease, then the same thing is also true as when they continue equal.

Theor. III. The sum of an infinite series of numbers all equal, or increasing continually, by whatever differences or ratios, is infinitely great; that is, such a series has no determinate sum but grows so as to exceed any assignable number.

Demon. 1. If the terms are all equal, as \( A \); \( A \); \( A \); &c., then the sum of any finite number of them is the product of \( A \) by that number, as \( An \); but the greater \( n \) is, the greater \( An \) will be, and hence \( An \) will be still greater than any assignable number.

Secondly, suppose the series increase continually (whether it does so infinitely or limitedly), then its sum must be infinitely
great, because it would be so if the terms continued all equal, and therefore will be more so since they increase. But if we suppose the series increases infinitely, either by equal ratios or differences, or by increasing differences or ratios of each term to the preceding; then the reason of the sums being infinite will appear from the first theorem: for in such a series, a term can be found greater than any assignable number, and much more therefore the sum of that and all the preceding.

Theor. IV. The sum of an infinite series of numbers decreasing in the same ratio is a finite number, equal to the quote arising from the division of the product of the ratio and first term, by the ratio less by unity; that is, the sum of no assignable number of terms of the series can ever be equal to that quote; and yet no number less than it is equal to the value of the series, or to what we actually determine in it; so that we can carry the series so far, that the sum shall want of this quote less than any assignable difference.

Demonstration. To whatever assigned number of terms the series is carried, it is so far finite; and if the greatest term is 1, the least A, and the ratio rl, then the sum is $S = \frac{A}{1 - r}$. See Geometrical Progression.

Now, in a decreasing series from 1, the more terms we actually raise, the list of them, A, becomes the lesser, and the less it is A, rl - A is the greater, and so also is $\frac{rl}{1 - r}$. But as $\frac{rl}{1 - r} - rl - A$ is being still less than rl, therefore $\frac{rl}{1 - r} - rl - A$ is still less than $\frac{rl}{1 - r}$; that is, the sum of any assignable number of terms of the series is still less than the quote mentioned, which is $\frac{rl}{1 - r}$, and this is the first part of the theorem.

Again: The series may be actually continued so far, that $\frac{rl}{1 - r} - \frac{rl}{1 - r}$ want of $\frac{rl}{1 - r}$ less than any assignable difference; for, as the series goes on, A becomes less and less in a certain ratio, and so the series may be actually continued till A becomes less than any assignable number (by Theorem II.). Now $\frac{rl}{1 - r} - \frac{rl}{1 - r} = \frac{rl}{1 - r}$ and $\frac{rl}{1 - r}$ is less than A; therefore, let any number assigned be called N, we can carry the series so far till the last term A is less than N; and because $\frac{rl}{1 - r} - \frac{rl}{1 - r}$ wants of $\frac{rl}{1 - r}$, the difference $\frac{rl}{1 - r} - 1$, which is less than A, which is also less than N, therefore the second part of the theorem is also true, and $\frac{rl}{1 - r}$ is the true value of the series.

Solutions. The sense in which $\frac{rl}{1 - r}$ is called the sum of the series, has been sufficiently explained: to which, however, we shall add this: that whatever consequences follow from the supposition of $\frac{rl}{1 - r}$ being the true and adequate value of the series taken in all its infinite capacity, as if the whole were actually determined and added together, can never be the occasion of any assignable error in any operation or demonstration where it is used in that sense; because if it is said that it exceeds that adequate extent it is demonstrated that this excess must be less than any assignable difference, which is in effect no difference, and so the consequent error will be in effect no error; for if any error can happen from $\frac{rl}{1 - r}$ being greater than it ought to be, to represent the complete value of the infinite series, that error depends upon the excess of $\frac{rl}{1 - r}$ over that complete value; but this excess being unassignable, that consequent error must be so too; because still the less the excess is, the less will the error be that depends upon it. And for this reason we may justly enough look upon $\frac{rl}{1 - r}$ as expressing the adequate value of the infinite series. But we are farther satisfied of the reasonableness of this, by finding in facts, that a finite quantity does actually correspond with an infinite series, which happens in the case of infinite ex-}

Theorem V. In the arithmetical progression 1, 2, 3, 4, &c., the sum is to the product of the number of terms, that is, to the square of the last term, in a ratio always greater than 1:3, but approaching infinitely near it. But if the arithmetical series begins with 0, thus, 0, 1, 2, 3, 4, &c., then the sum is to the product of the last term, by the number of terms, exactly in every step as 1 to 2.

Theorem VI. Take the natural progression beginning with 0, thus, 0, 1, 2, 3, 4, &c. and take the squares of any like powers of the former series, as the squares, 0, 1, 4, 9, 16, &c. or cubes, 0, 1, 8, 27, and then again take the sum of the series of powers to any number of terms, and also multiply the last of the terms summed by the next following (reckoning always 0 for the first term) the ratio of that sum to the product mentioned grows less and less: yet so as it never can actually be equal to $\frac{1}{2}$, but approaches infinitely near to it, or within less than any assignable difference.

SERIOLES, a genus of plants belonging to the order of polygamy equalis, and to the class of syngenis, and in the natural system ranged under the 40th order, composita. The receptacle is pellucid; the calyx simple; and the papulis is somewhat plumose. There are four species: 1. The legvatis: 2. Athamia: 3. Lithopsis: 4. Ursus. The first is a native of the island of Canada, and flowers in July and August; the second is a native of Italy; and the fourth is a native of the south of Europe.

SERIPHIUM, a genus of plants belonging so since it is not the order of homogamia, and to the class of syngenis. The calyx is imbricated; the corolla is monopetalous and regular, with one oblong seed within it. There are our species, natives of the Cape of Good Hope.

SERPENS. See Astronomy.

SERPENTIES, in natural history, an order of the amphibia class, the characteristics of which are, a mouth breathing by the lungs only; body tapering; neck not distinct; jaws dilatable, not articulate; no feet, fins, or ears: motion undulatory. They are
first naked upon the earth, without thins, exposed to every injury, but frequently armed with a poison the most deadly and horrible, which is contained in the tubular fangs or teeth; the lower fangs being without the upper jaw, protruded or retracted at pleasure, and surrounded with a glabrous vesicle, by which their fatal fluid is secreted. (See Poisons.) But lest this tribe should too generally spread upon the limits of other animals, the benevolent Author of Nature has armed only about a fifth in this dreadful manner. The jaws are dilatable and not articulate, and the osseous so lax, that they can swallow an animal twice or thrice as large as the neck. There are seven genera, viz. the

Acrodontus Coccula Amphilaxa Coluber Auguis Crotalus.

The distinction of species in this numerous tribe is often peculiarly difficult. Linnaeus professed himself that an infallible criterion might be found in the number of scaly plates on the abdomen and beneath the tail; and accordingly he arranged the Systema Naturae to discriminate the species by this mark alone. Experience, however, has sufficiently shown that, though often highly useful in the investigation of these animals, it is yet by much too uncertain and variable to be permitted to stand as an established specific test.

The distinction of serpents into poisonous and innoxious can only be known by an accurate examination of their teeth; the fangs or poisoning teeth being always of a tubular structure, and calculated for the conveyance or injection of the poisonous fluid from a peculiar reservoir communicating with the fangs on each side of the head: the fangs are always situated in the anterior and external part of the upper jaw, and are generally, but not always, of much larger size than the other teeth; they are also frequently accompanied by some smaller or subsidiary fangs, supposed to supply the place of the absent ones when lost, either by age or accident. The fangs are situated in a peculiar bone, so articulated with the rest of the jaw as to elevate or depress them at the pleasure of the owner: in a quiescent state they are recumbent, with their points directed forwards or backwards; but when the animal is inclined to use them as weapons of offence, their position is altered by the peculiar mechanism of the above-mentioned bone in which they are rooted, and they become almost perpendicular.

A general rule for the determination of the existence or non-existence of these organs in any species of serpent is proposed in a paper relative to the amphibias by Dr. Gray, and published in the Philosophical Transactions for the year 1788. The fangs, according to Dr. Gray, may be distinguished with great care, and, as he believes also, with absolute certainty, by the following simple method. When it is discovered that there is something like teeth in the anterior and external part of the upper jaw, which situation he considers as the only one in which venomous serpents are ever found, let a pinch of hardy be drawn from that part of the jaw to the angle of the mouth; (which operation may, for greater certainty, be tried on each side.) If no more teeth are felt in that line, it may, he thinks, be fairly concluded, that those first discovered are teeth; and the serpent is consequently venomous: if, on the contrary, the teeth first discovered are observed not to stand alone, but to be only a part of a complete row, it may as certainly be concluded that the serpent is not venomous. This rule, however, like most others, may have its exceptions, and perhaps the most legitimate test of real fangs in a serpent is their tubular structure, which may always be easily examined. In this instance of a proper extinguisher. It is to be observed, that all serpents, whether poisonous or not, have besides the teeth, (whether fangs or simple teeth) in the sides of the upper jaw, two additional rows, which are generally much smaller than the rest, and frequently scarcely visible: the general rule, therefore, is, that all venomous serpents have only two rows of true or proper teeth in the upper jaw, and that all other serpents have three rows.

A head entirely covered with small scales is in some degree a character, but by no means an universal one, of poisonous serpents; as are also crenated scales on the head and body; these are all as furnished with a prominent middle line.

All serpents are in the habit of casting their skin at certain periods; in temperate regions annually; in the warmer perhaps more frequently. The broad winds or serpents of the temperate and cold climates also conceal themselves, during the winter, in cavities beneath the surface of the ground, or in other convenient places of retirement, and pass the winter in a state more or less approaching, in the different species, to complete torpidity. It may be added, that some serpents are viviparous, as the rattlesnake, the viper, and many others of the poisonous kind, while the common snake, and probably the major part of the innoxious serpents, are oviparous, depositing their eggs in a kind of string or chain in any warm and close situation, where they are afterwards hatched.

The broad winds or scaly plates on the bellies of serpents are termed scuta, and the smaller or divided plates beneath the tail are called squamae subcudatales, or subcaudal scales; and from these different kinds of lining the Linnaean genera of serpents are chiefly instituted.

SERPENTARIUS. See Astronomy.

SERPENTINE, a mineral found in amorphous masses, forming strata, and even entire mountains. Its fracture is splintery, sometimes conchoidal. Specific gravity 2.57 to 2.71; feels soft and almost greasy; generally emits an earthy smell when breathed. Its colours are various shades of green, yellow, red, grey, brown, and blue: commonly one or two colours form the ground, and one or more appear in spots or veins. Before the blowpipe it hardens, but does not melt. According to Mr. Chenevix it contains

<table>
<thead>
<tr>
<th>Percentage</th>
<th>Description</th>
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<tbody>
<tr>
<td>34.5</td>
<td>Magnesia</td>
</tr>
<tr>
<td>28.0</td>
<td>Silica</td>
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<tr>
<td>23.0</td>
<td>Alumina</td>
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<tr>
<td>4.5</td>
<td>Oxide of iron</td>
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<tr>
<td>0.5</td>
<td>Lime</td>
</tr>
<tr>
<td>10.5</td>
<td>Water</td>
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101.0

SERPULCA, a genus of plants belonging to the class of monoeccus, and to the order of extrandria. The male calyx is quadrilateral, and the corolla consists of four petals. The female flowers have four parts, and the pericarpium is a tetraspermate nut. There are two species, the verticillata and repens.

SERPULCA, a genus of insects of the order verticillata. The generic character is: animal a terrella; shell univalve, tubular generally adhering to other substances; often separated internally by divisions at uncertain distances. There are 48 species.

SERRATULA, a genus of plants belonging to the class of scyphaseus, and to the order of polygamae. In the natural system it is ranged under the 49th order, composite. The calyx is subcylindrical, imbricated; the scales of it pointed, but not spinous. There are 60 species: 1. The tinctoria, grows in woods and wet pastures. It dyes cloth of an exceedingly fine yellow colour, which stands well when fixed with alum. Goats eat this plant; horses are not fond of it; cattle, oxen and sheep, leave it untouched. 2. The alpinia, or mountain saw-wort, grows on high mountains, and flowers commonly in July or August. 3. The arvensis, corn saw-wort, or way-thistle, cultivated by way-sides, and flowers in July or August. When burned, it yields good ashes for making glass or fixed alkali.

SERPOLPALUS, a genus of insects of the order anthocacti. The generic character is: antennae setaceous; fives, four, unequal; the anterior ones longer deeply serrate, composed of four joints, the last joint very large, truncate, compressed, petioliform; the posterior ones subulate; thorax margined, concealing the head, with a prominent angle on each side; head deflected; feet formed for digging. There are two species: the striatus is found on old wooden buildings in the evening in autumn.

SERTULARIA, in natural history, a genus belonging to the class of vernes, and to the order of zoophyta. The stem is radiated, fibrous, naked, and jointed; the florets are without a head, and the fruits a single joint. This genus comprehends 42 species of corallines.

SERVANT. See Master and Servant.

SERVICE, in law, is a duty which a tenant, on account of his fee, formerly owed to his lord.

SERUM, a thin transparent liquor, which makes a considerable part in the mass of blood.

The specific gravity of human blood is, at a medium, 1.037. Mr. Forcroy found the specific gravity of bullcock's blood, at the temperature of 60°, to be 1.036. The blood does not uniformly retain the same consistence in the same animal, and its consistence in different animals is very various. It is easy to see that its specific gravity must be equally various.

When blood, after being drawn from an animal, is allowed to remain for some time at rest, it very soon coagulates into a solid mass of the consistence of curdled milk. This mass gradually separates into two parts; one of which is fluid, and is called serum; the other the coagulum, has been called curd, because it retains the red corpuscles which distinguishes blood. This separation is very similar to the separation of curdled milk into curds and whey.
The proportion between the serum and the albumen in the blood varies much in different animals, and even in different parts of the same animal, in different circumstances. The most common proportion is about one part of albumen to three parts of serum; but in many cases the serum exceeds or falls short of this quantity; the limits of the ratios of these substances to each other appear, from a comparison of the conclusions of most of those who have written accurately on the subject, to be 1:1 and 1:4; but the first case must be very rare indeed.

The cause of this spontaneous decomposition of blood has not hitherto been ascertained. The coagulation takes place equally in close vessels and in the open air, whether the blood is allowed to cool, or is kept at the temperature at which it is when it issues from the animal; neither is the coagulation prevented by diluting it with water.

1. The serum is of a light greenish-yellow colour; it has the taste, smell, and feel of the blood, but its consistency is not so great. Its mean specific gravity is about 1.0297. It converts violets to a green, and therefore contains an alkali. On examination, Rouelle found that it owes this property to a portion of the albumen, the proportion of which, as far as he could determine, is about 16%; the serum coagulates, as Harvey first discovered. It coagulates also when boiling water is mixed with it; but if serum is mixed with six parts of cold water, the coagulum does not dissolve to such an extent as the coagulum of an egg. If the coagulum is cut into small pieces, a muddy fluid may be squeezed from it, which has been termed 'serosity.' After the separation of this fluid, if the residuum is carefully washed in boiling water and examined, it will be found to possess all the properties of coagulated albumen. The serum, therefore, contains a considerable proportion of albumen. Hence its coagulation by heat, and the other phenomena which albumen usually exhibits.

If serum is diluted with six times its weight of water, and then boiled to coagulate the albumen, the liquid which remains after the separation of the coagulum, if it is gently evaporated till it becomes concentrated, and then allowed to cool, assumes the form of a jelly, as was shown by Dr. Huc. Consequently it contains gelatine.

If the coagulated serum is heated in a silver vessel, the surface of the silver becomes black, being converted into a sulphuret. Hence it is evident that it contains sulphur; and Proust has ascertained that it is combined with ammonia in the state of a hydrosulphuret.

If serum is mixed with twice its weight of water, and after coagulation by heat, the albumen is separated by dilution, and the liquid slowly evaporated till it is considerably concentrated, a number of crystals are deposited when the liquid is left standing in a cool place. These crystals, first examined by Rouelle, consist of carbont of soda, muriat of soda, besides phosphat of soda and phosphat of lime. The soda exists in the blood in a caustic state, and seems to be combined with the gelatine and albumen. The carbonic acid combines with it during evaporation.

Thus it appears that the serum of the blood contains albumen, gelatine, hydrosulphuret of ammonia, soda, muriat of soda, phosphat of soda, and phosphat of lime. These compounds are not for the coagulation occasioned in the serum by acids and alcohol, and the precipitation produced by tan, acetate of lead, and other metallic salts.

With respect to the other part, the coagula of which, or that part which is sometimes called, is of a red colour, and possesses considerable consistence. Its mean specific gravity is about 1.245. If this coagulum is washed carefully by letting a small jet of water fall upon it till it takes up a watery consistence, it is partly dissolved, and partly remains upon the scarea. Thus it is separated into two portions, viz. (1.) A white, solid, elastic substance, which has all the properties of fibrina. 2. The portion held in solution by the water, which consists of the colouring matter, not however in a state of purity, for it is impossible to separate the coagulum completely from the serum.

We are indebted to Bouquet for the first precise set of experiments on this last watery solution. It is of a red colour. Bouquet found that it contained albumen and iron. Menghini had ascertained, that if blood is evaporated to dryness by a gentle heat, a quantity of iron may be separated from it by the magnet.

The quantity of iron was considerable; according to him, the blood of a healthy man contains above two ounces of it. Now, as neither the serum nor the fibrina extracted from the coagulum contains iron, it follows of course, that the water holding the colouring matter in solution must contain the whole of that metal.

This watery solution gives a green colour to syrup of violets. When exposed to the air, it gradually deposits flakes, which have the properties of albumen. When heated, a brown-coloured scum gathers on its surface. If it is evaporated to dryness, and then mixed with alcohol, a portion is dissolved; and the alcoholic solution yields by evaporation a residue, which lathers like soap in water, and tinges vegetable blue-green; the acids occasion a precipitate from its solution. This substance is a compound of albumen and soda. Thus we see that the watery solution contains albumen, iron, and soda.

Fourcroy and Vanquelin have ascertained that the iron is combined with phosphoric acid, and in the state of subphosphat of iron; thus confirming an opinion which had been maintained by Sage, and announced as a fact by the author of this work.

Nitric acid digested on this residuum dissolves a portion, which is phosphat of iron, and is precipitated white by ammonia, but assumes a red colour when treated with pure potass. This, like the demineralised water employed, phosphat of lime precipitates. By this treatment they ascertained, that of the residuum consisted of subphosphat of iron. Now phosphat of iron is soluable in acids, but insoluble in ammonia; and when treated with pure alkalies, it loses a portion of its acid, assumes a red colour, and is converted into subphosphat. Hence it is evidently the soda of the blood which reduces it to that state, or at least maintains it in that state. Subphosphat of iron readily dissolves in albumen and in serum.

When new-drawn blood is stirred briskly round with a stick, or the hand, the whole of the fibrina collects together upon the stick, and in this manner is separated from the rest of the blood. The red globules, in this case, remain behind in the serum. It is in this manner that the blood is prepared for the different purposes to which it is put, as clarifying sugar, making punch, dyes, &c. After the fibrina is thus separated, the blood no longer coagulates when allowed to remain at rest, but a spongy fleshy matter separates from it, and swims on the surface.

When blood is dried by a gentle heat, water exhalates from it, retaining a very small quantity of animal matter in solution, and consequently having the colour of blood. Blood dried in this manner being introduced into a retort and distilled, there comes over first a clear watery liquor, then carbonic acid, and carbonat of ammonia, which crystallizes in the neck of the retort; after these products there comes over a fluid oil, carbonat of hydrogen gas, and an oily substance of the consistence of butter. The watery liquor possesses the proper properties of blood; it is perfectly clear, forms a fluid from sulphat of iron a green powder; muriatic acid dissolves part of this powder, and there remains behind a little Prussian blue. Consequently this watery liquor contains both an alkaline and prussic acid. 9216 grains of dried blood being put into a large crucible, and gradually heated, at first became nearly fluid, and swelled up considerably, emitted a great many fleshy fumes of a yellowish colour, and at last took fire and burned with a white flame, evidently owing to the presence of oil. After the flames and the fumes had disappeared, a light smoke was emitted, which affected the eyes and the nose; it had the colour of prussic acid, and reddened moist paper stained with vegetable blue. At the end of six hours, when the matter had lost five-sixths of its substance, it melted anew, exhibited a purple flame on its surface, and emitted a thick smoke. This smoke collected the coagula and petals, and reddened moist paper stained with vegetable blue. But it had not the smell of prussic acid. When a quantity of it was collected and examined, it was found to possess the properties of phosphoric acid. The residuum amounted to the grains; it had a deep-black colour, and a metallic brilliancy; and its particles were attracted by the magnet. It contained no uncombined soda, though the blood itself, before combustion, contained it abundantly; but water extricated from it muriat of soda; part of the remainder was dissolved by muriatic acid, and of course was lime; there was besides a little alkalie, which evidently had been separated from the crucible. The iron had been reduced during the combustion.

Such are the properties of blood, as far as they have been hitherto ascertained by experiment. We have seen that it contains the following ingredients:

1. Water.
2. Fibrina.
3. Albumen.
5. Hydrosulphur of ammonia.
7. Subphosphat of iron.
Sesamum, oily grain, a genus of plants belonging to the class of daisyisms, and to the order of astersperma, in the natural system ranking under the 13th order, urtize. The calyx is divided into five parts. The corolla is comphomolate, the tube of which is nearly the length of the calyx, the lower lobe is divided, and very large; the border is divided into five parts, four of which are spreading and nearly equal; the fifth is the lowest and largest. There are four filaments, and the gvultinents of a fifth. The stigma is also divided, and the epidermis has four cells. There are only three species, the oriental, indipe, and luteum.

1. The orientale has ovate, obovate, entire leaves. It is an annual, and grows naturally on the coast of Mahabar and in the province of Calcuta; resting with an herbaceous four-corned stalk, two feet high, and sending out a few short side-branches. After the flowers are past, the germen turns to an oval acutely pointed capsule, with four cells, filled with oval compressed seeds, which ripen in autumn.

2. The indica, with trifoliate leaves, grows naturally in India; this is also an annual plant; the stalk rises taller than that of the former; the lower leaves are cut into three parts, which is the only difference between them. The first sort is frequently cultivated in all the eastern countries, and also in Africa, as a pulse; and of late years the seeds have been introduced into Carolina by the African negroes, which they succeed extremely well. The inhabitants of that country make an oil from the seed, which will keep good for many years, without having any rancid smell or taste; but in two years it gets quite mild; that when the warm taste of the seed, which is in the oil when first drawn, is worn off, they use it as a sal volatile, and for all the purposes of sweet oil.

The seeds of this plant are also used by the negroes; which seeds they parch over the fire, and then mix with water, and stew other ingredients with them, which makes a hearty food. Sometimes a sort of pudding is made of these seeds; the same as with wheat or rice, and is by some persons esteemed, but is rarely used for these purposes in Europe.

From nine pounds of this seed which came from Carolina, there were upwards of two quarts of oil drawn, which is as great a quantity as has been obtained from any vegetable whatever. This might occasion its being called the oily grain.

Seel, meadow-saffrine, a genus of plants belonging to the class of pentamides, and to the order of agrestima, ranging under the 43th order, unbelike. The umbels are globular; the involucre consists of one or two leaflets; the fruit is egg-shaped and streaked. There are nine species. The mountainous grows naturally in France and Italy; the glaucoma is a native of France; the seeds grow in the north of Europe; and the hyppontherium is a native of Austria.

SESSION, in law, denotes a sitting of justices in court upon their commission: as the sessions of eyer and termites. The session of the peace is a court of record held before two or more justices, when one of the justices, for the execution of the authority given them by the commission of the peace, and certain statutes and acts of parliament. The justices shall keep their sessions in every quarter of the year at least, and for three days if need be; to wit, in the first week after the feast of St. Michael, in the first week after the Epiphany, in the first week after Easter, and in the first week after St. Thomas, and oftener if need be.

Any two justices, one whereof is of the quorum, by the words of the commission of the peace, by their precept to the sheriff to summon a session for the general execution of their authority; and such session, held at any time within that quarter of a year, is a general quorum. And if such precept should bear no date, or be dated, fifteen days before the return. Nels. Inst. 33.

The sheriff shall also cause a jury to appear at such days and places as the said justices, or such two or more of them, as aforesaid, shall appoint.

There are many offenses, which, by particular statutes, belong properly to this jurisdiction, and ought to be prosecuted in this court, as the smaller misdemeanors against the public or commonwealth, not amounting to felony; and especially offenses relating to the game, highways, alehouses, bastard children, settlement and provision of the poor, vagrants, servants' wages, apprentices, and popish recusants. Some of these are proceeded upon by indictment; and others in summary way, by motion and order therefore, which shall consist, as far as the case may require, in cases where the defendant is guilty of any particular statute, may proceed to the court of king's bench by commission, and be there either quashed or confirmed.

Seventeenth, eighteenth, and nineteenth centuries and measures. In London, four justices from among the mayor, recorder, and alderman, (of which the mayor or recorder to be one) may hold a session to inquire into offenses by selling by false weights and measures, contrary to the statutes; and to receive judgments, punish the offenders, &c.

Sestercius, a silver coin in use among the Romans. See C Burrus. Some authors make two kinds of steseters: the less, called stesetinum, in the masculine gender; and the great one, called stesetinum, in the neuter, the latter containing a thousand of the former. Some, or stesetinum, was also used by the ancients for a thing containing two wholes and a half of another, as was taken for any whole or integer.

Sesuvium, a genus of plants belonging to the class of leguminosae, and to the order of consists, ranging under the 43th order of unbelike. The umbels are globular; the involucre consists of one or two leaflets; the fruit is egg-shaped and streaked. There are nine species. The mountainous grows naturally in France, and Italy; the glaucoma is a native of France; the seeds grow in the north of Europe; and the hyppontherium is a native of Austria.

Set-off, is, when the defendant acknowledges the justice of the plaintiff's demand on the one hand, but on the other sets up a demand of his own to counterbalance that of the plaintiff, either in part, or in full, as if the plaintiff sues for 10l. due on a note of hand, the defendant may set-off 9l. due to himself for merchandise sold to the plaintiff.

Black, B. 304.

The action in which a set-off is allowable upon the statutes 2 and 8 G. If. c. 22 and 24, are debt, covenant, and assumpsit, for the non-payment of money; and the demand intended to be set-off, must be such as might have been made the subject of one or other of these actions. A set-off, therefore, is never allowed in actions upon the cause, trespass, reprieve, &c. nor of a penalty, in debt on bond conditioned for the performance of covenants, &c. nor of general damages in covenant or assumpsit; but where a bond is conditioned for the payment of an annuity, a set-off may be allowed. A debt barred by the statute of limitations, cannot be set-off; and if so, the plaintiff may give the action, the defendant may reply the statute of limitations; or if 6l. in evidence, on a notice of set-off, it may be objected to at the trial. Tidd's Pract. K. B.
ing, and their proceedings are subject to the jurisdiction of the king's bench. In the making of a rate or tax, the commissioners are to assess every owner or possessor of lands in danger of receiving any damage by the water, or lands, or houses, called the slaggare, or shagrain, and much used in covering cases, books, &c.

It is imported from Constantinople, Tunis, Tripoli, Algiers, and from some parts of Poland, where it is prepared in the following manner: the skin being stretched out is first covered over with mustard-seed, which is bruised upon it; and being thus exposed to the weather for some days, it is then tanned. The best is of a brownish colour, as the white sort is the worst. It is extremely hard; yet, when steeped in water, it becomes soft and pliable; and being fashioned into covers, it really takes any colour; as red, brown, or yellow, by the fancy of the workman.

SHAKLES, in a ship, are the rings with which the ports are shut fast, by lashing the port-bar to them. There are also shackles put upon bitton-bolts, where the men have deserved corporal punishment.

SHAMBLES, among miners, a sort of niches, or landing-places, left at such distances in the adits of mines, that the shovel-men may conveniently throw the ore from shambles to shambles, till it comes to the top of the mine.

SHAMMY, or CHAMOIS LEATHER, a kind of leather dressed either in oil or tanned, and much esteemed for its softness, pliancy, and being capable of bearing soap without hurting it.

The real shammy is prepared of the skin of the chamois-goat.

The true chamois leather is counterfeited with common goat, kid, and even sheep-skin; the practice of which makes a particular profession, and consists in the Flemish chamoisery. The last is the least esteemed, yet so popular, and such vast quantities prepared, especially about Orleans, Marseilles, and Tholouse, that it may not be amiss to give the method of preparing it.

The manner of chamoisery, or of preparing sheep, goat, or kid-skins in oil, in imitation of chamois:

The skins being washed, drained, and spread out with quick-lime, on the fleshy side, are folded in two, lengthwise, the wool outwards, and laid on heaps, and so left to ferment eight days; or if they had been left to dry after faying, for fifteen days. Then they are washed out, drained, and half-dried, laid on a wooden leg or horse, the wool stripped off with a round staff for the purpose, and laid in a week pit, the lime whereof had been used before, and had lost the greatest part of its force.

After twenty-four hours they are taken out, and left to drain twenty-four more; then put into another strong pit. This done, they are taken out, drained, and put in again by turns; which begins to dispose them to take oil; and this practice they continue for six weeks in summer, or three months in winter; at the end whereof they are washed out, laid on the wooden leg, and the surface of the skin on the wood side peeled off, to render them the softer; then made into parcels, steeped a night in the river, in winter more;

stretched six or seven over one another on the wooden leg; and the knife passed strongly on the fleshy side, to take off any thing superfluous, and render the skin smooth.

Then they are dried by the fire as before in the river, and the same operation repeated on the wool side; then thrown into a tub of water with bran in it, which is brewed among the skins till the greatest part sticks to them; and then separated into distinct parts, till they swell and rise of themselves above the water.

By this means, the remains of the skin are cleaned out; they are then wrung out, hung up to dry in the open air, and thrown into the mill, with the quantity of oil necessary to fill them: the best oil is that of stok-fish.

Here they are first thrown in bundles into the river for twelve hours, then laid in the sharpener, or instrument, oil till they are well sooted; then oiled with the hand, one by one, and thus formed into parcels of four skins each, which are mixed and dried on cords a second time, then a third; then oiled again and dried.

This process is repeated as often as necessity requires; when done, if there is any moisture remaining, they are dried in a stove, and made up in parcels wrapped up in wool; after some time they are again oiled, but wrapped up again as before, till such a time as the oil seems to have lost all its force, which it ordinarily does in twenty-four hours.

The skins are then returned from the mill to the chamoiser to be scoured; which is done by putting them into a limewash of wood-ashes, working and beating them in it with their hands, and keeping them in the mill till the limes has had its effect; then wrung out, steeped in another limewash, wrung again, and this repeated till all the grease and oil is purged out. They are then half-dried, and passed over a sharpener, or instrument, oil till perpendicular in a block, which opens, softens, and makes them gentle; lastly, they are thoroughly dried and passed over the same instrument again, which finishes the preparation, and leaves them in form of chamois.

Kid and goat-skins are chamoised in the same manner as those of sheep; excepting that the hair is taken off without the use of lime, and that over the heads and legs they are opposed to the mill; when they undergo a particular preparation called ramnelling, the most delicate and diffi-

cult of all the others.

It consists in this, that as soon as brought from the mill they are steeped in a little limewash; taken out, stretched on a round wooden leg, and the hair scraped off with the knife; this makes them smooth, and in working cast a fine nap. The difficulty is in scraping them evenly.

SHANKER, or CHANCE. See MEDICINE.

SHARP, in music, a character, the power of which is to raise the note below which it is placed half a tone higher than it would be without such a preposition.

SHARPING-CORN, a customary gift of corn, said to be half a bushel for a plough-land; which the farmers pay in some parts of England to their smith, every Christmas, for sharpening their plough-irons, harrow-tines, &c.

SIIAWIA, a genius of the class and order syngecica polymer segrega. The caly-
is intricate, with five or six seeds, three interior larger; corolla five-cleft; seed one, oil-bearing. There is one species of New Zealand.

SHEATHING, in the sea language, is the casing that part of a ship which is to be under water, with fair-board of an inch thick; first-laying hair and tar, nailed together, under the boards, and then nailing them on, in order to prevent worms from eating the ship’s bottom.

SHEATS, in a ship, are ropes bent to the clew of the mizzen, lying, in the lower sails, to haul aft the clew of the sail; but, in top sails, they serve to haul home the clew of the sail close to the yard-arm.

SHEEL. See Ovis.

SHEEP. Any person who shall feloniously drive away, or feloniously steal, any sheep or lamb; or willfully kill any sheep or lamb, with a felonious intent to steal the carcasse or any part thereof; or assist or aid in committing any of the said offences, shall be guilty of felony without benefit of clergy. 13 Geo. II. c. 6.

Any person who shall apprehend and prosecute to conviction any such offender, shall have an office at his charge, for which purpose he shall have a certificate signed by the judge, before the hands of the assizes, certifying such conviction, and where the offence was committed, and that the offender was apprehended and prosecuted, by him claiming the reward; and if more than one claim it, he shall therein appoint what share shall be paid to each claimant. And on tendering such certificate to the sheriff, he shall pay the claimant for his charge, without deduction, or forfeit double, with treble costs; to be allowed in his accounts, or be repaid him out of the treasurer.

And any person who shall in the night time, maliciously and willfully main, wound, or otherwise hurt any sheep, whereby the same is not killed, shall forfeit to the party grinned treble damages, by action of trespass, or on the case.

At 26 Geo. III. c. 38, every person who shall export any live sheep or lambs, shall forfeit 3l. for every sheep or lamb, and shall suffer solitary imprisonment for three months, without bail, and until the forfeiture be paid; but not to exceed twelve months for such non-payment thereof. And all ships and vessels employed therein shall be forfeited.

SHEARING, or SHEARING, in woollen manufacture, is the cutting off with large shears the too long nap, in order to make the cloth more smooth and even. See the article CLOTH.

SHEARING, in the sea language, When a ship is not steered steadily, they say she shears, or goes shearing; or, when it anchor, she goes in and out by means of the current of the tide, they also say she shears.

SHERERS, in a ship, are two masts set across at the upper end of each other; a contrivance generally used for setting or taking out the men of a ship, where there is no hulk to do that office.

SHEFFIELDIA, a genus of plants belonging to the class of pentandria, and to the order of monogyne. The corolla is bell-shaped; the filaments are ten, of which every second is barren; the capsule consists of one cell, with two valves. There is only one species, the repens, of New Zealand.

SHEKEL, in Jewish antiquity, an ancient coin, worth 2s. 3d. sterling. See the article COIN.

Some are of opinion that the Jews had two kinds of shekels, viz. the common one, already taken notice of, and the shekel of the sanctuary; which last they made double the former, and consequently equal to 4s. 6d. but most authors make them the same; so that the shekel of the sanctuary, according to them, is only worth 2s. 3d.

SHELF, among miners, the same with what they otherwise call fast ground, or fast country; being that part of the internal structure of the earth, which they find lying even and in an orderly manner; and evidently by having retained its primitive form and situation, unmoved by the waters of the general deluge, while the circumjacent and upper strata have plainly been removed and tossed about.

SHELLS, chemically examined, are found like bones to consist of calcareous salts united to a soft animal matter; but in them the lime is united chiefly to carbonic acid, whereas in bones it is united to phosphoric acid. In shells, the predominating ingredient is carbonat of lime; but in bones it is phosphat of lime. Mr. Hatchett has divided shells into two classes. The first are usually of compact texture, resembling porcelain, and have an enamelled surface, often finely charged. These are denominated porcelainous shells; to this class belong the various species of veludo, cyprica, &c. The second class consists of shells usually covered with a strong epidermis, below which lie the shell in layers, and composed entirely of the substance well known by the name of mother of pearl. They have been distinguished by the name of mother of pearl shells. The shell of the fresh-water heloites, the turbo olivarius, are examples of such shells. The shells of the first class contain a very small portion of solid animal matter: those of the second contain a very large proportion. Hence the difference of their component parts.

Porcelainous shells, when exposed to a red heat, crackle, and lose the colour of their enamelled surface. They emit no smoke nor smell; their figure continues unaltered; their colour becomes opaque white, tinged partially with pale grey. They dissolve when fresh with effervescence in acids, and without leaving any residue; but if they have been burnt there remains always a little charcoal. The solution is transparent, gives no precipitate with ammonia or acetic of lead; of course it contains no sensible portion of phosphat or sulphat of lime. Carbonat of ammonia forms down an abundant precipitate of carbonat of lime. Porcelainous shells, then, consist of carbonat of lime cemented together with a small portion of animal matter, which is soluble in acids, and therefore resembles gelatine.

2. Mother of pearl shells when exposed to a red heat, crackle, blacken, and emit a strong foetid odour. They exfoliate, and come partly dark grey, partly a fine white. When immersed in acids they effervescence at first strongly; but gradually more and more feebly, till at last the effervescence of air-bubbles is scarcely perceptible. The acids take up only lime, and leave a number of their mucilaginous substances which still retain the form of the shell.

Some genera of sea-shells are extremely numerous, and the species under many of them are also very much so. However, they may be divided into three series or orders; the first comprehending all shells formed only of one piece, called simple or univalve shells; the second, all those shells composed of two parts or valves, under the name of bivalves; and the third, all shells composed of several parts or valves, under the name of multivalves. This method takes in all the shells hitherto known; the land, as well as the sea-shells, being all comprehended under one or other of these divisions; indeed, all the recent land-shells are univalve, but the fossil shells belong to all the three series.

SHELLS, fossil, those found buried at great depths in earth, and often immersed in the hardest stones. These fossil shells, as well as those found lying on the sea-shore, make an excellent manure, especially for cold clayey lands.

SHELLS, in the military art. See Gun- NERY.

SHERARDIA, a genus of the monogyna order, in the tetradina class of plants, and in the natural method ranking under the 47th order, stellata. The calyx is small, quadridentate; the corolla monopetalous, long, and trilobate. Their seeds are naked, and crowned with the calyx. There are three species, viz. 1. arvensis; 2. muralis; 3. triticaus.

SHERIFF. As keeper of the king’s peace, the sheriff is the first man in the county, and superior in rank to any nobleman therein, during his office. He may apprehend and commit to prison all persons who break the peace, or attempt to break it, and may bind any one in a recognizance to keep the king’s peace. He may, and is bound ex officio, to pursue and take the king’s felons, traitors, forgers, debtors, and other misdeemers, and commit them to goal for safe custody. He is also to defend his county against any of the king’s felons when they come into the land; and for this purpose, as well as for keeping the peace and pursuing felons, he may command all the people of his county to attend him; which is called the pose comitatus, or power of the county; which summons, every person above fifteen years of age, and under the degree of a peer, is bound to attend upon warning, on pain of fine and imprisonment. Yet he cannot exercise the office of a justice of the peace, for then this inconvenience would arise, that he should command himself to execute his own precepts. 1 Black. 343.

The sheriff has a jurisdiction both in criminal and civil cases; and therefore he has two courts: his for criminal cases, which is the king’s court; the other is his county court, for civil cases, and the court of the sheriff himself. 3 Salk. 329.

When the new sheriff is appointed and sworn, he ought at or before the next county court, to deliver a writ of discharge to the old sheriff; who is to set over all the prisoners in the gaol, severally by their names, (to-
SHIP, a general name for all large vessels, particularly those equipped with three masts and a bowsprit; the masts being composed of a lower-mast, top-mast, and top-gallant-mast; each of these being provided with yards, sails, &c. Ships, in general, are either employed for war or for navigation.

Straits of war are vessels properly equipped with artillery, ammunition, and all the necessary martial weapons and instruments for attack or defence. They are distinguished from each other by their several ranks or classes, called rates, as follows: ships of the first rate mount from 100 guns to 110 guns and upwards; second rate, from 90 to 98 guns; third rate, from 64 to 74 guns; fourth rate, from 30 to 60 guns; fifth rate, from 19 to 34 guns; and sixth rate, from 50 to 28 guns. Vessels carrying less than 20 guns are denominated sloops, cutters, fire-ships, and bombketches.

In Plate I. Ship-building, fig. 1, is the representation of a first-rate, with rigging, &c., the several parts of which are as follow:

Parts of the hull.

A. The cat head P. The house-holes
B. The fore chain-wales Q. The chess-trees
C. The main-chiefs R. The mizen-chains
D. The mizen-chiefs S. The stern
E. The turret port

1. The bowsprit T. Preventer-stay and lanyard
2. Yard and sail U. Yard
3. Gammorning V. Buntlines
4. Manrop W. Bowsprit
5. Bobstay X. Spinnakers
6. Spritsail sheets Y. Yards
7. Staylines Z. Top-sails
8. Staylines and pennants A. Top
9. Halliards B. Yard-tackles
10. Lifes C. Yard
11. Clew-lines D. Buntlines
12. Spritsail horses E. Standing-lifts
13. Buntlines F. Bowsprit-shroud
14. Standing-lifts G. Bow-lines and bridle
15. Bowsprit-shroud H. Jib-boom
16. Jib-boom I. Jibstay and sail
17. Jibstay and sail J. Staylines
18. Halliards K. Forebetimes
19. Sheets L. Mistrees
20. Horses M. Spanker
22. Spritsail-top-sail O. Yard
23. Horses P. Stay and sail
24. Sheets Q. Bows
25. Lifes R. Spanker
26. Braces and pennants S. Runner and tackle
27. Cap of bowsprit T. Mistrees
28. Jack-staff U. Spanker
29. Truck V. Halyards
30. Jack flag W. Halyards
31. Fore-mast X. Runner and tackle
32. Runner and tackle Y. Lanyards
33. Shrouds Z. Bows and bridle
34. Laniards A. Stay and lanyard
35. Stay and lanyard B. Reef-tackles
36. Preventer-stay and lanyard C. Buntlines
37. Forecast-mast D. Reef-tackles
38. Runner and tackle E. Cross-trees
39. Bows and bridle F. Cap
40. Halyards G. Mistrees
41. Lanyards H. Spanker
42. Bows and bridle I. Halyards
43. Bows and bridle J. Mistrees
44. Halyards K. Runner and tackle
45. Runner and tackle L. Bows and bridle
46. Bows and bridle M. Halyards
47. Runner and tackle N. Mistrees
48. Bows and bridle O. Halyards
49. Runner and tackle P. Mistrees
50. Bows and bridle Q. Halyards
51. Runner and tackle R. Mistrees
52. Bows and bridle S. Halyards
53. Runner and tackle T. Mistrees
54. Bows and bridle U. Halyards
55. Runner and tackle V. Mistrees
56. Bows and bridle W. Halyards
57. Runner and tackle X. Mistrees
58. Bows and bridle Y. Halyards
59. Runner and tackle Z. Mistrees
60. Bows and bridle A. Halyards
61. Runner and tackle B. Mistrees
62. Bows and bridle C. Halyards
63. Runner and tackle D. Mistrees
64. Bows and bridle E. Halyards
65. Runner and tackle F. Mistrees
66. Sheets G. Halyards
67. Buntlines H. Mistrees
68. Cross-trees I. Halyards
69. Cap J. Mistrees
70. Forecast-mast K. Halyards
71. Shrouds L. Mistrees
72. Yard and sail M. Halyards
73. Backstays N. Mistrees
74. Stay O. Halyards
75. Lifes P. Mistrees
76. Clew-lines Q. Halyards
77. Braces and pennants R. Mistrees
78. Bow-lines and bridles S. Halyards
79. Flagstaff T. Mistrees
80. Truck U. Halyards
81. Flagstaff-staff V. Mistrees
82. Flag of the lord W. Halyards
83. High admiral X. Mistrees
84. Shrouds Y. Halyards
85. Lamiards Z. Mistrees
86. Runner and tackle A. Halyards
87. Futtock-shrouds B. Mistrees
88. Top-lantern C. Halyards
89. Crank of ditto D. Mistrees
90. Stay E. Halyards
91. Preventer stay F. Mistrees
92. High-admiral G. Halyards
93. Woodling of the mast H. Mistrees
94. Jeers I. Halyards
95. Yard-tackles J. Mistrees
96. Derrick and spank B. Halyards
97. Braces and pennants C. Mistrees
98. Horses D. Halyards
99. Sheets E. Mistrees
100. Tacks F. Halyards
101. Bowsline and bridles G. Mistrees
102. Crow-foot H. Halyards
103. Cap I. Mistrees
104. Top J. Halyards
105. Buntlines K. Mistrees
106. Leciellines L. Halyards
107. Yard and sail M. Mistrees
108. Mia-topmast N. Halyards
109. Shrouds and laniards O. Mistrees
110. Yard and sail P. Halyards
111. Futtock shrouds Q. Mistrees
112. Backstays R. Halyards
113. Stay S. Mistrees
114. Stay-sails and hal S. Halyards
115. Cross-trees T. Mistrees
116. Ships U. Halyards
117. Lifts V. Mistrees
118. Clew-lines W. Halyards
119. Braces and pennants X. Mistrees
120. Bows and bridle Y. Halyards
121. Sheets Z. Mistrees
122. Bowsline and bridles A. Halyards

SHEEP, a vessel fitted up to attend on a fleet of men of war, and receive their

Ships of war are fitted out either at the expense of the state or by individuals. Those fitted out at the public expense are called king's ships, and are divided into ships of the line, frigates, sloops, &c. Ships of war fitted out by individuals are called privateers.
When the wind is cross, or nearly cross off shore, or on the opposite direction, ships will always back. This is done by the mizen-top sail, assisted, if needful, by the mizzen-staysail; such as have no mizen-top sail commonly use the main-top sail, or if it blows hard, the top-gallant-sail, or any such sail at the gaff.

In backing, a ship should always wind with a tawt cable, that it may be certain the anchor is drawn round. In case there is not a sufficiency for that purpose, the ship should be hove about.

Riding with the wind afore the beam, the yards should be braced forward; if abaft the beam, they are to be braced all aback.

If the wind is so fair that the ship will not back (which should not be attempted if, when the tide eases, the ship forges ahead, and brings the buoy on the lee quarter), she must be set ahead: if the wind is fair, and blows fresh, the utmost care and attention are necessary, as ships riding in this situation often break their sheets and come to windward of their anchors again. It should be observed, that when the ship lies in this situation, it is best to braced forward, and the fore-yards the contrary way; she will lie safe, as the buoy can be kept on the lee quarter; or suppose the helm is aport, as long as the buoy is on the fore-yards, wind the helm off, and the wind right aft, or nearly so, the starboard main and fore braces should be hauled in. This supposes the main braces to lead forward.

When the ship begins to tend to leeward, and the buoy comes on the weather-quarter, the first thing to be done is to brace about the fore-yard; and when the wind comes near the beam, set the fore-stay sail, and keep it standing until it shakes; then brace all the yards sharp forward, especially if it is likely to blow strong.

If lying in the aforesaid position, and she breaks her head, brace about the main-yard immediately; if she recovers and brings the buoy on the lee or larboard quarter, let her main-yard be again braced about; but if she comes to a shear the other way, by bringing the buoy on the other quarter, change the helm and brace the fore-yard to.

Riding leeward tide with more cable than the windward service, and expecting the ship will go to windward of her anchor, begin as soon as the tide eases to shorten in the cable. This is often hard work; but it is necessary to do it, otherwise the anchor may be fouled by the great length of cable the ship has to draw round; but even if that could be done, the cable would be damaged against the bows or cut-water. It is to be observed, that when a ship rides windward tide the cable should run down upon the short service towards the anchor, as far as will prevent the bare part touching the ship.

When the wind tends to windward and must be set ahead, hoist the fore-stay sail as soon as it will stand; and when the buoy comes on the larboard quarter, let the fore-yard be braced to the fore-yard and put the helm alee; for till then the helm must be kept aweather and the yards full.

When the ship rides leeward tide, and the wind increases, care should be taken to give her more cable in time, otherwise the anchor may start, and probably it will be troublesome to get her right up again; and this care is the more necessary when the ship rides in the hause of another ship. Previous to giving a long service it is usual to take a weather-linet, that is, a turn of the cable over and then lowering away the ship will be under command. The service ought to be greased, which will prevent its chafing in the hause.

If the Gale continues to increase, the topsmasts should be struck in time; but the fore-yard should remain till it be lowered down, in case of parting the foresail may be ready to be set. At such times there should be more on deck than the common anchor-watch, that no accident may happen from instant failure of aseye.

In a tide-way a second anchor should never be let go but when absolutely necessary; for a ship will sometimes ride easier and safer, especially if the sea runs high, with a very long scope of cable and one anchor, than with less length and two cables; however, it is advisable, as a preventive, when ships have not room to drive, and the night is dark, to let fall a second anchor under foot, with a range of cable along the deck. This is not thought necessary to be done if the deep-sea lead should be thrown overboard, and the line frequently handed by the watch, that they may be assured she rides fast.

If at any time the anchor-watch, presuming on their own knowledge, should wind the ship, or suffer her to break her sheer without calling the mate, he should immediately, or the very first opportunity, oblige the crew to brave the anchor in sight; which will prevent the commission of the like fault again; for, besides the share of trouble the watch will have, the rest of the crew will blame them for neglecting their duty.

Prudent mates seldom lie a week in a roadstead without having their anchor in sight; even though they have not the least suspicion of its being foul. There are other reasons why the anchor should be looked at; sometimes the cable receives damage by overwearing rakes or anchoring too long, or being lost, or iron rocks or stones; and it is often necessary to trip the anchor, in order to take a clearer birth, which should be done as often as any ship brings up too near.

SHIP-BUILDING may be defined, the manner of constructing ships, or the work itself, as distinguished from naval architecture, which may be considered as the theory or art of delineating ships on a plane.

Art of delineating ships on a plane.

All edifices, whether civil or military, are known to be erected in consequence of certain established plans, which have been preserved altered or improved till they have arrived at their destined point of perfection. The construction of ships appears also to require at least as much correctness and precision as the buildings which are founded upon terra firma; it is therefore absolutely necessary that the mechanical skill of the shipwright should be assisted by plans and sections, which have been drawn with all possible exactness, examined by proper calculations, and submitted to the most accurate scrutiny.

Naval architecture may be distinguished
SHIP-BUILDING.

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into three principal parts. 1. To give the ship such an exterior form as may be most suitable to the service for which she is designed. 2. To give the various pieces of a ship their proper figure, to assemble and unite them to a framework, so that by their combination and disposition they may form a solid fabric, sufficient to answer all the purposes for which it is intended. 3. To provide convenient accommodations for the officers and crew, as well as suitable apartments for the cargo, furniture, provisions, artillery, and ammunition.

The exterior figure of a ship may be divided into the bottom and upper works. The bottom, or quick-work, contains what is termed the hold, and which is under water when the ship is laden. The upper works, called also the dead-work, comprehend that part which is usually above the water when the ship is laden. The figure of the bottom is therefore determined by the qualities which are necessary for the vessel, and conformable to the service for which she is proposed.

The limits of our design will not admit of a minute description and enumeration of all the pieces of timber which enter into the construction of a ship, nor of a particular description of every angle and union, or the manner in which they reciprocally contribute to the solidity of those floating cities.

It is usual among shipwrights to delineate three several draughts. 1. The whole length of the ship is represented according to a side view, perpendicular to the keel, and is termed the plane of elevation, or sheer draught. Plate II. fig. 10, 11, the name exhibited according to an end view, and stripped of her planks, so as to present the outlines of the principal timbers; and this is properly termed the plane of projection, or the vertical plane of the timbers (fig. 11), because it shows the projection of their frames relatively to each other. 2. It is not sufficient to have the vertical curves of the bottom in different planes, for a distinct idea of the horizontal curves is equally necessary, as obtained by the horizontal lines, traced upon what is called the horizontal plane (fig. 11). In this draught the curves of the transoms, called the round- aft, are also marked, and sometimes the breadth and thickness of the timbers.

The plane of elevation (fig. 10), determines the length and depth of the keel; the difference of the draughts of water; the length and projection, or rake, of the stem and stern-post; the position of the midship-frame upon the keel, together with that of the principal upper deck abreast and abaft; the loadwater line; the water; the dimensions and situations of the gun-ports; the projection of the rails of the head and stern-galley; with the stations of the masts and channels.

This draught, however, conveys no idea of the vertical curve of the ribs or timbers; for as their projection will be only represented in a plane elevated upon the length of the keel, they will appear as different straight lines. To perceive these curves accurately, they must be regarded in another point of view; which will represent their projection upon a vertical plane, supposed to cut the keel at right angles in the place where the ship is broadest.

For, as all ships are broadest near the middle of their length than towards the extremities, it is evident that the timbers are more extended in proportion. The most capacious parts of the ship represent the midship frame; and upon the area of this frame is delineated the projection of all the others.

Thus the plane of projection limits the different breadths of a ship in various points of her length, and exhibits the outline of the timbers respectively to each other as they are erected upon the keel. Accordingly, this draught ought to present a variety of sections of the ship in different places of her length, and always perpendicular to the surface of the water; so that the eye of the observer, when placed in what may be properly termed the axis of the ship, may perceive the several sections at one glance; that is to say, when looking full on the stem from before the ship, he shall discover the forestimbers; and when looking from behind, directly to the stern, he shall perceive the form of the after-timbers.

To form a just idea of this plane, therefore, we ought to suppose a ship resting upon the bottom, with the stern in the same situation above the water, and the prow directed to the water. Thus a variety of black vertical lines may be drawn at equal distances upon the bottom, which is white, to form different outlines of the ship corresponding to the timbers within. It is to be observed, that the fashion of the inferior timbers must conform to the figure of the midship-frame, which is placed in the fullest part of the ship; and as the planes of all their timbers diminish in a certain progression as they approach the stern and stem, they are properly delineated upon the plane of the midship-frame, which also represents the depth of the keel and length of the midship-beam.

As the two sides of a ship ought to be exactly alike, it is judged sufficient to represent the sections of the fore-part of the ship on the left side, and those in the after-part on the right side, so as to perceive all the sections, as well afore as abaft, upon one plane. See the Plate, fig. 12.

However necessary it may be to understand precisely the vertical curves of the bottom, it is far less necessary than to have a just idea of those which are horizontal.

The horizontal or floor-plane is that upon which the whole frame is erected, and will be more clearly understood by previously describing the water-lines and ribs of which it is composed.

When a ship floats upon the stream, it is evident that her upper works will be separated from the bottom by the surface of the water, which will accordingly describe an imaginary horizontal line upon the bottom from the stem to the stern-post.

The most elevated of those lines is termed the load-water line, which is supposed to be drawn by the surface of the water on the upper part of the bottom, when she is sufficiently laden for her draught. For it we suppose this surface a rule, and thereby describe a corresponding black line along the vessel's bottom, that line will be distinguished upon the bottom, which is white, and represent what is called the load-water line.

If the ship is lightened of any part of her lading, and preserves the same difference in her draught of water at the two ends; or, what is the same thing, if she is lightened so as to preserve the same equilibrium of the keel with regard to the surface of the water, it is evident that the water will rise higher out of the water; so that the load-water line may be elevated above it; and another black line may be delineated upon the bottom, close to the surface of the water, which will exhibit a second water-line parallel to the first, but nearer the keel in proportion to the number of feet which the ship has risen.

Thus by lightening a ship gradually, and at the same time preserving the direction of her keel, or the angle which the keel makes with the surface of the water, a variety of water-lines may be drawn parallel to each other, and to the load-water line.

The ribs are likewise of great utility in ship-building; they are narrow and flexible planks placed on the bottom at different heights, so as to form a sort of mould for stationing the inferior timbers between the principal ones. They  differ from the water-lines, inasmuch as the latter is a line curve, which is horizontal; whereas the ribs, besides their horizontal one, have a vertical curve. To convey a just idea of these curves, which cannot be represented on the draughts at their true magnitude, or an oblique section of the ship's length, it will be necessary to have recourse to two planes; that of the elevation, which exhibits their vertical curve; and to the floor-plane, upon which the horizontal curve is expressed.

These different lines are extremely useful in exhibiting the various curves of a ship's bottom, that, as they are gradually diminished, their uniformity or irregularity may be discovered by the skilful artist.

The qualities required in a ship ought to be determined by the figure of the bottom. A ship of war, therefore, should be able to sail swiftly, and carry her lower tier of guns sufficiently out of the water; otherwise a small ship will have the advantage of a large one, inasmuch as the latter cannot open her lower battery in a fresh side-wind without being exposed to extreme danger by receiving a quantity of water between decks. Merchant-ship ought to contain a large cargo of merchant-goods, and be navigated with few hands; and both should be able to carry sail firmly, steer well, drive little to leeward, and sustain the shocks of the sea without being violently strained.

The first thing to be established in the draught of a ship, is her length; and as a ship of war, according to her rate, is furnished with a certain number of cannon, which are placed in battery on her decks, it is necessary that a sufficient distance should be left between their ports to work the guns with facility; and particularly to leave space enough between the foremost guns and the stern, and between the aftmost gun and the stern-post on each side, on account of the arching or inward curve of the ship toward her extremities.

When the length of a ship is determined, it is usual to fix her breadth by the dimensions of the midship-beam. On this occasion the shipwrights, for the most part, are conducted by rules founded on their own observation; for, having remarked, that some vessels, which by repeated experience have
been found to answer all the purposes of navigation, have a certain breadth in proportion to their length, they have inferred that it would be improper to depart from this proportion; but no other ships have been constructed with different breadth without which a ship would be incapable of being driven to a ship relatively with her length, whilst each one produces a reason and experience in support of his own standard. Those who would diminish the breadth, allege: 1. That a narrow vessel meets with less resistance in passing through the water. 2dly. That by increasing the length she will drive less to leeward. 3dly. That according to this principle, the water-lines will be more conveniently formed to divide the fluid. 4thly. That a long and narrow ship will require less sail to advance quickly; that her masts will be lower, and her rigging lighter, and, by consequence, the seams less fatigued with more rigorous sail to the wind. Those of the contrary, who would enlarge the breadth, pretend, 1st. That this form is better fitted to preserve a good battery of guns. 2dly. That there will be more room to work the guns conveniently. 3dly. That by having more sail, the ship will be enabled to run faster, or, that this quality will at least overbalance the advantage which the others have of more easily dividing the fluid. 4thly. That being broader and more water-line, or place where the surface of the water describes a line round the bottom, they will admit of being very narrow on the floor, particularly towards the extremities. And, 5thly. That a broad vessel will more readily rise under the waves than a narrow one. From such opposite principles has resulted that variety of standards adopted by different shipwrights.

It has been remarked above, that a ship of war must carry her lower tier of cannon high enough above the water, otherwise a great ship which cannot open her lower battery, when sailing with a fresh side-wind, may be taken by a small one that can make use of the same advantage.

A ship should be duly poised, so as not to dive or pitch heavily, but go smooth and easy through the water, rising to the waves when they run high, and the ship has reduced her sail to the storm; otherwise they will break aback, and stran the decks or carry away the boats: the masts are likewise in great danger from the same cause.

A ship should sail well when large and before the wind, but chiefly close hauled, or with a side-wind, and her sails sharp trimmed, and the main gaff full off to the larder.

Now, the great difficulty lies in uniting so many different qualities in one ship, which seems to be nearly impossible; the whole art, therefore, consists in forming the body in such a manner that none of these qualities should be absolutely denied, and giving a preference to that which is chiefly required in the particular service for which the vessel is designed. We shall briefly show the possibility of uniting them all in one ship, that can be equally driven in long, and highly felt by the wind. If it happens otherwise, the fault must lie in the builder, who has not applied himself to study the fundamental rules and principles of his art.

To make a ship carry a good sail. A flat fore-timber, and somewhat long, or the lower futtock pretty round, a straight upper futtock, and the spar-timber to throw the breadth out aloft, in order to carry her main and breadth as high as the lower deck. Now, if the rigging is well adapted to such a body, and the upper works lightened as much as possible, so that they all consent to lower the centre of gravity, there will be no room to doubt of her carrying a good sail.

To make a ship steer well, and answer the horn quickly. If the fashion-pieces are well formed, the tack, or spreading parts under the stern, carried pretty high, the midship-frame well forward, a considerable difference in the draught of water abaft more than aloft, a great rake forward and oblong, a snug quarter-deck and fore-castle; all these will make a ship steer well. A ship which sails well is very easily driven.

To make a ship carry her guns well out of the water. A long floor-timber, and not of great rising; a very full midship-frame, and low tack, with light upper works.

To make a ship go smoothly through the water without pitching hard. A long keel, a long floor, not to rise too high aloft and abaft; but the area or space continued in the fore-body, according to the respective weights they are to carry; all these are necessary to make a ship go smoothly through the water.

To make a ship keep a good wind, and drive lickety to the leeward. A good length of keel, but not too long; and pretty deep in the hold, which will occasion her to have a short floor-timber, and a great rising. As such a ship will meet with great resistance in the water going over the breadthside, and little when going ahead, she will not fall much to the leeward.

Now, some builders imagine it is impossible to make a ship carry her guns well, bear a good sail, and be a prime sailer, because it would require a very full bottom to gain the first two; whereas, a sharp ship will answer better for the latter; but when it is considered that a full ship will carry a great deal more sail than a sharp one, a good artist may so form the body as to have all these three good qualities, and also steer well.

Without attempting to describe the pieces of which a ship is composed, and to explain the principal draughts used in the construction thereof, we observe that in vessels of war, the general dimensions are established by authority of officers appointed by the government to superintend the building of ships. In the merchant-service, the extreme breadth, lengths of keel, depth in the hold, height between decks and abaft, are agreed on by contrast; and from these dimensions the shipwright is to form a draught suitable to the trade for which the ship is designed. In projecting the draught of a vessel of war, the first article to be considered is her length. As all ships are much longer above than below, it is also necessary to distinguish the precise part of her height from which her length is taken; this is usually the lower gun-deck, or the main water-line. It has been already observed, that water-lines are described longitudinally on a ship's bottom by the surface of the water in which she floats; and that the line which determines her depth under the water, is usually termed the load water-line. In this draught it will be proper to consider it necessary to leave sufficient distance between the water-line and the deck, to contain the effects of the faults of construction.

The next object is to establish the breadth of the midship-beam. Although there is great difference of opinion about proportioning the breadth to the length, yet it is most admitted to be necessary to have ships of the same rate. After the dimensions of the breadth and length are determined, the depth of the hold must be fixed, which is generally half the breadth; but the breadth of the ship should be considered on this occasion; for a flat floor will require less depth in the hold than a sharp one. The distance between the decks must also be settled.

We may then proceed to fix the length of the keel, by which we shall be enabled to judge of the rake of the stem and stern-post. The rake is known to be the projection of the ship at the height of the stem and stern-post, and the ends of the keel above and abaft, or the angle which they may be increased as the fabric rises. To this we may also add the height of the stem and wing-transom. After these dimensions are settled, the timbers may be considered which form the sides of the ship. A frame of timbers, which appears to be one continued piece, is composed of one floor-timber, whose arms branch outward to both sides of the ship; two or three futtocks, and a top-timber. The futtocks are connected to the upper arms of the floor-timbers, and cause the frame to be prolonged the timber in a vertical direction; and the top-timbers are placed at the upper part of the futtocks for the same purpose; all these being united, and secured by crossbars, or a circular inclosure, which is called a frame of timbers. And as a ship is much broader at the middle than at the extremities, the arms of the floor-timber will form a very acute angle at the extreme breadth; but this is decreased by the dimensions of the timbers from the midship-frame, so that the foremost and aftermost ones will form a very acute angle. Floor-timbers of the latter sort are usually called crutches.

Shipwrights differ extremely in determining the station of the midship-frame; some placing it at the middle of the ship's length, others further forward. They who place it before the middle, allege, that if a ship is full forwards, she will meet with no resistance after she has opened a column of water; and that the water so discharged will easily unite abaft, and by that means force the ship forward; besides having more power on the rudder, in proportion to its distance from the centrefore, the motions of the vessel cause the form of shives, which should be the most advantageous for dividing the fluid.

When the rising of the midship floor-timber is decided, we may then proceed to describe the rising line of the floor, on the stem-post above the station of the midship-frame; some placing it at the middle of the ship's length, others forward. They who place it at the middle of the ship, allege, that if a ship is full forwards, she will meet with no resistance after she has opened a column of water; and that the water so discharged will easily unite abaft, and by that means force the ship forward; besides having more power on the rudder, in proportion to its distance from the centrefore, the motions of the vessel cause the form of shives, which should be the most advantageous for dividing the fluid.

The height of the lower-deck is the next thing to be considered; it is determined in the middle by the depth of the hold; and some builders make it no higher than the stem; but they raise it abaft as much above its height in the middle, as the load water-
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mask, or of draught of water abaft, exceeds that at
take with regard to the height between decks, it is altogether arbitrary, and must be
determined by the rate of the ship and the service she is designed for.

It is also necessary to remember the sheer of the wales and to give them a proper hang-
ing; because the beauty and stateliness of a ship greatly depend upon their figure and curve, which, if properly drawn, will make her appear airy and graceful and the water line plain.

We come now to consider the upper works and all that above water, called the deck-
work: and here the ship must be narrower so that all the weight lying above the low water-line, will thereby be brought nearer the middle of the breadth, and of course the ship will be less strained by the working of her guns, &c.

But although some advantages are acquired by diminishing the breadth, above water, we must be careful not to narrow her too much; as there must be sufficient room left on the upper deck for the quarter gallery, the direction of the mast, etc. The stern, the quarter gallery with its windows, ED, the quarter galleries, which limit the stern on each side, F, the taffrail, or upper piece of the stern, FG, profile of the stern with its galleries, H, the gun-port, I, the channel, K, the winch-pan, KG, the counter, LB, the deck-pan. MNO, the first, second, and third transoms, of which O K is the third or lowest, OL, the deck-piece, L, the fashion-piece, having its breadth carried aft nearly towards the stern. QR, the main sked, for holding in the keels clear of the ship's side. SR, the main wale, with its sheer at the head and curved parallel to the main-wale. ST, the sheer parallel to the wales. T, the rudder. A, P, the rake of the stern. YW, the waist rail. P, P, the drip rails abaft and at the drift rails forward. TUC, the water-line, XX, the rails of the head. Y, the knee of the head, or cutwater. ZZ, the checks of the head, A, the cathead. MG, C, the rising line of the floor. K C, the cutting-down line, which limits the thickness of all the floor-timbers, and likewise the height of the dead wood abaft and stern. U, UW, the midship-frame. a, b, c, d, e, f, g, h, the frames or timbers in the fore body of the ship, that is, before the midship-frame. I.

As the eye of a spectator is supposed in this projection to view the ship's side in a line perpendicular to the plane of elevation, it is evident that the convexity of that side of a cylinder of globes, when viewed at a great distance; and that the frames will consequently be represented by straight lines, except the fashion-piece abaft and the knuckle-timber forward.

It has been already observed, that the plane of projection may be defined a vertical delineation of the curves of the timbers upon the plane of the midship-frame, which is perpendicular to that of the elevation. It is necessary to observe here, that the various methods by which these timbers are described, are equally mechanical and arbitrary. In the latter sense, they are calculated to make a ship fuller or narrower, according to the service for which she is designed; and in the former they are drawn according to those rules which the artist has been implicitly taught to follow, or which his fancy or judgment has esteemed the most accurate and convenient. They are generally composed of several arches of a circle, connected together by moulds framed for that purpose.

The radii of those arches, therefore, are of different lengths, according to the breadth of the ship in the place where such arches are swept; and they are all based on the plane of projection either by horizontal or perpendicular lines; the radii of the breadth-sweeps being always in the former, and the radii of the floor-sweeps in the latter direction. These arches are divided by a third, which coincides with both without intersecting either. The curve of the top-timber is either formed by a mould which corresponds to the arch of the breadth-sweep, or by another sweep, whose centre and radius are without the plane of projection. The breadth of the ship at every top-timber, is limited by a horizontal line drawn on the floor-plane, called the half-breadth of the top timbers. The extreme breadth is also determined by another horizontal line on the floor-plane; and the lines of half-breadth are thus mutually transferable from the projection and floor-planes to each other.

The necessary data by which the curves of the timbers are determined, then, are the perpendicular height from the midship-frame to the main or principal breadth; and the top breadth; for as a ship is much broader near the middle of her length than towards the end, so she is broader in the middle of her height than above and below; and this latter difference of breadth is contained throughout every point of her length. The main breadth of each frame of timbers, is therefore the ship's breadth nearly in the middle of her height in that part, and the top breadth is the line of her breadth near the upper ends of each timber. It has been already observed, that as both sides of a ship are alike, the arches only draw one side, from which both sides of the ship are copied. Therefore the timbers abaft the midship-frame are exhibited on one side of the plane of projection, and the timbers before it on the other.

Plane of projection.

Fig. 12. A, the keel. BC, the line which expresses the upper edge of the keel, from which the height of each timber and height of its different breadths are measured. BD, and CE, perpendiculars based on the line BC, to limit the ship's extreme breadth and height and breadth abaft, by other words, to limit the breadth and height of the midship-

frame. AF, a perpendicular erected from the middle of the keel to intersect the line of the ship's breadth in two equal parts. P, G, the half-breadth line of the aftmost top-tim-
ber; being the uppermost horizontal line in this figure.

The seven lines parallel to and immediately under this, on the right side of the line AF, are all top-timber half-breadths, where the midship-frame; the lowest of which coincides with the horizontal line DE.

The parallel horizontal lines nearly opposite to these, on the left side of the line AF represent the top-timber half-breadths in the fore-body, or the half-breadths of the top-timbers before the midship-frame.

G, H, I, Q, R, S, T, the radii of the breadth-sweeps abaft the midship-frame; those of the breadth sweeps in the fore-body, or before the midship-frame, are directly opposite on the right side.

G, A, show the midship-frame, from the extreme breadth downwards, 1, 2, 3, 5, 6, 7, 8, 9, the outlines of the upper deck, or the midship-frame, in different parts of the height, K, L, M, N, O, the outlines of the timbers before the midship-frame, in different parts of their height, K being the foremost or knuckle-timber. K, L, the wing-timbers, with a dotted line, the figure of the fashion-piece, L, the deck-transom, parallel to and under the wing timbers. MNO, the lower transoms, of which O K is the third and lowest. m, n, p, q, r, s, the radii of the floor-sweeps, sbnt before the midship-frame; those before the midship-frame are on the opposite side of the line AF, to which they are all parallel.

1st R, 2d R, 3d R, 4th R, the diagonal ribs abaft the midship: t, u, x, y, the same ribs expressed in the forebody.

It has been remarked, above, that the horizontal plane is composed of water-lines and ribs; also it contains the main and top-timber-breadths, or longitudinal lines by which the main-breadth and top-timbers are limited in every point of the ship's length. The horizontal lines upon the deck-pan and timbers, and the ordinates drawn from them, are the lines of the main-breadth, the main and top-timbers abaft the midship-frame are limited by every point of the ship's length. The horizontal and vertical lines on the deck-pan and timbers, and the ordinates drawn from them, are the lines of the main-breadth, the main and top-timbers abaft the midship-frame are limited by the length of the ship.

Horizontal Plane.

RAC, Fig. 11, the line of the ship's length, passing through the middle of the stem and stern-post. C, the upper end of the stem. B, the length of the rake abaft. DWX, the top-timber-breadth line, or the line which limits the breadth of each top-timber. DEF, the breadth of the aftermost timbers. BS, the wing-transom. BIL, the horizontal curve of the deck-transom. AE, the top-timber-breadth line, or the line which limits the breadth of each top-timber. AM, the horizonal curve of the second transom; it is prolonged into a water-line, N S. O, the horizontal curve of the third transom, which is also prolonged into another transom, O N, U, Q, to O P, the plane of the fashion-piece, as con-
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Of constructing ships.

The pieces by which this complicated machine, a ship, is framed, are joined together in various pieces, by scarfing, rabiting, tenoning, and dovetailing. Thus the plane of elevation of the timbers of the midship-frame, the keel, and the floor-timber, are mutually transferred, and thus the height of the midship-frame of the ship is increased.

During the construction of a ship, she shall be supported in the dock, or upon a wharf, by a number of solid blocks of timber placed at equal distance from, and parallel to, each other, and thus secured to the boat-blocks, as shown by the letter "\(X\)," the figure of the upper rail of the head, \(Y\), the projection of the knee of the head.

The third horizontal riband is marked on the plate, \(a\), \(a\), the projection of the cut-head.

Thus, we have endeavoured briefly to explain the nature and uses of the principal draughts used in the construction of a ship, which also correspond with each other in the dimensions of length, breadth, and depth. Thus, the plane of elevation of the timbers in the floor-plane, and that of the projection, are mutually transferable, and the height of the timbers in the projection conforms to their height in the elevation. Thus, let it be required to transfer the height of the wing-transom from the elevation to the projection.

Extend the compasses from the point \(K\), in the elevation, down to the dotted line prolonged from the upper edge of the keel, and setting the other foot in the point \(p\), then shall the line \(K\) be the perpendicular height, in the wing-transom, transfer the line from the midship-frame to the elevation, to the point \(K\) in the perpendicular AF, then will \(AK\) be the height of the wing-transom in the plane of projection; and thus the height of all the transoms may be laid from the form upon the latter.

Again: Let it be required to transfer the main-breadth of the midship-frame from the projection to the horizontal plane: Set one foot of the compasses in the point \(a\) on the perpendicular \(CE\), and extend the other along the main-breadth sweep \(G\), till it touches the perpendicular \(AP\) parallel to \(CE\); by this distance upon the horizontal plane from the point \(a\) in the line of the ship's length, \(BAC\), along the plane of the midship-frame to the point \(a\); so shall the line \(G\) will be the breadth of the midship-frame on the horizontal plane.

Thus also the top-timber-breadth, or the depth of the ship by-drawer from the midship of the ship's breadth, may be in the same manner transferred, by extending the compasses from the line \(BAC\), in the horizontal plane, to the top-timber-breadth line upon any particular timber, as 1, 2, 3, &c., which will give its proper dimensions thereon.

In the same manner the breadths of all the timbers may be laid from the projection to the horizontal plane, and, vice versa, from the elevation to the projection. Thus the height of each timber may also be transferred from the elevation to the projection, &c.

The principal utility of these draughts, therefore, is to exhibit the various curves of the ship's body, and of the pieces of which it is framed, in different points of view, which are either transverse or longitudinal, and will accordingly present them in very different directions. Thus the horizontal curves of the timbers, and the water-line, are represented on the floor-plane, all of which are transferred into the midship-frame, which is framed, in different points of view, which are either transverse or longitudinal, and will accordingly present them in very different directions. Thus the horizontal curves of the timbers, and the water-line, are represented on the floor-plane, all of which are transferred into the midship-frame, and the vertical curves of the timbers are all exhibited on the projection, although they appear as straight lines in the elevation and floor-plane.
The hull being thus fabricated, they proceed to separate the apartments by bulkheads, or partitions; to frame the ports; to fix the cut-heads and chess-tees; to form the hatchways and scuttles, and fit them with proper covers or gratings. They next fix the hold by the frames of the different hatchways; and build the manger on the lower deck, to carry off the water that runs in at the hawse-holes when the ship rides at anchor in a sea. The breast-room and magazines are then lined; and the gunnel, cabin, and gangways, fixed on the upper part of the ship. The ceats, keels, and rade ranges, by which the ropes are fastened, are afterwards bolted or nailed to the sides in different pieces.

The rudder, being fitted with its iron, is next hung to the stern-post; and the tiller, or bar, by which it is managed, let into a morrobine at its upper end. The stoppers, or leaden tubes, that carry the water off from the deck, are then placed in holes cut through the ship's sides; and the standards bolted to the beams and sides above the decks to which they belong. The poop-lanthorns are fast fixed upon the deck near the bow and stern; the forward and after frames, or cracles, placed under the bottom, to conduct the ship steadily into the water whilst launching.

Stowing and trimming of ships, the method of disposing of the cargo in a proper and judicious manner in the hold of a ship. A ship's sailing, steering, and wearing, and being lively and comparatively easy at sea in a storm, depend greatly on the cargo, ballast, or other materials, being properly disposed according to their shape and bulk, and the proportional dimensions of the built of the ship, which may be made too crab or too stiff to pass on the ocean with safety. These things render this branch of knowledge of such consequence, that rules for it ought to be endeavoured after, if not to prevent, as much as possible, the danger of a ship over-setting at sea, or being so laborious as to roll away her masts, &c. by being improperly stowed in the case.

When a ship is new, it is prudent to consult the builder, who may be supposed best acquainted with a ship of his own planning, and most likely to judge what her properties will be. The cargo of materials, according to the nature of them, ought to be disposed of to advantage, so as to put her in the best sailing trim; and at every favourable opportunity afterwards it will be proper to endeavour to find out her best trim by experiment.

Ships must differ in their form and proportional dimensions; and to make them answer their different purposes, they will require different management in the stowage which ought not to be left to mere chance, or done at random, as goods or materials happen to come to hand, which is too often the case that such improper stowage makes ships unfit for sea; therefore the stowage should be considered, planned, and contrived, according to the built and properties of the ship, which if they are not known should be inquired after. If she is narrow and high-built in proportion, so that she has a heavy list in the hold, it is a certain sign such a ship will require a great part of heavy goods, ballast, or materials, laid low in the hold, to make her stiff enough to bear sufficient soil without being in danger of over-reaching. But if a ship is built broad and low in proportion, so that she is stiff and will support herself without any weight in the hold, such a ship will require heavy goods, ballasting and hogging. If the ship is stowed too high up, to prevent her from being too stiff and laborious at sea, so as to endanger her masts being rolled away, and the hull worked loose and made leaky.

In order to help a ship's sailing, that she should be lively and easy in her pitching and ascending motions, it should be contrived by the stowage, that the principal and weightiest part of the cargo or materials should lie as near the main body of the ship, and as far from the extreme ends, fore and aft, as things will admit of. For it should be considered, that the roomy part of our ships lengthwise, forms a sweep or curve near four times as long as they are broad; therefore those roomy parts at and above the water's edge, which are made by a full haring and a broad transom to support the ship steady and keep her from plunging into the sea, and also by the entrance and run of the ship's having little or no accommodations for the purpose of water to support them, of course should not be stowed with heavy goods or materials, but all the necessary vacancies, broken stowage, or light goods, should be at these extremities ends fore and aft; and proportion as they are kept lighter by the stowage, the ship will be more lively to fall and rise easy in great seas; and this will contribute greatly to her working and sailing, and to prevent in the contrary way, that the principal weight may be more easily stowed in the main body of the ship, above the flattest and lowest floorings, where the pressure of the water acts the more to support it. See Navigation.

Stirres, mast, &c.

The mast of a ship is a long round piece of timber, elevated perpendicularly upon the keel of a ship, to which are attached the yards, the sail, and the rigging. A mast, with regard to its length, is either mainmast or mizzenmast, which is called a pole-mast, or composed of several pieces joined together, each of which retains the name of mast separately. The lowest of these is accordingly named the lower mast; the next in height is the top-mast, which is erected at the head of the former; and the highest is the top-gallant mast, which is prolonged from the upper end of the top-mast. Thus the two last are no other than a continuation of the first upwards.

The lower-mast is fixed in the ship; the foot, or heel of it, rests on a block of timber called the step, which is fixed upon the keel, and the top-mast is attached to the head of the cross-trees. The latter of these are two strong bars of timber, supported by two Primences, which are as shoulders on the other sides of the mast, a little under its upper end; these are fixed in the frame of the top of the support. Between the lower-mast-head, and the foremost of the cross-trees, a square space remains vacant, the sides of which are bounded by the two treestrees. Perpendicularly above this is the foremost hole in the cap, whose after-hole is solidly fixed on the head of the lower-mast. The top-mast is erected by the person whose effort is confined to the head of the lower-mast to the foot of the top-mast; and the upper end of the latter is accordingly guided into and conveyed up through the holes between the treestrees and the cap. Besides the parts already mentioned in the construction of masts, with respect to their length, the lower-masts of the largest ships are composed of several pieces united into one body. As these are generally the most substantial parts of various trees, a mast formed by this assemblage, is justly esteemed much stronger than one consisting of any single trunk, whose internal solidity may be very uncertain.

The whole is secured by several strong hoops of iron, driven on the outside of the mast, where they remain at proper distances.

Figs. 1, 2, and 3, Plate Masts, &c. represent one of Mr. George Smart's patent hulling masts. It is principally composed of four small beams ABDE, figs. 1 and 2, which are each quarters of one small tree; these are held at the proper distance apart by cross bars EF mortised into them. The spaces between the bars are filled up by thick planks GG, which have grooves cut across them to receive one-half of the bars FF as shown in fig. 3, and the whole is bound together by hoops HH. By this means a trunk is formed in every direction; for in every strain, before the mast can give way, the beams and planks on the side nearest the strain must compress, and those on the opposite side must be torn asunder lengthwise.

There are several other methods of constructing these masts, as right planks dovetailed together at the edges, or four planks tabbed into each other with oak wedges at the end of the tables, to prevent the end wood from cutting into each other.

Masts on these principles can be made at one half the expense of the common ones, and of the same strength without any increase of the weight.

Figs. 4 and 5, represent a contrivance included in Mr. Smart's patent for masts, by which temporary yards for ships can be made when at sea, and of such spars as can conveniently be carried on board a ship.

They are formed of two small spars, each half the length of the yard, which are sawn down lengthwise in two directions, so as to cut them into four branches, but left joined together at one end. A fig. 4 that end is then lopped so as to prevent splitting; the four pieces DEF, &c. are opened out as in the figure, and blocks of wood put in between them at GHIK to keep them apart; the two spars thus opened are joined together to make one yard at the block K formed of four pieces, of which is shown in fig. 5. It has a groove in it to receive the ends of one of the bars DEF in each spar and connect them; it has some small pieces put across in the angle of the groove, to hold the ends of the pieces DEF, so that when they are kept in their places, by a broad loop L, they cannot be drawn apart endways; the four pieces composing the block K are laid together, and put in between the bars, leaving a space between them to put in
wedges which are driven in until the pieces, fig. 5 are shoved out so as to fill the hoop and hold it firmly.

All masts may be made from one spar without joints; in that case the four pieces are left connected at each end, and the piece K is a plain block like the rest.

The principal articles to be considered in equipping a ship with masts are, 1st, the number; 2d, their situation in the vessel; and, 3d, their height above the water.

The masts being used to extend the sails by means of their yards, it is evident, that if their number was multiplied beyond what is necessary, the yards must be extremely short, that they may not entangle each other in working the ship, and by consequence the sail too narrow, and receive a small portion of wind. If, on the contrary, there is not a sufficient number of masts in the vessel, the yards will be too large and heavy, so as not to be managed without difficulty. There is a mean between these extremes, which experience and the general practice of the sea have determined; by which it appears, that in large ships every advantage of sailing is retained by three masts and a half yard.

The most advantageous position of the masts is undoubtedly that from whence there results an equilibrium between the resistance of the water on the body of the ship on one part, and of the direction of their effort on the other. By every other position this equilibrium is destroyed, and the greatest effort of the masts will operate to turn the ship horizontally about its direction; a circumstance which retards its velocity. It is counter-balanced indeed by the helm; but the same in-convenience still continues; for the force of the wind, having the resistance of the helm to overcome, is not entirely employed to push the ship forward. The aim of the resistance of the water should then be previously determined, to discover the place of the main-mast, in order to suspend the efforts of the water equally, and place the other masts so that their particular direction will coincide with that of the main-mast. The whole of this would be capable of a solution if the figure of the vessel was regular, because the point, about which the resistance of the water would be in equilibrium, might be discovered by calculation.

The exact height of the masts, in proportion to the form and size of the ship, remains yet a problem to be determined. The more the masts are elevated above the centre of gravity, the greater will be the surface of sail which they are enabled to present to the wind; so in an additional height seems to have been advantageous. But this advantage is diminished by the circular movement of the mast, which operates to make the vessel stoop to its effort; and this inclination is increased in proportion to the additional height of the mast, an inconvenience which it is necessary to avoid. Thus much is gained upon one hand is lost upon the other. To reconcile these difficulties, it is certain, that the height of the mast ought to be determined by the inclination of the vessel, and that the point of her greatest inclination should be the term of this height above the centre of gravity.

In order to secure the masts, and counterbalance the force of the current from the side of the sails impressed by the wind, and the agitation of the ship at sea, they are sustained by several strong ropes, extended from their upper ends to the outside of the vessel, called shrouds. These are further supported by other ropes, stretched from their heads towards the fore-part of the vessel.

The mast, which is placed at the middle of the ship's length, is called the main-mast; that which is placed in the forepart, the fore-mast; and that which is towards the stern, is termed the mizen-mast.

SHIESTS. See Scrinthus, and Rocks primitive.

SILVERS, or Sleeviers, in the sea-language, are the little rollers or round wheels of pulleys. See Pulley.

SHOE, a covering for the foot, usually made of leather, by the company of cordwainers.

SHOOK, horse. See Farriery.

SHOE, for an anchor, in a ship, the place for the anchor to rest, and fitted to receive the stock, &c. as to prevent the sheets, tacks, and other running-rigging, from galling, or entangling with the blocks.

SHOOTING, in the military art. See Artillery, Gunnery, and Projectiles.

SHOOTING, in sportsmanship, the killing of game by the gun, with or without the help of dogs.

The first thing which the sportsman ought to attend to is the choice of his fouling-piece. Convenience requires that the barrel should be as light as possible, at the same time it ought to possess that degree of strength which will make it not liable to burst. In a former article (Gun-smithery, vol. i. p. 890) it was stated that very little was gained by extending the length of the barrel. It ought, however, to bear some proportion to the bore, and be of sufficient length to hold the powder to infame. The usual length is now from 30 to 36 inches.

It may appear as an objection to this, that a duck-gun which is five or six feet long kills at a greater distance than a fouling-piece; but this is not owing to its length, but to its lighter and greater weight and thickness, which give it such additional strength, that the shot may be increased, and the charge of powder doubled, tripled, or even quadrupled. More, indeed, will depend on the goodness of the powder, and using a proper charge (which must be learned by trying the gun at a mark), than on the length of the barrel.

The point musl be made very generally used, and is reckoned superior to any other. The size of the shot must vary according to the particular species of game which is the object of the sportsman's pursuit, as well as adapted to the season. In the first month of partridge-shooting, No. 4 is most proper.

As hares also sit closer, and are thinly covered with fur, at this season, they may easily be killed with this shot at 30 or 35 paces. No. 5 is proper for shooting quails; and No. 6, for pheasants. About the beginning of October, when the partridges are stronger, and pleasant-shooting commences, No. 3 may be used.

In loading a piece, the powder ought to be slightly rammed down by only pressing the ramrod two or three times on the wadding, and not have the ramrod and then returning it into the barrel with a touch of the arm several times. The shot ought to be rammed down with some force, since it is from the shot being loose in the gun, and the spaces being left between it and the powder, that accidents most frequently happen by the bursting of guns. A sportsman ought never to carry his gun under arm with the muzzle inclined downwards, for this practice hinders the wadding and charge too much.

Immediately after the piece is fired it ought to be re-loaded; for, while the barrel is still warm, there is no danger of any moisture lodging in it to hinder the powder from falling down to the bottom. As it is found that the coldness of the barrel, and perhaps the moisture condensed in it, diminish the force of the powder in the first shot, it is proper to fire off a little powder before the piece is loaded with game; but this is not necessary when shooting, but this is not proper unless the touch-hole is very large. After every discharge the touch-hole ought to be pricked, or a small feather may be inserted to clear away any humidity or fœlth that has been contracted.

The sportsman having loaded his piece must next prepare to fire. For this purpose he ought to place his hand near the entrance of the ramrod, and at the same time grasp the barrel firmly. The muzzle should be a little elevated, for it is more usual to shoot low than high. This direction ought particularly to be attended to when the object is a little distant, because shot as well as ball only moves a certain distance point-blank, when it begins to describe the curve of the parabola.

Practice soon teaches the sportsman the proper distance at which he should shoot. The distance at which he ought infallibly to hit a piece of game with perfect shot, provided the aim is well taken, is from 22 to 32 paces for the footed, and from 40 to 45 paces for the winged game. Beyond this distance even to 30 or 35 paces, both partridges and hares are sometimes killed; but in general the hares are only slightly wounded, and carry away the shot; and the partridges at that distance present so small a surface, that they frequently escape untouched between the spaces of the circle. Yet it does not follow that a partridge may not be killed at 60 and even 70 paces distance; but these shots are rare.

In shooting at a bird flying, or a hare running across, it is necessary to take aim at the forepart of the object. If a partridge flies across at the distance of 30 or 35 paces, it will be sufficient to aim at the head, or at most but a small space before it. Another thing to be attended to is, that the shot be directed and then stopped by the motion of the arms at the moment of pulling the trigger; for, on the instant the hand stops in order to fire, however inconvenient the time may be, the bird gets beyond the line of aim, and the shot will miss it. A sportsman ought there-
before to accustom his hand while he is taking his follow the object. When a hare runs in a straight line from the greater that his influencing will he run the hazard either of missing, or at least not of killing dead, or, as it is sometimes called, clean.

A foolish piece should not be fired more than 20 or 25 times without being washed; a barrel when boil neither shoots so readily, nor carries the shot so far, as when clean. The flint, pan, and hammer, should be well wiped after each shot; this compounds greatly to make the piece go off quick, but then it should be done with so much precaution, that the barrel may be reddened whilst warm, for the reasons before advanced. The flint should be frequently changed, without waiting until it misses fire, before a new one is put in. Fifteen or eighteen shots, therefore, should only be fired with the same flint; the expense is too trilling to be regarded, and by changing it thus often much vexation will be prevented.

A gun also should never be fired with the prime of the preceding day; it may happen that an old priming will sometimes go off well, but it will more frequently contract moisture and smoke; fire from such a priming will most probably be missed, and that because the piece was not freshly primed.

For the information of the young sportsman we shall add a few more general remarks. In winter, when at a shot to seek for game in plains and open grounds; and in cold weather he may search little hills exposed to the sun, along hedges, among heaths, in stubbles, and in places where there is much furze and heath. The morning is the best time of the day, before the dew is exhaled, and before the game has been disturbed. The colour of the shotter's dress ought to be the same with that of the fields and trees; in summer it ought to be green, in winter a dark grey. He ought to hunt as much as possible against the wind, not only to prevent the game perceiving the approach of him and his dog, but also to enable the dog to scent the game distance.

He should never be discouraged from hunting and ranging the same ground over and over again, especially in places covered with heath, brambles, high grass, or young cabbage wood. The dog frequently suffer him to pass several times within a few yards of its form with out getting up. He should be still more patient when he has marked partridges into such places; for it often happens that after the hares have been sprung many times, they lie so dead that they will suffer him almost to treat upon them before they rise. Pleasants, quails, and woodcocks, do the same.

He ought to look carefully about him, never passing a bush, or tuft of grass, without examination; but he ought never to strike them with the muzzle of his gun, for it will loosen his wadding. He who patient beats and ranges his ground over again, without being discouraged, will always kill the greatest quantity of game; and if he is shooting in company, he will find game where others have passed without discovering any.

When he has killed, it is proper in his dog, that he may have the mortification to see game rise which he cannot shoot. When he has killed a bird, instead of being anxious about picking it up, he ought to follow the rest of the covey with his eye till he

Three species of dogs are capable of receiving the proper instructions and of being trained. These are the smooth pointer, the rough pointer, and the spaniel. The smooth pointer is the best dog in his range, but in general is proper only for an open country.

The greatest part of these dogs are afraid of water, branches, and thickets; but the smooth pointer and the rough pointer are easily taught to take the water, even in cold weather, and to range the woods and rough places as well as the plain. Greater dependence may therefore be had on these two last species of dog than on the smooth pointer.

The education of a pointer may commence when he is only five or six months old. The only lessons which he can be taught at this time are, to fetch and carry any thing when desired; to come in when he runs far off, and to go behind when he returns; using, in the one case, the words here, come in, and in the other, back, or behind. It is also necessary at this period to accustom him to the sound of time to place of time in any country; for he is not at first to be tied too long. He should be let loose in the morning, and fastened again in the evening. When a dog is not early accustomed to be chained, he disturbs every one in the neighborhood by barking and howling. It is also of importance that the person who is to train him should give him his food.

When the dog has attained the age of ten or twelve weeks, he should be taken into the field to be regularly trained. At first he may be allowed to follow his own inclination, and to run after every animal he sees. His instinctive cagering ness will soon abate, and he will pursue only partridges and hares. He will soon become tired of following partridges in vain, and will content himself after having flushed them, to follow them with his eyes. It will be more difficult to prevent him from following hares than partridges.

All young dogs are apt to take; that is, to hunt with their noses close to the ground, to follow birds rather by the track than by the wind. But partridges he much better to dogs if he approaches it in the manner of the birds. The dog that winds the scent approaches the birds by degrees, and without disturbing them; but they are immediately alarmed, when they see a dog tracing their footsteps. When you perceive that your dog is committing this fault, call him to him in an angry tone, hold up; he will then grow uneasy and agitated, going first to the one side and then to the other, until the wind gives him the scent of the birds. After finding the game four or five times in this way, he will take the wind of himself, and hunt with his nose high. If it is difficult to correct this fault, it will be necessary to put the puddle-peg upon him. This is of very simple construction, consisting only of a piece of oak or deal inch-board, one foot in length, and an inch and a half in breadth, tapering a little to one end; at the broader end are two holes, running longitudinally, through which the tail of the dog is put, and the whole is buckled round his neck; the piece of wood being projected beyond his nose, is then fastened with a piece of leather thong to his under jaw. By this means the peg advancing seven or eight inches beyond his snout, the dog is prevented from putting his nose to the ground and raising.

As soon as the young dog knows his game, you must bring him under complete subjection. If he is tractable, this will be easy; but if he is still a little wild, or has been taught to the trash cord, which is a rope or cord of 20 or 25 fathoms in length fastened to his collar. If he refuses to come back when called, you must check him smartly with the cord, which will often bring him upon his haunches. But be sure you never call him except when you are within reach of the cord. After repeating this several times, he will not fail to come back when called; he ought then to be dressed, and a bit of bread should be given him. He ought now constantly to be tied up; and never unchained, except when you give him his food, and even then only when he has done something to deserve it.

The next step will be to throw down a piece of bread on the ground, at the same time taking hold of the dog by the collar, calling him, "take heed, softly." After having held him in this manner for some time, he will be taught to lie down, and to not get up until you give him the order to rise. If he is impatient to lay hold of the piece of bread before the signal is given, correct him gently with a small whip. Repeat this lesson until he "takes heed" well, and no longer requires to be held fast to prevent him from laying hold of the bread. When he is well accustomed to this manage, turn the bread with a stick, holding it in the manner you do a feeding-piece, and having done so, cry "take heed!" He never forgets this lesson; he will not eat either in the house or field, without having first made him take heed in this manner.

Then, in order to apply this lesson to the game, try small pieces of bread in dog's head, with the dung of partridge; take these in a linen bag into the fields, stubbles, ploughed grounds, and pastures, and there put the pieces in several different places, marking the spots with little cleft pickets of wood, which will be readily visible in finding the dog, putting pieces of card in the tracks. This being done, cast off the dog and conduct him to these places, always hunting in the wind. After he has caught the scent of the bread, he will be very eager to take it up, and seems eager to fall upon it, cry to him in a menacing tone, "take heed," and if he does not stop immediately, correct him with the whip. He will soon comprehend what is required of him, and will stand.

At the next lesson, take your gun charged only with powder, walk gently round the piece of bread once or twice, and fire instead of crying seize. The next time of practicing this lesson, walk round the bread four or five times, but in a greater circle than before, and continue to do this until the dog is conquered of his impatience, and will stand without moving until the signal is given him.

When he keeps his point well, and stands steady in this lesson, you may carry him to the birds; if he runs in upon them, or barks when they spring up, you must correct him; and if he continues to do so, you must return to the fried bread; but this is seldom necessary.

When the dog has learned by this use of the bread to take heed, he may be carried to the fields with the trash-cord dragging on the
ground. When he springs birds for the first time, if he runs after them or backs, check him by calling out to him, "Take heed!" If he points properly, care him, but you ought never to hunt without the cord until he points straight.

The principal objects of this sport are, 1. Partridges, which pair in the spring, and lay their eggs (generally from 15 to 20) during May and part of June. The young begin to fly about the end of June, and their plumage is complete at the beginning of October. The mare has a conspicuous horse-shoe upon her breast, and an obtuse spur on the hinder part of the leg, which distinguishes him from the female. He is also rather larger.

When a sportsman is shooting in a country where the birds are thin, and he no longer chooses to range the field for the bare chance of meeting with them, the following method will show him where to find them on another day. In the evening, from sun-set to nightfall, he should post himself in a field, at the foot of a hedge or at the edge of a wood, and there wait until the partridges begin to call or juck, which they always do at that time; not only for the purpose of drawing together when separated, but also when the birds composing the company are dispersed. After calling in this manner for some little space of time, the partridges will take to flight; then, if he marks the place where they alight, he may be assured they will be there the whole night, unless disturbed.

2. The pleasant lays its eggs generally in the woods, the number of which is ten or twelve. Partridges are accounted stupid birds; for when they are surprised they will frequently squat down like a rabbit, supposing themselves to be in safety as soon as their heads are concealed; and in this way they will sometimes suffer themselves to be killed with a stick. They love low and moist places, and haunt the edges of those pools which are found in woods, as well as the high grass of marshes that are near at hand; and above all, places where there are clumps of alders.

3. Grouse, or moor-game, are found in Wales, in the northern counties of England, and in the northern and central parts of Scotland. They chiefly inhabit those mountains and moors which are covered with heath, and seldom descend to the low grounds. They fly in companies of four or five brace, and love to frequent moisy places, particularly in the middle of the day, or when the weather is warm. In pursuing this game, when the pointer sets, and the sportsman perceives the birds running with their heads erect, he must run after them as fast as he can, in the hope that he may get near enough to shoot when they rise upon the wing; for he may be pretty certain they will not lie well that day. As these birds are apt to grow soon putrid, they ought to be drawn carefully the instant they are shot, and stuffed with heath; and if the feathers happen to be wetted, they must be wiped dry.

4. The woodcock is a bird of passage; it commonly appears about the end of October, and remains until the middle of March. Woodcocks are fattest in December and January, but from the end of February they are lean. At their arrival they drop any where, but afterwards take up their residence in copes of nine or ten years growth. They seldom, however, stay in one place longer than twelve days. During the day they remain in those parts of the woods, where there are void spaces or glades, picking up earthworms and grubs from the fallen leaves. In the evening they go to drink and to roost in marshes and springs, after which they repair to the open fields and meadows for the night.

5. The snipe is a bird of passage as well as the woodcock. In the month of November they grow fat. Snipes frequent springs, bogs, and marshes, fly heavily against the wind. The slant and cross-shots are rather difficult, as the birds are small and fly very quickly. The sportsman ought to look for them in the direction of the wind; because if they fly towards him, he will present a fairer mark.

6. The wild duck also may in some measure be accounted a bird of passage, and arrives here in great flocks from the northern countries in the beginning of winter. Still, however, a good many remain in our marshes and fens during the whole year, and breed.

The wild duck differs little in plumage from the tame duck, but is more distinctly distinguished by its size, which is less; by the neck, which is more slender; by the foot, which is smaller; by its bill, which are more black; and above all, by the web of the foot, which is much finer and softer to the touch.

In the summer season, when it is known that a team of young ducks are in a particular piece of water, and just beginning to fly, the sportsman finds them early in the morning dabbling, at the edges of the pool, and amongst the long grass, and then he may very near to them; it is usual also to find them in those places at noon.

In the beginning of autumn almost every pool is frequented by teams of wild ducks, which remain there during the day, concealed in the rushes. If these pools are of small extent, two shooters, by going one on each side, making a noise and throwing stones into the rushes or rushes from them fly up; and then they will in this way frequently get shots, especially if the pool is not broad, and contracts at one end. But the surest and most successful way, is to launch a small boat or row on the pool, and to plant the rushes by the edge of the boat, and behind the rushes which are found; at the same time making as little noise as possible. In this manner the ducks will suffer the sportsmen to come sufficiently near them to shoot, and for it often happens that the ducks, after having flown up, only make a circuit, return in a little time, and again alight upon the pool. Then the sportsmen endeavour a second time to come near them. If several shooters are in company, they should divide; two should go in the boat, whilst the other spread themselves about the edge of the pool, in order to shoot the ducks in their flight. In pools which will not admit a row, water-sparrows are absolutely necessary for this sport.

In winter they may be found on the margins of little pools; and when pools and rivers are frozen up, they must be watched for in places where the springs and waters which do not freeze. The sport is then much more certain, because the ducks are confined to these places in order to procure aquatic herbs, which are almost their only food at this period.

SHORLITE. No word has been used by mineralogists with less limitation than shorl. It was first introduced into mineralogy by Constvedt, to denote any stone of a columnar form, considerable hardness, and a specific gravity from 3 to 3.4. This description applied to a very great variety of substances; and succeeding mineralogists, though they made the word more definite in its signification, let it still so general, that under the designations of shorl almost twenty distinct species or minerals were included. Mr. W. Emmet first defined the word shorl precisely, and restricted it to one species of stones. It occurs commonly in granite, gneiss, and other similar rocks; often in mass, but very frequently crystallized. The primitive form of its crystals is an obtuse rhomboid, the solid angle at the summit of which is 139°, having rhomboidal faces, with angles of 114° 12' and 65° 45': but a usually occurs in 3, 5, 8, 9, or 12 sided prisms, terminated by a post of five-sided prisms, variously truncated. Colour black. Found in mass, disseminated and crystallized. Crystals three-sided prisms, having their lateral edges truncated. Sometimes terminating in a pyramid. Lateral prisms terminated by trin- gulated. Vitreous. Fracture conchoidal. Opaline. Scratch grey. Feel cold. Specific gravity from 3 to 3. It becomes electric by friction. When heated to redness, its colour becomes brownish red; and at 1277 Wedgewood, it is converted into a brownish compact enamel. According to Wiegler, it is composed of

\[ 41.25 \text{ alumina} \]
\[ 33.18 \text{ silica} \]
\[ 20.00 \text{ iron} \]
\[ 5.41 \text{ manganese} \]

100.02

SHORLITE ELECTRIC. This stone was first made known in Europe by specimens brought from Ceylon; but it is now found frequently forming a part of the composition of mountains, and sometimes in amorphous pieces, but much more frequently crystallized in three or nine-sided prisms, with four-sided summits.

Colour usually green; sometimes brown, red, blue. Found in mass, in grains, and crystallized. Crystals three, six, or nine-sided prisms, variously truncated. Faces usually striated longitudinally. Its texture is foliated. Specific gravity 3. Colour brown, sometimes with a tint of green, blue, red, or yellow. When heated to 200° Fahrenheit, it becomes electric, one of the sums negatively and the other positively. It reddens when heated, and is fusible per se, with white intumesce, into a white or grey enamel. According to Vaupelium, it is composed of

\[ 40 \text{ silica} \]
\[ 39 \text{ alumina} \]
\[ 12 \text{ oxide of iron} \]
\[ 4 \text{ lime} \]
\[ 2.3 \text{ oxide of manganese} \]

97.5

SHORLITE. A stone which received its name from Mr. Klaproth, is generally found in oblong masses, which, when regular, are six-sided prisms, inserted in granite. Its
Shot, case, formerly consisted of all kinds of old iron, nails, musket-balls, stones, &c., used as above, which, by their friction against one another, and against the sides of the cylinder, they are rendered perfectly round and very smooth. The other patent-shot is cast in moulds, in the same way as bullets are.

Shot, common small, or that used for fencing, should be well sized; for, should it be too great, then it flies thin and scatters too much; or if too small, then it has no weight and strength to penetrate far, and the bird is apt to fly away with it. In order, therefore, to have it suitable to the occasion, it not being always to be had in every place fit for the purpose, we shall set down the true method of making all sorts and sizes under the name of the shot, formerly made after the following process:

Take any quantity of lead you think fit, and melt it down in an iron vessel; and as it melts keep it stirring with an iron ladle, skimming off all impurities whatever that may arise at top; when it begins to look of a greenish colour, stern on it as much arispermatic or yellow orpiment, finely powdered, as will lie on a sliding, to every twelve or fourteen pounds of lead; then stirring them together, the orpiment will flame. The ladle should have a notch on one side of the brim, for more easily pouring out the lead; the ladle must remain in the melted lead, that its heat may be the same with that of the lead, to prevent inconveniences which otherwise might happen by its being either too hot or too cold; then, to try your lead, drop a little of it into water, and if the drops prove round, then the lead is of a proper heat; if otherwise, and the shot have tais, then add more orpiment to increase the heat, till it is found sufficient.

Then take a plate of copper, about the size of a trencher, which must be made with a hollowness in the middle, about three inches compass, within which must be bored about 40 holes according to the size of the shot which you intend to cast; the hollow bottom should be laid on the shot, and then, by leading the lead molten upon it, then take some lead and pour molty on the coals on the plate, and it will make its way through the holes into the water, and form itself into shot; do thus till all your lead is run through the holes of the plate, taking care, by keeping up the coals, that the lead does not cool, and so stop up the holes.

While you are casting in this manner, another person with another ladle may catch some of the shot, placing the ladle four or five inches underneath the plate in the water, by lead, and when they are disposed, fetch them with a bottle, and thus you will have your shot to your command.

And to render the coolness of your lead and plate, you must blow your fire; observing, that the cooler your lead is, the larger will be your shot; as, the hotter it is, the smaller it will be.

After you have done casting, take them out of the water, and dry them over the fire with a gentle heat, stirring them continually that they do not melt; when dry, you are to separate the great shot from the small, by the help of a vase made for that purpose, according to their several sizes. But those who would have very large shot, make the lead trickle with a stick out of the ladle into the water, without the plate. If it stops on the plate, and yet the plate is not too cool, give but the plate a little knock, and it will run again; care must be had that none of your implements are greasy, oily, or the like; and when the shot, being separated, are found too large, or too small, for your purpose, or otherwise imperfect, they will serve again at the next operation.

Shot, tin-case, in artillery, is formed by putting a great quantity of small iron shot into a tin cylindrical box called a canister, that just fits the bore of the gun. Leaden bullets are sometimes used in the same manner; and it must be observed, that whatever number or sizes of the shots are used, they must weigh with their cases nearly as much as the shot of pieces.

SHREW-MOUSE. See Sorex.

SHRIMP. See Cancer.

SHRINE, in ecclesiastical history, a case or box, to hold the relics of some saint.

SHROUDS. See Shrowds.

SHROWDS. In a ship, are the great ropes which come down both sides of the mast, and are fastened below to the chains on the ship's side, and aloft to the top of the mast; being parcelled and served, in order to prevent the mast's galling them.

The topmast shrouds are fastened to the topmasts, by dead-eyes and Iamards, as the others are. Some of the terms relating to the shrowds are: rake, shrowds, which is, sheathed them; and, set up the shrowds; that is, set them in position.

SHUTTLE, in the manufactures, an instrument much used by weavers, in the middle of which is an eye, or cavity, wherein is enclosed the end of the wool. See Weaver.

Shi, in music a seventh note or sound, added by Le Maire to the six antient notes invented by Guido Artusino, viz. ut, re, mi, fa, sol, la.

SIBBALDIA, a genus of plants belonging to the class of pentandria, and, to the order of angiopterous; and in the natural method ranking under the 35th order, sentiss. The calyx is divided into ten segments. The petals are five, and are inserted into the calyx. The styles are attached to the side of the germen. The seeds are five. There are three species belonging to this genus, the procumbens, erecta, and alata. The procumbens, or reclining sibbaldia, is a native of North Britain.

SIBTHORPIA, a genus of plants belonging to the class of chlamydia, and to the order of angiopterous; and in the natural system classed with the group of which is doubtful. The calyx is spreading, and divided into five parts, almost to the base. The corolla is divided into five parts in the same manner, which are rounded, equal, spreading; and of the length of the calyx. The stamina grow in pairs at a distance from each other. The capsule is compressed, orbicular, bilocular, the partition being transverse. There is one species; the Europs, or bastard wood-sorrel, Another of South Britain. It blossoms from July to September, and is found in Cornwall on the banks of rivulets.

SICE-ACE, a game with dice and tables, whereas five may play; each having six men, and the last out losing. At this game, they load one another with aces; sixes bear away; and doubles, drinks, and throws again.

SICYOS, a genus of plants belonging to the class of monocotyledons, to the order of syngeenia; and in the natural system arranged under the 34th order, cumbibacter. The male flowers have their calyx quinquidented, their corolla quinquepartite, and there are three filaments, while the stamens have their calyx and corolla similar; but their style is trid, and their stipe monoporous. There are three species, the angulata, bicinata, and garcini, which are all forest plants.

SIDA, yellow or Indian mallow: a genus of plants belonging to the class of monadelphus, and to the order of polyandria; and in the natural system ranked under the 37th order, commelinae. All are fugitans. The calyx is simple and angulated; the style is divided into many parts; there are several capsules, each containing one seed. There are 99 species, all natives of warm climates; and most of them are found in the East or West Indies. The Chinese make cords of the sida ablation. This plant loves water, and may be advantageously planted in marshes and ditches, where nothing else will grow. The maturation of the smaller species is finished in fifteen days; of the larger in a month. The strength and goodness of the thread appears to be in proportion to the perfection of the vegetation, and to the distance the plant is kept at from other plants. The fibres the
in strata, of which there are sometimes six; they are not quite straight, but preserve an undulating direction, so as to form a network in their natural positions. Their smell resembles that of hemp; the fibres are winter, but more dry and harsh, than those of hemp. The harshness is owing to a greenish gluten which connects the fibres; and the white colour must always be obtained at the expense of having this kind of thread less supple; when of its natural hue, it is very soft and flexible.

SIDERIA, in natural history, the name of a genus of crystals, used to express those altered in their figure by particles of iron. These are of a rhomboidal figure, and composed only of six planes. Of this genus there are four known species: 1. A colorless, pellucid, and thin one; found in considerable quantities among the iron ores of the forest of Dean in Gloucestershire, and in several other places. 2. A dull, thick, and brown one, not uncommon in the same places with the former. And, 3. A black and very glossy one, a fossil of great beauty; found in the same place with the others, as also in Leicestershire and Sussex.

SIDERITE, a substance discovered by Mr. Meyer, and by him supposed to be a new minerals. Bergman and Kirwan discovered that it is nothing else than a natural combination of the phosphoric acid with iron. Mr. Klaproth of Berlin also came to the same conclusion, without any communication with Mr. Meyer. It is extremely difficult to separate this acid from the metal; however, he found the artificial compound of phosphoric acid and iron to agree in its properties with the calc siderite, obtained by Bergman and Meyer from the cold short iron extracted from the swampy or marshy ores.

SIDERITIS, IRONWORT; a genus of plants belonging to the class of thallophyta, and to the order of gymnospermae; and in the natural system ranging under the 49th order, verticillata. The stamens are within the tube of the corolla. There are two stigmas, one of which is cylindrical and concave; the other, which is lower, is membranous, and is attached to the other. The species are 19.

SIDEROXYLM, IRONWOOD; a genus of plants belonging to the class of pentadria, and to the order of monogynia; and in the natural system ranging under the 49th order, durinumose. The corolla is cut into five parts, the calix or segments being incurvated alternately; the stigma is simple; the berry contains five seeds. There are nine species: 1. The seed of smooth iron-wood; 3. melanophyllum, lauric-leaved iron-wood; 4. gymnocarpum, 5. sericicum, silky iron-wood, native of New South Wales; 6. tomentum; 7. tenax, silvery-leaved iron-wood, a native of Carolina; 8. lycodes, willow-leaved iron-wood, a native of North America; 9. decandrum. The wood of these trees are very close and solid, has given occasion for this name to be applied to them, it being a necessary to sink in water. As they are natives of warm countries, they cannot be preserved in this country unless tie are placed in the winter in a warm stove, the others in a green-house. They are propagated by seeds, when these can be procured from abroad.

SIEGE, in the art of war, the employment of an army before a fortified place, with a design to take it.

SIENITE. See Rocks, primitive.

SIGESBECKIA, a genus of plants belonging to the class of thallophyta, and to the order of polygama superflua, and in the natural system ranging under the 49th order, compositae. The receptacle is paleaceous; the pappus wanting; the external calyx is papillosus, proper, and spreading; the radius is halved. There are three species: 1. The orientalis, which is a native of India and China. 2. The occidentalis, which is a native of Virginia. 3. The flosculosa, a native of Pers. SIGS OF A quadrant, &c. thin pieces of brass, raised perpendicularly on its side, or on the index of a theodolite, circumferentor, &c. They have each an aperture, or slit, up the middle, through which the visual rays pass to the eye, and distant objects are seen.

SIGNS, in astronomy, a constellation containing a twelfth part of the zodiac, or 30'. See Zodi.

The names of the signs, in the order wherein they follow each other, are: aries, taurus, gemini, cancer, leo, virgo, libra, scorpio, sagittarius, capricornus, aquarius, pisces. The three first of these signs are called the vernal, or spring-signs; the next three, cancer, leo, virgo, the autumnal, or summer signs; libra, scorpio, and sagittarius, the astronomical signs; and capricornus, aquarius, pisces, the winter signs. The vernal, or spring, and autumnal and astral signs are also called the northern, and the autumnal and brumal the southern signs.

SIGN-MANUAL, in law, is used to signify a bail, or writing, signed by the king's own hand-writing.

SIGNALS, certain alarms or notices used to communicate intelligence to a distant observer. Signals are made by firing artillery, and displaying colours, lanterns, or fireworks; and these are combined by multiplication and repetition. Thus, like the words of a language, they become arbitrary expressions, to which we have previously annexed particular names; and hence we may say that the general sources of intelligence throughout a naval armament, &c.

Signals ought to be distinct, with simplicity. They are simple when every instruction is expressed by a particular token, in order to avoid any mistakes arising from the double purport of one signal. They are distinct when issued without precipitation, when sufficient time is allowed to observe and obey them, and when they are exposed in a conspicuous place, so as to be readily perceived at a distance.

All signals may be reduced into three different kinds, viz. those which are made by the sound of particular instruments, as the trumpet, horn, or life; to which may be added, striking the bell, or beating the drum. Those which are made by displaying pendant, ensigns, and flags of different colours: or by sounding cannon-shots from the ship, and by this means to call the attention of those on shore. Those which are made by rockets of different kinds; by firing cannon on small arms; or by artificial fire-works; and by lanterns.

For the best guns will serve equally in the day or night, or in a fog, to make or communicate signals, or to raise the attention of the hearers to a future order. This method, however, is attended with some inconveniences, and should not be used indiscriminately. Too great a report of the cannon is apt to mix the sounds, and to cause confusion, as well as to discover the track of the squadron. The report and flight of rockets is liable to the same objection, when at a short distance from the enemy.

It is then by the combination of signals, previously known, that the admiral conveys orders to his fleet; every squadron, every division, and every ship of which, has its particular signal. The instruction may therefore occasionally be given to the whole fleet, or to any of its squadrons; to any division of those squadrons, or to any ship of those divisions.

Hence the signal of command may at the same time be displayed for three divisions, and for three ships of each division; or for three ships in each squadron, and for only nine ships in the whole fleet. For, the general signal of the fleet being shown, if a particular pendant is also thrown out from some particular place of mast with the general signal, it will communicate intelligence to nine ships that wear the same pendant.

The preparatory signal given by the admiral to the whole or any part of his fleet, is immediately answered by those to whom it is directed; by showing the same signal, to testify that they are ready to put his orders in execution. Having obtained their answer, he will show the signal which is to direct their operations: as, to chase, to form the line, to begin the engagement, to board, to double upon the enemy, to rally or return to action, to continue the fight, to retreat and save themselves. The dexterity of working the ships in a fleet depends upon the precise moment of executing these orders, and on the general harmony of their movements; a circumstance which evinces the utility of a signal of preparation.

As the extent of the line of battle, and the fire and smoke of the action, or other circumstances in navigation, will frequently prevent the officers from being seen through the smoke of the fleet, therefore three signals, repeated by the officers next in command, by ships appointed to repeat signals; and, finally, by the ship or ships for which they are intended. The ships that repeat the signals, besides the chief of squadrons or divisions, are usually frigates lying to windward or to leeward of the line. They should be extremely vigilant to observe and repeat the signals, whether they are to transmit the order of the command in any case to the vessels, to any part of the fleet; or to report the fortune or distressful situation of any part thereof. By this means all the ships from the van to the rear will, unless disabled, be ready at a moment's warning to put the admiral's designs in execution.

To preserve order in the repetition of signals, and to favour their communication, every ship in the squadron is embrazed, from the commander in chief to the ships in his rear; they are calculated, the commanders of the squadrons repeat after the admiral; the chiefs of the divisions, according to their order of the line, after the commanders of the squadrons; and the particular ships after the chiefs of the divisions.
and those in return, after the particular ships, vice versa, when the object is to convey any intelligence from the latter to the admiral. Besides the signals above-mentioned, there are others for different ranks of officers; as

**Signs.**

**Signature.** In printing, is a letter put at the bottom of the first page at least, in each sheet, as direction to the binder, in folding, gathering, and collating them. The signatures consist of the capital letters of the alphabet, which change in every sheet: if there are more sheets than letters in the alphabet, to the capital letter is added a small one of the same sort, as Aa, Bb; which are repeated as often as necessary. In large volumes it is usual to distinguish the number of alphabets, after the first three or four, by placing a figure before the signature, as 5th, 6th, &c.

**Signet.** One of the king's seals, made use of in sealing his private letters, and all grants that pass by him signed under his majesty's hand: it is always in the custody of the secretaries of state.

**Significative.** In law, a writ which issues out of the court of chancery, on a certificate given by the ordinary of a person's standing excommunicated forty days, in order to have him imprisoned till he submits to the authority of the court.

**Silene, Catchfly, or viscous campion.** A genus of plants belonging to the class of decandria, and order of tricygium; and in the natural system arranged under the 23rd order, carpyrophyllae. The calyx is ventricose; the petals are fire in number, bifid and undulated, and crowned by a nectarium; the capsule is cylindrical, covered, and tri-locular. There are 66 species, of which seven are natives of Britain and Ireland.

**Silica.** There is a very hard white stone, known by the name of quartz, very common in almost every part of the world. Sometimes it is transparent and crystallized, and then is called rock crystal. Very frequently it is in the form of sand. As this stone, and several others which resemble it, as flint, agate, calcedony, &c. have the property of melting into a glass when heated along with fixed alkali, they were clasped together by mineralogists under the name of vitrifiable substances. Mr. Pot, who first described their properties in 1746, gave them the name of silicious stones, on the supposition that they were all chiefly composed of a peculiar earth called silicious earth or silica. This earth was known to Glauber, who describes the method of obtaining it: but it was long before its properties were accurately ascertained. Geoffroy endeavored to prove that it might be converted into lime, and in this respect it might be converted into alumina; but these assertions were refuted by Carthus, Scheele, and Bergman. To this last chemist we are indebted for the first accurate detail of the properties of silica.

1. Silica may be obtained pure by the following process: Mix together, in a crucible, one part of pounded flint or quartz, and three parts of potass, and apply a heat sufficient to melt the mixture completely. Dissolve the mass formed in water, saturate the potass with muriatic acid, and evaporate to dryness. Towards the end of the evaporation the liquid assumes the form of a jelly; and when all the moisture is evaporated, a white mass remains behind. This mass is to be washed in a large quantity of water, and dried; it is then silica in a state of purity.

2. Silica, thus obtained, is a fine white powder, without either taste or smell. Its particles have a hard feel, as if they consisted of very minute grains of sand. Its specific gravity is 2.66. It may be subjected to a very violent heat without undergoing any change. Lavrovier and Morveau exposed it to the action of a fire maintained by oxygen gas without any alteration. Sousisse, indeed, has succeeded in fusing, by means of the blowpipe, a portion of it so extremely minute as scarcely to be perceptible without a glass. According to the calculation of this philosopher, the temperature necessary for producing this effect is equal to 4034° Wedgewood.

3. It is insoluble in water except when newly precipitated, and then one part of it is soluble in 1000 parts of water. It has no effect on vegetable colours.

4. It is capable of absorbing about one-fourth of its weight of water, without letting any drop fall from it; but on exposure to the air, the water evaporates very readily. When precipitated from potass by means of muriatic acid and slow evaporation, it retains a considerable portion of water, and forms with it a transparent jelly; but the moisture gradually evaporates on exposure to the air.

Silica may be formed into a paste with a small quantity of water; this paste has not the smallest ductility, and when dried forms a loose, friable, and incoherent mass.

Silica is capable of assuming a crystalline form. Crystals of it are found in many parts of the world. They are known by the name of rock crystal. When pure they are transparent and colourless; when glass: they assume various forms; the most usual is a hexagonal prism, surmounted by hexagonal pyramids on one or both ends, the angles of the prism corresponding with those of the pyramids. Their hardness, equal to 7.

11. Their specific gravity is 2.66.

4. Silica neither combines with oxygen, with the simple combustibles, nor with metals; but it combines with many of the metallic oxides by fusion, and forms various coloured glasses and enamels.

5. Azote has no action on silica, neither has muriatic acid when the silica is in a solid state; but when the silica is combined with an excess of alkali, muriatic acid dissolves the compound, and forms a permanent solution.

By concentrating this solution, the silica separates from it in the form of a jelly.

6. There is a strong affinity between silica and fixed alkalies. It may be combined with them either by fusing them along with it in a crucible, or by boiling the liquid alkalies over it. When the silica exceeds the compound is transparent and colourless like rock crystal, and is neither acted on by water, nor (excepting one) by acids. This is the substance so well known under the name of glass. See Glass.

Silica is not acted on by ammonium, whether in the gaseous or liquid state.

7. There is a strong affinity between barytes and silica. When barytes is poured into a solution of silica in potass, a precipitate appears, which is considered by Morveau as the two earths in a state of combination. Barytes and silica may be combined by means of heat. The compound is of a greenish colour, and coheres but imperfectly. The effect of heat on various mixtures of barytes and silica will appear from the following experiments of Mr. Kirwan:

**Proportions.**
- 80 Silica
- 20 Barytes
- 75 Silica
- 20 Barytes
- 60 Silica
- 33 Barytes

**Heat.**
- 135° Wedg.
- 150
- 150

**Effect.**
- A white brittle mass.
- A brittle hard mass, semitransparent at the edges.
- Melted into a hard somewhat porous porcelain mass.
The silkworm is a native of China, and feeds on the leaves of the white mulberry. That inhuman nation was acquainted with the manufacture of silk from the most remote ages; but it was scarcely known in Europe before the time of Augustus. Its beauty attracted the attention of the luxurious Romans; and after the calamitous reign of Flamininus, it became a common article of dress. It was brought from China at an enormous expense, manufactured again by the Phenicians, and sold at Rome for its weight of gold. In the reign of Justinian this commerce was interrupted by the conquests of the Scythian tribes, and all attempts to procure it failed till two Persian monks had the address to convey some of the eggs of the insect from China to Constantinople, concealed in the hollow of a canoe. They were hatched, and the breed carefully propagated. This happened in 553; and some years after we find that the Greeks understood the art of procuring and manufacturing silk as well as the Romans, who, with their emperor, Loger, king of Sicily, brought the manufacture to Constantinople in 1130, forcibly carrying off the weavers from Greece, and settling them in Sicily. From that island the art passed into Italy, and thence into France: and the revocation of the edict of Nanius established the manufacture of silk in Britain.

Silk, as spun by the animal, is in the state of fine threads, varying in colour from white to reddish yellow. It is very elastic, and has considerable properties, if we consider its small diameter. It is covered with a varnish, to which its elasticity is owing. This varnish is soluble in boiling water; but alcohol does not act upon it. Hence it has been compared to a gum, though it approaches much nearer to a gelatine; since Berthollet has shown that it is precipitated by tin and by muriatic acid. It differs, however, from gelatine in several particulars. Alain throws it into a solution of a dirty white, and that of copper of a dark brown, and spathul of iron of a brown colour. When the water is evaporated, the varnish is obtained of a black colour, brittle, and of a shining fracture. Its weight is nearly one-third of the raw silk from which it was extracted. It may be separated from silk by soap as well as water, and the soap in remaining has taken it soon putrefy.

Besides the varnish, silk contains another substance to which it owes its yellow colour. This substance possesses the properties of resin. It is yellow, soluble in alcohol, and in a mixture of alcohol and muriatic acid. Beuville has ascertained, that by this last mixture it may be separated completely, and the silk deprived of it assumes a fine white colour.

The chemical properties of silk itself have been but imperfectly examined. It is not acted upon by water or alcohol, has no taste, and is but imperfectly combustible: though it burns rapidly blackens and decomposes it. When distilled, it yields, according to Neumann, an uncommonly great proportion of ammonia.

The alkalies dissolve it by the assistance of heat: and it is not unlikely that they form with it an animal soap.

It is dissolved likewise by sulphuric and muriatic acids, and by nitric acid. By the
action of this last acid, Berthollet obtained from silk some oxalic acid, and a fatty matter which swam on the surface of the solution. By a similar treatment, Welter obtained fine yellow crystals, very combustible, to which he gave the name of cotton, but which, at the same time, that silk is kept in a damp place it rots (to use the common language) in a much shorter time.

Silk, manufacture, or preparation of. When the silkworms have completed their cocoons or silkworms (thl., in the 359), they are collected, and put into little baskets; and thus exposed to the heat of an oven, to kill the insect, which, without this precaution, would not fail to open itself to go away and leave these new broods abroad, it has acquired within.

Ordinarily, they only wind the more perfect balls; those that are double, or too weak, or too coarse, are laid aside, not as altogether useless, but that, being improper for winding, they are reserved to be drawn out into skeins. The balls are of different colours: the most common are yellow, orange-colour, isabella, and flesh-colour; there are some also of a sea-green, others of a sulphur-colour, and others white; but there is no necessity for separating the colours and shades to wind them apart, as all the colours are to be lost in the future scouring and preparing of the silk.

The goodness of silk is best distinguished by its lightness. The organzine silk is the best of any made in the country of Piedmont, and its two threads are equal in fineness, the thl., in the shortness, smoothness, and fineness, length, for the thread of the first twist. For the second, it matters not whether the single thread is strong between the two are joined, unless to see whether the first twist proves well. It is necessary that he be clean, and it is to be observed, that the straw-coloured is generally the lightest, and the white the heaviest of all.

The skins should be even, and of all an equality, which, if they were not so united; otherwise we may with justice suspect that it is refuse silk, and cannot be equally drawn out and spun, for one thread will be stronger than the other, which is labour and loss. It will also be requisite to search the bale more than once, and take from out of the parcels a skin to make an essay; for unless it is known by trial, there is the greatest danger of being cheated in this commodity. To wind silk from all the balls, two machines are necessary; the one a furnace, with its copper; the other a reel, or frame, to draw the silk. The winder then, seated near the furnace, throws into the copper of water over the furnace (first heated and boiled to a certain degree, which custom alone can teach) a hundred or two of balls, which have been first well purged of all their loose furry substance. She then stirs the whole very briskly about with birchen rods, bound and cut like brushes, and when the heat and agitation have detached the ends of the silks of the cocoons, which are apt to catch on the rods, she draws them forth, and joining ten or twelve, or even fourteen of them together, she forms them into threads, according to the size required to the works they are destined for: eight ends sufficing for ribbons; and velvets, &c. requiring no less than fourteen. The ends, thus joined into two or three threads, are first passed into the holes of three iron rods, in the top-part of the rod, then upon the bobbins or pulleys, and at last are drawn out to the real itself, and there fastened, each to an end of an arm or bronce of the reel. Thus disposed, the worker giving motion to the real, by turning the handle, guides the threads; substitutes new ones, when any of them break, or any of the balls are wound out; strengthens them, where necessary, by adding others; and takes away the balls wound out, or that, having been pierced, are full of water.

In this manner, twos persons will spin and reel three pounds of silk in a day, which is done with greater dispatch than is made by the spinning-wheel or distaff. Indeed, all silks cannot be spun and reeled after this manner; either because the balls have been perforated by the silkworms themselves, or because they are double, or too weak to bear water; or because, &c. Of all these together, they make a particular kind of silk, called fioretta; which being carded, or even spun on the distaff, or the wheel, in the condition it comes from the ball, makes a tolerable silk.

As to the balls, after opening them with scissors, and taking out the insects (which are of some use for the feeding of poultry), they are steeped three or four days in troughs, the water of which is changed every day to preserve the skin. On these cards, they are well softened by this soaking, and cleared of that gummy matter the worm had lined the inside with, and which renders it impenetrable to the water, and even to air itself, they boil them till an hour in a lye of ashes, very clear and well strained; and after washing them out in the river, and drying them in the sun, they card and spin them on the wheel, &c. and thus make another kind of fioretta, somewhat inferior to the former.

As to the spinning and reeling of raw silks off the balls, such as they are brought from Italy and the Levant, the first is chiefly performed on the spinning-wheel; and the latter, either on hand-reels, or on reels mounted on machines, which serve to reel several skins at the same time.

As to the milling, they use a mill composed of several pieces, which may mill two or three hundred bobbins at once, and make them into as many skins.

For spinning of silks, see DYING.

SILPHIUM, a genus of plants belonging to the class of syngenesia, and to the order of polyagania necessaria; and in the natural system arranged under the 4th order, composite. The receptacle is paleaceous; the pappus has a two-borner margin, and the calyx is squamous. There are eight species: the lacinatum, terebinthinum, perforatum, con- natum, astericum, trifolium, arboresum, and trifoliatum. The first six of these are natives of North America.

Several of the spilix are of an entirely oval outline: of this kind is the S. thoracica, which is easily distinguishable by its red thorax, every other part of the animal being coal-black: it is about half an inch in length.

Silpha strata is of similar size, but totally black, and has the wing-sheaths marked by three rising lines: its larva, which may be found in gardens, is of a lengthened shape and of a black colour. See Plate Nat. Hist., figs. 301 and 302.

SILVER, in natural history, is a metal of a fine white colour, without either taste or smell; and in point of brilliance perhaps inferior to none of the metallic bodies, if we except polished steel. Its hardness is 7. When melted, its specific gravity is 10.475; when hammered, it is capable of being shaped into thin sheets, and, in the form of a thin leaf, into the form of a bowl or vessel of any shape, by means of a hammer, as thin as skin, and capable of being bent into any form. Its ductility is equally remarkable: it may be drawn out into wire much finer than human hair; so fine, indeed, that a single grain of silver may be extended about 400 feet in length. Its tenacity is such, that a wire of silver 0.078 inch in diameter is capable of supporting a weight of 187.133bs. without breaking.
Silver melts when it is heated completely red hot; and while melted, its brilliancy is much increased. According to the calculation of Bergman and Mortimer, its fusing point is 1084° of Fahrenheit. It continues melted at 289°, and requires a much greater heat to bring it to fusion. If the heat is increased after the silver is melted, the liquid metal boils, and may be volatilized; but a very strong and long-continued heat is necessary.

When cooled slowly, its surface exhibits the appearance of crystals; and if the liquid part is still, it is poured out as soon as the surface congeals, pretty large crystals of silver may be obtained. By this method Timlet, and Mongez, junior, obtained it in four-sided pyramids, both insulat in and in groups.

Silver is not oxidized by exposure to the air; it gradually, indeed, loses its lustre, and becomes tarnished; but this is owing to a different cause. Neither is it altered by being kept under water. But if it is kept for a long time melted in an open vessel, it gradually attracts the oxygen from the atmosphere, and is blackened by it. Moreover, by exposing silver 20 times successively to the heat of a porcelain furnace, obtained a glass of an olive-green colour. Nay, if the heat is sufficient, the silver even takes fire and burns like other combustible bodies. Van Marum, in his machine pass through a silver wire; the wire exhibited a greenish-white flame, and was dissipated into smoke. Before a stream of oxygen and hydrogen gas, it burns rapidly, with a light-green flame.

The oxide of silver, obtained by means of heat, is of a greenish or yellowish grey colour; and is easily decomposed by the application of heat in close vessels, or even by exposing it to the light. When silver is dissolved in nitric acid, and precipitated by lime water, it falls to the bottom under the form of a powder, of a dark-greenish brown colour. From the experiments of Wenzel and Berg- man it followed, that the greenish or yellowish, grey oxide is composed of about 90 parts of silver and 10 of oxygen. When this oxide is exposed to the light, part of its oxygen is separated, as Scheele first ascertained; and is converted into a black powder, with but a very small portion of oxygen, and may be considered as silver reduced. By exposing the solution of silver in nitric acid to sunshine, the silver precipitates in the form of a flesh-brown powder.

Neither carbon nor hydrogen has been combined with silver; but it combines readily with sulphur and phosphorus.

1. When thin plates of silver and sulphur are laid alternately above each other in a crucible, they melt readily in a low red heat, and form sulphuric silver. It is of a black or very deep violet colour; brittle, but capable of being cut with a knife; often crystallized in small needles; and much more fusible than silver. If sufficient heat is applied, the sulphur is slowly volatilized, and the metal remains in a black powder, which is very difficult to determine the proportion of the ingredients which enter into the composition of this substance, because there is an affinity between silver and its sulphuret, which disposes them to combine readily. The greatest quantity of sulphur which a given quan-

ity of silver is capable of taking up, is, according to Weazel, 1/13.

It is well known, that when silver is long exposed to the air, especially in frequented places, as churches, theatres, &c., it acquires a covering of a violet colour, which deprives it of its brilliancy. This covering, which forms a thin layer, can only be detached from the silver by beating it, or breaking it in pieces with a hammer. It was examined by Mr. Proust, and found to be sulphide of silver.

2. Silver was first combined with phosphorus by Mr. Pelletier. If one ounce of silver, one ounce of phosphoric glass, and two draughts of charcoal, are mixed together, and heated in a crucible, the phosphuret of sulphur is formed. It is of a white colour, and appears granulated, or crystallized.

It breaks under the hammer, but may be cut with a knife. It is composed of four parts of silver and one of phosphorus. Heat decomposes it by separating the two metals. Peltier has observed, that silver in fusion is capable of combining with more phosphorus than solid silver: for when phosphuret of silver is formed by projecting phosphuret into melted silver, after the crucible has taken from the fire, a quantity of phosphorus is emitted the moment the metal congeals.

Silver does not combine with the simple incombustibles.

Silver combines readily with the greater number of metallic bodies.

1. When silver and gold are kept melted together, they combine, and form an alloy composed, as Homberg ascertained, of one part of silver, and five of gold. He kept equal parts of gold and silver in gentle fusion for a quarter of an hour, and found, on breaking the crucible, the uppermost of which was pure silver, the underneath the whole gold combined with 1/5 of silver. Silver, however, may be melted with gold in almost any proportion; and if the proper precaution be employed, the two metals remain combined together.

The alloy of gold and silver is harder and more sonorous than gold. Its hardness is a maximum when the alloy contains two parts of gold and one of silver. The density of these metals is but little increased; but the colour of the gold is much altered, even when the proportion of the silver is small; one part of silver produces a sensible whiteness in twenty parts of gold. The colour is not only pale, but it has also a very sensible greenish tinge, as if the light reflected by the silver passed through a very thin covering of gold. This alloy being more fusible than gold, is employed to solder pieces of that metal together.

2. When silver and platinum are fused together (for which a very strong heat is necessary), they form a mixture, not so ductile as silver, but harder and less white. The two metals are separated by keeping them for some time in the state of fusion; the platinum sinking to the bottom from its weight. This circumstance would induce us to suppose that there is very little affinity between them.

The affinities of silver, and its oxides, are placed by Bergman in the following order:

Silver.

<table>
<thead>
<tr>
<th>Oxide of Silver</th>
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<tbody>
<tr>
<td>Lead, Muriatic acid</td>
</tr>
<tr>
<td>Copper, Oxalic</td>
</tr>
<tr>
<td>Mercury, Sulphuric</td>
</tr>
<tr>
<td>Bismuth, Sachtic,</td>
</tr>
<tr>
<td>Tin, Phosphoric</td>
</tr>
<tr>
<td>Gold, Sulphuric</td>
</tr>
<tr>
<td>Antimony, Nitric</td>
</tr>
<tr>
<td>Iron, Arsenic</td>
</tr>
<tr>
<td>Mangastic, Fluoric</td>
</tr>
<tr>
<td>Zinc, Tannic</td>
</tr>
<tr>
<td>Arsenic, Citric</td>
</tr>
<tr>
<td>Nickel, Lactic</td>
</tr>
<tr>
<td>Platinum, Acetic</td>
</tr>
<tr>
<td>Sulphur, Succinic</td>
</tr>
<tr>
<td>Phosphorus, Carbonic</td>
</tr>
</tbody>
</table>

Silver, fulminating. See Fulmination.

Silver-leaf, that beaten out into fine leaves for the use of the gilders, which is performed in the same manner as gold-leaf.

Silver-wire, that drawn out into fine wires for the use of the masons, which see the articles Gold-wire, and Wire-drawing.

Silver, shell, is prepared of the shreds of silver-leaves, or of the leaves themselves, for the use of painters, after the same manner as shell-gold. See Gold.

Silvering. The art of silvering wood, &c., is performed in the same manner as gilding, making use of silver instead of gold leaf.

To silver copper or brass, clean the metal with aqua fortis, by washing it lightly, and then throwing it in water; or by scouring it with salt and tartar with a wire brush. Dissolve some silver in aqua fortis, and put pieces of copper into the solution; this will throw down the silver in a state of metallic powder. Take 20 gr. of this powder, and mix with it two grains of tartar, the same quantity of common salt, and half a drachm of alum; rub the articles with this composition till they are perfectly white, then brush it off, and polish them with leather.

To silver the dial-plates of clocks, scales of barometers, &c., take an ounce of silver lace, add to it an ounce of double-refined aqua fortis, put them into an earthen pot, and place them over a gentle fire till all is dissolved, which will happen in about five minutes; then take them off, and mix it in a pint of clear water, after which, pour it into another clean vessel, to free it from grit or sediment; then add a spoonful of common salt; and the acid, which has now a green tinge, will immediately let go the silver particles, which form themselves into a white curd; pour off the acid, and mix the curd with two ounces of salt of tartar, half an ounce of whitening, and a large spoonful of salt, more or less, according as you find it for strength. Mix it well up together, and it is ready for use.

Having well cleared the brass from scratch es, rub it over with a piece of old hat and rottenstone, to clear it from all greasiness, and then rub it with a cloth wetted with water by your hand; take a little of the beforementioned composition on your finger, and rub it over where the salt has touched, and it will adhere to the brass, and completely silver it. After which, wash it well with water, to take off
what aqua fortis may remain in the composition; when dry, rub it with a clean rag, and give it one or two coats of varnish. This silver is not durable, but may be improved by heating the article, and repeating the operation till the covering seems sufficiently thick.

Silver plating. The coat of silver applied to the surface of the copper by the methods mentioned above, is very thin, and is not durable. A more substantial method of doing it is as follows. Take small pieces of silver and copper, and tie them together with string, so as to form a little borbax between. The proportion of silver may be to that of copper, a 1 to 12. Put them into a white heat, when the silver will be firmly fixed to the copper. The whole is now made to pass between rollers till it is of the required thickness for manufacturing the articles required.

SILURUS, a genus of fishes of the order amphibians. The generic character is, head large, depressed; mouth wide, bearded by longer, lateral, and a row of small teeth on the upper lip. A single dorsal fin, sometimes preceded by a small, first ray of the pectoral fins, or of t.e first dorsal fin, toothed backwards. There are 28 species.

1. Silurus glanis, European silure. The great or common silure may perhaps be considered the representative of all European river fishes; growing to the length of eight, ten, or even fifteen feet, and to the weight of three hundred pounds. Its more general length, however, is from two to three or four feet. The head is broad and depressed; the body thick and of a lengthened form, with the abdomen very thick and short. It is a fish of a remarkably inert or sluggish disposition, being rarely observed in motion, and commonly living by itself in the soft bottom of the rivers it frequents, under the projecting roots of trees, rocks, logs, or other substances. In this situation it remains, with its wide mouth half-open, gently moving about the long cirri or tentacles situated on each side the jaws; which the smaller fishes mistaking for worms, and attempting to seize, become a ready prey to the sluggish silure. The usual colour of this species is dark olive, variegated with irregular spots of black; the abdomen and lips being of a pale flesh colour, and the fins tinged with violet. It is an inhabitant of the larger rivers of Europe, as well as some parts of Asia and Africa; but appears to be most plentiful in the north of Europe. It is in no very high estimation as a food, the flesh being of a somewhat glutinous nature; but, from its cheapness, is in much request among the inferior ranks, and is eaten either fresh or salted: the skin also, which is smooth, and destitute of apparent scales, is dried and stretched, and after rubbing with oil, becomes of a horny transparency and strength, and is used in some of the northern states of glass window. The silure is not a very prolific fish; depositing but a small quantity of spawn, consisting of large globules or ova: these, as well as the newly hatched young, are frequently found, along with many smaller fishes, in the silure, and thus the great increase of the species is prevented. The ova, according to Dr. Bouch, usually hatch in the space of seven or nine days from their exclusion.

2. Silurus coelestis, electric silure. Length about twenty inches; head and fore-parts very broad and depressed; on the upper lip two cirri; on the lower four; teeth small and numerous. Native of the African rivers; observed by Forskal in the Nile: possesses a degree of electric or galvanic power, but in a much smaller degree than the torpedo.

SILURUS caspius, cat silure. Length about two feet; form rounded and thick; colour dusky above, pale flesh-colour beneath; head round; mouth very large; on the upper jaw, beneath each eye, a very long beard; on the lower jaw four short beards; first dorsal fin small; caudal fin forked; all the fins, with the rest of the fins small and red; tail forked. Inhabits the sea and rivers of North America, preying on all kinds of smaller fishes; and not sparing even those of its own kind, in taste resembles an eel, and is much esteemed by the Americans: is a fish of slow motion, like the European silure.

4. Silurus costatus is an inhabitant of South America and India. See Plate Nat. Hist. fig. 360.

SIMIA, apa, a genus of quadrupeds of the order primates. The Libian generic character is, front teeth in each jaw four, placed near together; canine teeth solitary, longer than the others, distant from the remaining teeth, or grinders; grinders obtuse. This genus is divided into four sections, of which there are about 70 species, viz. 1. Apes, or such as are destitute of a tail. 2. Baboons, or such as have very muscular bodies, and whose tails are commonly long, slender, and flexible; or, lastly, apas, or monkeys, with what are termed prehensile tails, viz. such as can, at pleasure, be twisted round any object, so as to answer the purpose of an additional hand to the animal.

Of the whole genus, or the monkey tribe in general, it may be observed, that the baboons are commonly of a ferocious and sullen disposition. The larger apes are also of a malignant temper, except the orang otan and the gibbons. The monkeys properly so called, are very various in their dispositions; some of the smaller species are lively, harmless, and entertaining; while others are as remarkable for the mischievous malignity of their temper, and the capricious uncertainty of their manners.

It may not be improper here to observe, that it is no easy task to determine with exact precision the several species of this extensive genus; since, exclusive of the varieties in point of colour, they are often so nearly allied as to make it difficult to give real distinctive characters. The most remarkable species are:

APES.

1. Simia satyris, orang otan. Of these singular animals, the species which has most excited the attention of mankind is, the orang otan, or, as it is sometimes called, the satyr, great ape, or man of the woods. It is a native of the warmer parts of Africa and India, as well as of some of the Indian islands, where it re-ites principally in woods, and is a common sight among the inhabitants of that genus, on fruits. The orang otan appears to admit of considerable variety in point of colour, size, and proportions; and there is reason to believe, that, in reality, there may be two or three kinds, which, though nearly approximated as to a general similitude, are yet specifically distinct. The specimens imported into Europe have rarely exceeded the height of two or three feet, and were supposed to be young animals; but it is said that the full grown ones are, at least, six feet in height. The general colour of these animals is reddish brown; in some ferruginous or reddish brown, and in others coal-black, with the skin itself white. The face is bare; the ears, hands, and feet, nearly similar to the human, and the whole appearance such as to exhibit the most striking approximation to the human figure. The likeness, however, is only a general one; and the structure of the hands and feet, when examined with anatomical exactness, seems to prove, in the opinion of those most capable of judging with accuracy on the subject, that the animal was principally designed by nature for the quadrupedal manner of walking, and not for an upright posture, which is only occasionally assumed, and which, in those exhibited to the public, is, perhaps, rather owing to instruction than truly natural. The count de Buffon, indeed, makes it one of the distinctive characters of the real or proper apes (among which the baboons and orang otans are included) to walk erect on two legs only; and it must be granted, that these animals support an upright position much more easily and readily than most other quadrupeds, and may probably be very often seen in this attitude even in a state of nature.

The manners of the orang otan, when in captivity, are gentle, and perfectly void of that disgusting ferocity so conspicuous in some of the larger baboons and monkeys. It is docile, and may be taught to perform, with dexterity, a variety of actions in domestic life. Thus it has been seen to sit at table, and, in its manner of feeding and general behaviour, to imitate the company in which it is placed: to pour out tea, and drink it, without awkwardness or constraint; to prepare its bed with great exactness, and to dispose itself to sleep in a proper manner. Such are the actions recorded of one which was exhibited in London in the year 1738: and the count de Buffon relates that of an orang otan of the same species, which he saw at Paris, Dr. Tyson, who, about the close of the last century, gave a very exact description of a young orang otan, then exhibited in the metropolis, assures us, that, in most of his actions, it seemed to display a very high degree of sagacity. "The most gentle and loving creature that could be. Those that he knew a slip-board he would come and embrace with the greatest tenderness, opening their bosoms, and clasping his hands about them; and, as I was informed, though there were monkeys abroad, yet he was observed he never would associate with them, and, as if nothing to do, would always avoid their company."

But however docile and gentle when taken young, and instructed in its behaviour, it is said to be possessed of great ferocity in its native state, and is considered as a dangerous animal, capable of really overpowering the most powerful of our species. Its ferocity is in direct ratio to its strength, and for this reason it is rarely to be obtained in its full-grown state; the young alone being taken. A few years past, the hand of a supposed full-grown orang otan was brought from Sierra Leone, which, from its
SINIA.

On its first arrival it had but very little hair, except on its body and arms; but on the approach of winter it became extremely well covered; the hair on the back being three inches in length. The whole animal then appeared of a chestnut-colour; the skin of the face, &c. was of a mouse-colour, but about the eyes and round the mouth of a dull flesh-colour.

It came from the island of Borneo, and was deposited in the museum of the prince of Orange.

Upon the whole, it appears clearly that there are two distinct species of this animal, viz. the pongos, or more and black orang otan, which is a native of Africa, and the reddish brown or chestnut orang otan, called the jooke, which is a native of Borneo and some other Indian islands. This latter, as appears from a collection of most of the specimens which have been surveyed with the necessary degree of exactness, is distinguished by having no nails on the great toes; whereas in the pongo, or black species, they are conspicuous.

2. Sinia lar, or long-armed ape. This is a species of a more deformed appearance than the oran otan, and is distinguished by the excessive length of its arms, which, when the animal stands upright, are capable of touching the ground without raising its feet. It is a native of India and some of the Indian islands, and grows to the height of four feet or more. Its colour is black; but the face is commonly surrounded by a whitish beard.

Notwithstanding the apparent ferocity of the gibbon, and the deformity of its figure, it is a quiet and gentle animal, and is not likely to do any injury to man. It is a native of the islands of Borneo, and is of small size, and are of a hazel colour. The hands and feet have strong black claws; but the thumbs of the hands have rounded nails. The tail is very short. It is ferocious in its manners, and its appearance is at once grotesque and terrorizing.

The region surrounding the tail, to a considerable distance on each side, is perfectly bare and callos, and of a red colour. This is also common, in a greater or smaller degree, to the rest of this division. It is a native of the islands of Borneo.

5. Sinia mormon, variegated baboon. This is at least equal in size, if not superior, to the former, and, when in an upright posture, is about five feet high. It is the most remarkable of the whole genus for brilliancy and variety of colour. The general tinge is a rich and very deep yellowish-brown; the hairs, if viewed near, appearing speckled with yellow and black. The form of the face is long, with the snout ending somewhat abruptly; the whole length of the nose, down the middle, is of a deep blood-red; but the parts on each side are of a fine violet-blue, deeply marked by several oblique furrows. The under part is of a pure white, or whitish-yellow. It is a native of the interior parts of Africa; but it is said to have been also brought from India.

The variegated baboon is of a fierce disposition, and is of a much larger size than the former. Its voice somewhat resembles the slight roar of a lion; it is a rare species, and is not often imported into Europe.

6. Sinia malinon, malimon. The species between these two and the former are commonly confounded. It is described by the count de Buffon under the name of mandrill. It is an active animal, and seems far less inoffensive and malignant than the rest of the baboons. The general likeness which it bears to the former species is such as to give the idea of the same animal in a less advanced state of growth, and with less brilliant colours; the nose, instead of being red on the sides, is white, or pale coloured; but the sides are blue and tawny, as in the former species. This baboon is not uncommon in exhibitions of animals. Its length from nose to tail is about two feet. Tail exactly as in the former.

The next division of the baboons consists of such as have long tails. Of these the chief is the

7. Sinia lamadryas, dog-faced baboon. This species is of an elegant colour, composed of a mixture of grey and brown, the hair appearing as if speckled. It is a very large animal, at least equal, if not superior, in size to the common brown baboon and the monkey, and extremely numerous. It has a vast quantity of flowing hair on each side the head, as well as round the shoulders, spreading in such a manner as to give the appearance of a short cloak or mantle. The whole face is naked, and of a flesh-colour, more or less deep in different individuals. The tail is almost the length of the body, and is commonly a little tuffed at the end. The nails on the hands and fore-feet are flat; those on the hind-feet resemble the nails of the common baboon, and a rare species of the same genus. The tail is compared with the common baboon, and is a native of the hottest parts of Africa and Asia, where it is said to reside in vast troops, and to be very fierce and dangerous. There is a wonderful degree of sagacity in the coun-
disposition of the hair on the top of the head, which spreads out in a circular direction, somewhat in the manner of a Chinese cap, is a native of Ceylon, and is about the size of a cat. Its general colour is a pale yellowish-brown, pale ochre, and the ears are black. The face is very dusky, and sometimes the general tinge of the animal is dusky-ferruginous. This species is easily distinguished when seen in a healthy state: the hair on the top of the head resembling that of a boy; as if parted in the middle, and lying smooth over the head. They are said to inhabit the woods in great troops, and to be very destructive to such gardens and plantations as he within reach of their retreats. The tail in this species is very long: the nails of the thumbs are round; the rest long.

12. S. petrannis. Vaulting monkey. This is described by Mr. Allman in his edition of Buffon's Natural History of Quadrupeds. It is said to be somewhat more than a foot high, and the tail about twenty inches long. The upper parts of the animal are of a dark olive-coloured, owing to a mixture of olive-green and black hair, and the same is the case with the white. The face is indicated by a fine long chevelure of grey-brown hair, and a large beard of fair grey. The chevelure or spreading hair round the face stretches upwards over the eyes and forehead, as in particular that of the head is not the same in the short-tailed, nor the long-tailed baboon, to which, indeed, from the figure as well as description, it appears so extremely similar, that it might well pass for a variety of the same animal.

M. de l'Isle.

Diana. Spotted monkey. Mr. Pennant describes this species as of a middling size, and of a reddish colour on the upper parts, and as siveen, and marked with white specks; the belly and chin whitish; the tail very long. The Limarcan description differs. Limarcan says the animal is of the size of a large cat, and is black, spotted with white; the hind part of the back ferruginous; the face black; from the top of the nose a white line, passing over the eye, and arched on the cheek, which arches the mouth; (this circumstance was probably the reason of the Limarcan name Diana, by which he has chosen to distinguish the animal) the beard pointed, black above, white beneath; a kind of hair on the crown; the hair of the beard and throat white; from the scull the hair of the face white, when passing through the eyes, the nose, and mouth, and over the teeth, it is a dull flesh-colour; the cheeks are surrounded by long white hairs, inclining to yellow; the forehead is grey, and above the eyes, from car to ear, extends a black line. The upper part of the animal is dusky and tawny; the breast, belly, and loin, are of the same colour; whenever the animal is alarmed, its face is covered with a tawny mane. The size is greater in the thickness of the limbs and arms black; hands and feet black and naked: the tail of a cinnamon brown. On each side the base of the tail is commonly an oval white spot. This species inhabits Barbary, Athiopia, and other parts of Africa.

14. S. nasina. Proboscis monkey. Amongst the whole tribe of monkeys this perhaps may be considered as the most singular in its peculiar long nose, being of such length and form as to present, especially in a profile view, an appearance the most grotesque imaginable; and indeed from an inspection of the figure alone, one would be apt to imagine that it must have been designed for a caricature of a monkey. The animal, however, is preserved in the royal cabinet at Paris, and was first described by Mons. D'Aubenton. It is a large species, measuring from the nose to the tail, which is more than two feet long. The face has a kind of curved form, and is of a brown colour, and marked with blue and red; the ears broad, thin, naked, and hid within the hair. The size of the nose is most singular, being divided almost into two lobes at the tip; a longitudinal furrow running along the middle. It is said to be found chiefly in Cochinchina, and to grow to a very large size. It is sometimes seen in great troops, and is considered as of a ferocious disposition. It feeds on fruits. Its native name is khai do, or great monkey.

15. S. nemaua. Cochinchina monkey. The douc or Cochinchina monkey is a very large species, measuring at least two feet from the nose to the tail. The face is flat, and of a yellowish-brown colour, as are also the ears; across the forehead runs a narrow dusky band. The back, the under parts of the body, and sides, are of a yellowish grey; the lower part of the arms and tail are white; the feet dusky. It is a native of Cochinchina, and also of Madagascar. It is said that a bezoar is more frequently found in the stomach of this species than of almost any other. When in an upright posture this animal measures three and a half or four feet in height, being nearly of the size of a Barbary ape. This species seems considerably allied in its general form and colours to the preceding, but is distinguished in other parts, so as to form a large mode like that of a lion; near the face this mane is of a redish colour, and grows paler as it recedes from the cheeks; the face itself is of a dusky purple; the ears are large and fat; the hands and feet are also naked, and of the same dull purple colour as the face; the claws are small and sharp; the tail is very long, and rather bushy at the extremity. It is a native of Guiana, and is a lively, active species, and gentle in a state of confinement.

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16. S. rosalis. Silky monkey. This species is said to be of the size of a fox, and of a black colour, with smooth glossy hair; round, beard beneath the chin and brest, and throat; the fore limbs are of the same colour, and the hind parts are black; the hands and feet are also black, and of the same dull purple colour as the face; the claws are small and sharp; the tail is very long, and rather bushy at the extremity. It is a native of Guiana, and is a lively, active species, and gentle in a state of confinement.

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17. S. costae. Preacher monkey. This species is said to be of the size of a fox, and of a black colour, with smooth glossy hair; round, beard beneath the chin and breast, and throat; the fore limbs are of the same colour, and the hind parts are black; the hands and feet are also black, and of the same dull purple colour as the face; the claws are small and sharp; the tail is very long, and rather bushy at the extremity. It is a native of Guiana, and is a lively, active species, and gentle in a state of confinement.

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18. S. paniscus. Four-fingered monkey. This animal is distinguished by the gracility of its body and limbs; its uniform black colour, except on the face, which is of a dark greyish-brown, and a yellowish-brown on the fore feet, instead of which are very small projections or appendages. It is one of the most active and lively of animals, and is besides a gentle and tractable disposition in a state of confinement. It inhabits the woods of South America; associating in great multi-
tudes; assailing such travellers as pass through their haunts with an infinite number of sportive and mischievous gambols; cherishing and throwing down dry sticks, swinging strings, all tails from the birch, and endeavouring to intimidate the passengers by a variety of menacing gestures.

SIMILAR, in arithmetic and geometry, the same with like. In mathematics, similar parts have the same ratio to their wholes; and if the wholes have the same ratio to the parts, the parts are similar. Similar angles are also equal. In solid angles, when the planes under which they are contained are equal, both in number and magnitude, and are disposed in the same order, they are similar, and consequently equal. Similar arches of a circle are such as are like parts of their whole circumferences, and consequently equal. Similar plane numbers are those numbers which may be ranged into the form of similar rectangles, that is, into rectangles whose sides are proportional; such are 12 and 48, for the sides of 12 are 6 and 2, and the sides of 48 are 12 and 4; but 6:2::12:4, and therefore these numbers are similar. Similar polygons are such as have their angles equally. and the sides about those angles proportional. Similar rectangles are those which have their sides about the equal angles proportional. Hence 1. All squares are similar rectangles. 2. All similar rectangles are to each other as the squares of their homologous sides. Similar right-lined figures are such as have equal angles, and the sides of the former are proportional to the sides of the latter. Similar segments of a circle are such as contain equal angles. Similar curves: two segments of two curves are called similar, if, any right-lined figure being inscribed within one of them, we can inscribe always a similar right-lined figure in the other. Similar conic sections: two conic sections are said to be similar, when any segment being taken in the one, we can assign always a similar segment in the other. Similar diameters of two conic sections: the diameters in two conic sections are said to be similar, when they make the same angles with their ordinates. Similar solids are such as are contained under equal angles, and have all their sides proportional. Similar triangles are such as have their three angles respectively equal to one another. Hence, 1. All similar triangles have the sides about their angles proportional. 2. All similar triangles are to one another as the squares of their homologous sides.

SIMILAR FIGURES, in geometry, such as have their angles respectively equal, and the sides about the equal angles proportional.

SIMONIANS, in church history, a sect of antient christians, so called from their founder Simon or the magician. The heresies of Simon Magus were principally his pretending to be the great power of God, and thinking that the gifts of the Holy Ghost were venal.

SIMONY, is the corrupt presentation of any one as ecclesiastical benefice, for money, gift, reward, or benefit.

By one of the canons of 1603, every person before his admission to any ecclesiastical promotion, shall, before the ordinary, take an oath, that he has made no simoniacal contract, promise, or payment, directly or indirectly, by himself or any other, for the obtaining of the said promotion; and that he will not afterwards perform or satisfy any such kind of payment, contract, or promise, by any other without his knowledge or consent.

To purchase a presentation, the living being actually given, and the sale of the same presentation is; but it is void by the common law. 2 Black. 22.

A bond of resignation is a bond given by the person intended to be presented to a benefice, with condition to resign the same, and it is void unless of the special one is to resign the benefice in favour of some certain person, as a son, kinsman, or friend of the patron, when he shall be capable of taking the same. By a general bond within three months after being requested, to the intent that the patron might present his son or other heir to a benefice, and the judgment was affirmed in the exchequer-chamber; for a man may, without any colour of simony, bind himself for good reasons, as if he takes a second benefit, or that he is not interested in the patronage, or that the patron presents his son, to resign; but if the condition had been to let the patron have a lease of the glebe or tithes, or to pay a sum of money, it would have been simoniacal.

SIMPLICITY in music, a pure, unmixed, single sound or note, which shall not allow that there is, musically speaking, any such sound in nature; but assert on the contrary that every sound which is produced is at least accompanied with its twelfth and seventeenth.

SIMPLE, in pharmacy, a general name given to all herbs or plants, as having each its particular virtue, whereby it becomes a simple remedy.

SIMPLE SOUNDS, see Elements.

SIMPLICITY, in composition, a natural unadorned melody, or incomplex combination of parts, in which the composer endeavours, rather by the force of his genius and feeling than the refinement of science, to produce his own ideas and emotions, without disturbing the purity of the text.

SINAPIS, mustard, a genus of plants belonging to the class of tetracyanids, and to the order of siliqueae, and in the natural system ranged under the 39th order, siliqueae. The calyx consists of an expanding strap-shaped deciduous leaves; the unites or branches of the petals are straight; two glands between the shorter stamina and pistillum, also between the longer and the calyx. There are 10 species, three of them natives of Britain.

1. The white, or white mustard, which is generally cultivated as a salad-herb for winter and spring use.
2. The nigra, or common mustard, which is frequently found growing wild, and is but inferior to the white, but is also cultivated in fields for the seeds, of which the sauce called mustard is made.
3. The arvensis grows naturally on arable land in many parts of Britain. The seed of this is commonly sold under the title of Durham mustard seed. Of this there are two varieties.
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\text{SINAPISM. See Pharmacy.}
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INCIPUT, in anatomy, the fore part of the head, lying from the forehead to the coronal suture. S I N, or right siste of an arch. See Tri-

IONOMETRY. SINE-CURE, is where a rector of a parish has a vicar, a brother endowed and charged with the cure, so that the rector is not obliged either to do duty or residence.

SINE-DIE, without day, in law, a term frequently used in our proceedings at common law; as when judgment is given against the plaintiff, he is said to be in misericordia pro fabo clamarque suo; so when judgment passes for the defendant, it is entered ex inde sine, being as much as to say, he is discharged, or dismissed the court.

SINISTER. See HERALDRY.

SINKING FUND, in political economy, a portion of the public revenue appropriated to the reduction or discharge of the public debts, and consisting of sums adopted in other countries long before it was resorted to in Great Britain, a provision of this kind had appeared necessary at a much earlier period, and had been established in France, to which country it was introduced under the name of the state in 1682. These funds were both formed by reducing the interest payable on the public debts, and appropriating the annual sum thus saved to the gradual discharge of the principal.

In the reign of king William, when the mode of providing for extraordinary expenses by incurring public debts, which has become so general, was first adopted in this country, the tax on which, money was borrowed, generally produced much more than sufficient to pay the annual interest, and the surplus was applied in sinking or discharging the principal, which was generally effected in a few years. Had this plan been pursued, there never could have been any very great accumulation of public debts; but, as the expenditure increased, and the necessity of loans of still greater amount became more frequent, the mode of proceeding found itself so perfectly diffused to provide effectually for the yearly interest of the sums thus borrowed; and the repayment of the principal was either put off to a distant period, or left without any provision to the chance of more flourishing times.

Some of the effects of an accumulating public debt soon became evident in the discount at which all government securities sold, and in the difficulties experienced in providing for the annual expenditure; the propriety of reducing, and even of wholly discharging, the principle, was acknowledged; and the plan of a sinking fund very similar to that which was afterwards adopted, was recommended in a pamphlet published in 1701. In 1713 Mr. Archibald Hutcheson presented to George I. a plan for the public debts. In 1715 different projects for this purpose were published by Edward Leigh, Mr. Avill, and others. And in 1717 a plan for the gradual discharge of the debt was actually adopted, which was afterwards generally known by the appellation of the sinking fund.

The country had been engaged in an expensive war during nearly the whole of the reign of queen Anne; and it had been found impracticable to obtain the large sums required without paying the interest, a very high interest; but upon the return of peace the current rate of interest lowered considerably, which proceeded in part from a real increase of the national capital, as well as from proceedings to governments of that amount, being no longer necessary. It was therefore deemed a proper opportunity for effecting a reduction of the high interest payable to the public creditors, and of establishing a sinking fund for reducing by degrees the debts of the nation. Accordingly, on the 20th of May, 1717, general Stanhope, who was then first lord of the treasury, and chancellor of the exchequer, submitted to parliament the terms of a proposition with the bank of England and the South Sea company, by which the interest was to be reduced from 6 to 5 per cent, on the capitals of these corporations, who were the principal public creditors, and who were likewise furnished money, if it should be necessary, for paying off such individuals as should not agree to a similar reduction of the interest payable to them. The total annual interest saved to the government by this arrangement was no less than 328,560l. 12s. 7d.

The different funds on which most of the public debts had been charged were consolidated; and the produce of all the permanent taxes was distinguished into only three funds, called the aggregate fund, the South Sea fund, and the general fund. From these three funds the interest of all the public debts was payable; and the excess or overplus beyond the payments with which each fund was charged, was to be appropriated, reserved, and applied, to reducing the principal, and to the payment of the annual interest of the national debts and incumbrances, as were incurred before the 25th day of December 1716, and are declared to be national debts, and were provided for by act or acts of parliament, to be discharged therewith, or out of the same, and to or for none other use, intent, or purpose, whatsoever.

This constituted the sinking fund; and as the plan originated while sir Robert Walpole was in office for the last time, he is much honored as the father of it: but it is evident that it required no invention, but little judgment, to adopt a measure which had been found efficacious in other countries, which had been publicly recommended some years before, and the utility of which was so obvious, that not to have adopted it, when the reduction of interest rendered it so practicable, and when an example had been set in the establishment of the aggregate fund, would have been inexusable. It was a case of appropriating generally the surplus of funds which were before established, to the uses to which the greater part had before been specifically appropriated.

For a few years the fund was strictly applied to the purposes for which it was established; and so well were its nature and importance then understood, that rather than encroach upon it, money was at the same time borrowed for extraordinary expenses. This perseverance was however of no long duration; and in 1722 it was made a collateral security for the interest of a million raised by exchequer bills, which prepared the way for more direct encroachments. In 1728 the sum of 15,144l. was taken from the fund, to make good the loss to the treasury from the reduction of the value of gold coin; and within twelve years from its establishment it was charged with the interest of new loans. In the period of half a million was taken from it towards the supplies, at which time the medium annual produce of the fund for five years had been 1,212,000l. This amount, with its proper increase, would have been sufficient for the discharge of the debt which then existed, but the alienation of it was continued; and Mr. Price has shewn that no greater part of the public debt than about eight millions and a half was reserved from this period to the year 1786; when, in consequence of a new arrangement of the public accounts, the distinction of the different funds above-mentioned was abolished, and the produce of all the permanent taxes included under one general head, called the consolidated fund.

One of the objects of this arrangement was to lay the foundation of a new sinking fund, formed from the general surplus of the revenues of the old fund, in the application of the principle of compound interest. Among those whom Mr. Pitt consulted on this occasion, he particularly sought the advice and assistance of the immortal Mr. Price, who communicated three plans, which he conceived to be best adapted for carrying into execution a measure that he had so often urged in his different publications, particularly before the American war had wrested the public debts to what then appeared to be a hopeless magnitude: it was one of the plans thus communicated, which was afterwards adopted, but with some alterations which considerably affected its efficacy, and still remained necessary to correct. By the act which was passed for carrying this scheme into execution, 20 Geo. 3. c. 31, the annual sum of 1,000,000l. was placed in the hands of commissioners, who are, the speaker of the house of commons, the chancellor of the exchequer, the master of the rolls, the accountant-general of the court of chancery, and the governor and deputy-governor of the bank, for the time being respectively. This sum is paid into the bank in quarterly payments, and to be applied either in paying off such redeemable annuities as were at or above par, or in the purchase of annuities below par, at the market-price. The dividends on the sums redeemed or purche-
ed, with the annuities for lives or terms that should fall in or expire, and the sums which might be saved by any reduction of interest, were to be added to the fund, which was thus to continue increasing till it amounted to four millions a year; and this it was computed would be in about 26 years. To raise upwards of 56 millions of stock would have been redeemed, from which the dividends on such capital as should afterwards be paid off or purchased by the commissioners, with such annuities as might fall in, were to be at the disposal of parliament.

On the 17th of February, 1792, Mr. Pitt proposed that the sum of 400,000£. should be issued in addition to the million, for the purpose of accelerating the operation of this fund; and stated, that in consequence of this and future intended additions, it might be expected that 25 millions of 3 per cent. would be paid off by the year 1800; and that in the year 1808, the fund would amount to four millions per annum, being the sum to which it was intended to go. But the most important provision was a provision, that whenever, in future, any sums should be raised by loans on perpetual redeemable annuities, a sum equal to one per cent. on the stock created by such loan, should be issued out of the produce of the consolidated fund, quarterly, to be placed to the account of the commissioners, who were to keep a separate account of the stock redeemed by this new fund, with the object of avoiding the accumulation of the original fund. By these means the immediate progress of the fund was quickened, and future loans were put into a regular course of redemption.

The indiscriminate restriction of the fund to four millions per annum, was done away by an act passed in 1802, which directed that the produce of the two funds should continue to accumulate, without any limitation as to its amount, and be from time to time applied, according to the former provisions, in the redemption or purchase of stock, until the whole of the perpetual redeemable annuities, existing at the time of passing the act, shall have been completely redeemed or paid off. At the same time the usual annual payment of 200,000£. in aid of the fund, was made a permanent charge, to be issued in quarterly payments from the consolidated fund, in the same manner as the original million per annum. In consequence of these improvements, the increase of the fund has been much greater than it was originally estimated; and its total amount, with the sources from which it arose, was on the 1st of February, 1809, as follows:

| Annual charge, by act of 29 Geo. Ill. | £1,000,000 | 0 | 0 |
| Ditto, 42 Geo. Ill. | 200,000 | 0 | 0 |
| Annuities for 99 and 96 years, as agreed to 1792 | 54,880 | 14 | 6 |
| Short annuities, expired 1787 | 25,000 | 0 | 0 |
| Life annuities, unclaimed and expired | 50,308 | 5 | 7 |
| Dividends on 98, 386, 402£. at 3 per cent. | 2,951 | 592 | 1 | 2 |
| Ditto on 2,617,400£. at 4 per cent. | 104,696 | 0 | 0 |
| Ditto on 142,000£. at 5 per cent. | 7,100 | 0 | 0 |

One per cent. on capitals created since 1793 £3,292,972 1 10

Total £7,996,249 3 1

This sum is exclusive of the fund for the reduction of the public debt of Ireland, funded in Great Britain, which at the above period amounted to 479,337£. 8s., and of the fund for reduction of the imperial debt, which amounted to 53,696£. 15s. 4d.

The commissioners are directed by the act to make their purchases "in equal proportions, as nearly as may be, on every day (Saturdays and Mondays excepted) on which the same shall be transferable." So that they purchase on four days in every week in which there are no holidays. They are empowered to subscribe towards any public loan, to be raised by act of parliament, upon perpetual annuities, subject to redemption, and for the following reasons:

1. To begin the interest of the amounts issued to them, and of the stock purchased to the 1st of February in every year, is to be annually laid before parliament on or before the 15th of February. The purchases, at first, were made in the 3 per cent., probably with the view of redeeming the five per cent. if the state of the public funds should render such a measure practicable, or of inducing the proprietors to agree to a reduction of the interest at the time when they should become redeemable.

2. The progress of the fund from the commencement of its operation on 1st August 1766, to the 1st of February 1806, will appear from the statement of the total amount of the stock redeemed by the commissioners to the latter period.

| Consolidated 3 per cent. annuities | £3,992,421 |
| Reduced 3 per cent. annuities | 31,006,081 |
| Old South Sea annuities | 3,492,000 |
| New South Sea annuities | 2,769,000 |
| Three per cent. | 190,000 |
| Consolidated 4 per cent. annuities | £2,167,400 |
| Navy 5 per cent. annuities | 142,000 |

Total £101,145,802

The total sum which had been paid for this amount of stock, was 62,427,782£. 7s. 10d. the consolidated 3 per cent. having been bought on an average at 61 per cent. and the reduced at somewhat less.

The progress already made by the fund, and the important effect it has had in supporting the value of the government securities at a time when it has been necessary to borrow sums on unprecedented sums in almost every year, sufficiently demonstrate the great utility of this measure. As its increase will be continually augmenting, it will, if steadily persevered in, and faithfully applied, become ultimately capable of discharging a debt of any amount which it is possible to suppose the country will ever be encumbered with.

It has been shown that the fund, including the provision for the reduction of the debt in Ireland, in Great Britain, for the imperial loans, amounts at present to upwards of eight millions per annum; and as the stock has been bought up at little more than 60 per cent. the money has been improved at nearly 5 per cent. interest. It is neither desirable, nor to be expected, that it will always be possible to invest the produce of the fund at this rate of interest; but it will be shewn that if the fund is never diverted from its purpose, its effects will in time be almost omnipotent, particularly when it is considered that the following are the money, and consequently much less than the nominal capital of stock that would be bought up at any of the current prices at which these securities have been for many years past:

Amount to which the present sinking fund of eight millions per annum will accumulate, if improved at 4 or 5 per cent. compound interest.

<table>
<thead>
<tr>
<th>Years</th>
<th>Millions</th>
<th>Millions</th>
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<tbody>
<tr>
<td>1810</td>
<td>33</td>
<td>34</td>
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<tr>
<td>1820</td>
<td>146</td>
<td>156</td>
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<td>1830</td>
<td>312</td>
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<td>1840</td>
<td>358</td>
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<td>1850</td>
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<td>1860</td>
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<td>3433</td>
<td>3757</td>
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<tr>
<td>1890</td>
<td>5193</td>
<td>5718</td>
</tr>
<tr>
<td>1900</td>
<td>7372</td>
<td>8340</td>
</tr>
</tbody>
</table>
When the liquid, after these substances have been separated from it, is concentrated by evaporation, it deposits crystals of acetate of soda. Sinovia, therefore, contains soda. Margueron found that 100 parts of sinovia contain 0.71 of soda.

When strong sulphuric, nitric, nitro, acetic, or sulphurous acid, is poured into sinovia, a number of white flakes precipitate at first, but they are soon re-dissolved, and the viscosity of the liquid continues. When these acids are diluted with five times their weight of water, they diminish the transparency of sinovia, but not its viscosity; but when they are further diluted till their acid taste is just perceptible, they precipitate the peculiar thready matter, and the viscosity of the sinovia disappears.

When sinovia is exposed to a dry atmosphere, it gradually evaporates, and a scaly residuum remains, in which cubic crystals and a white saline efflorescence are apparent. The cubic crystals are muriated of soda. One hundred parts of sinovia contain about 1.75 of this salt. The saline efflorescence is carbonate of soda.

Sinovia soon putsrefies in a moist atmosphere, and during the putrefaction ammonia is exhaled. When it is distilled in a retort, there comes over, first water, which soon putrefies, then water containing ammonia, then empyreumatic oil and carbonat of amonia. From the residuum muriat and carbonat of soda may be extracted by lixiviation. Sinovia is composed of

\[
\begin{align*}
31.86 \text{ sulphur ash} & \\
4.32 \text{ albumin} & \\
1.73 \text{ muriat of soda} & \\
.71 \text{ soda} & \\
.70 \text{ phosphate of lime} & \\
80.13 \text{ water} & \\
\end{align*}
\]

100.00

**SINUATE LEAF.** See Botany. **SINUS.** See Anatomy. **SINUS.** See Surgery. **SIPHON, or SYPHON.** See Hydrostatics.

**SIPHONIATUS, a genus of the tetradria monogynia class and order.** The corolla is one-petalled, very long, funnel-form, inferior; berries four, one-seeded. There are two species, herbs of South America.

**SIPHIÖNIA, a genus of the class and order monoxea monadelphia.** The caulis is one-leaved, no corolla; male anders five; fem. style none; stamin three; caps. tricoceous; seed one. There is one species, a tree of Guiana.

**SIPUNCULUS, or tube-worm.** A genus of insects of the order venae intestinae: the generic character is, body round, elongated; mouth cylindrical at the end, and narrower than the body; aperture at the side of the body, and crooked. There are two species: the S. nudus, inhabits the European seas, under stones, and is eight inches long. The S. saccatus, body covered with a loose skin, and rounded at the lower end: inhabits the Mediterranean and Indian seas.

**SIREN, a genus of amphibia, of the order meutes, of which there are the following species:**

1. **Siren lacertina, or eel-shaped siren:** This species stands easily distinguished in the list of amphibia by the agility of its characters, which are such as to have induced the great Linnaeus to institute for it a new order of amphibia, under the title of meutes; andorder, 

The species of sirens at present to be described is extremely rare; and is found in the spring, and towards the decline of summer, in some particular parts of the above-mentioned lakes, and considered as a full-grown, from about ten to twelve or thirteen inches in length; the largest specimens being near three quarters of an inch in diameter. It is entirely of a pale rose or pinkish-white, or even nodocolour, or even whitish, excepting the three pairs of ramified branched fins on each side the head, which are of a bright red or carmine-colour. Its general shape is that of an eel; the body being cylindric, till towards the end of the tail, where it becomes flat, and is attenuated both above and below into a kind of fatty fin, scarcely distinguishable from the rest of the tail; the skin is everywhere smooth and even; the head of a somewhat depressed form; with a lengthened, obtuse, and whitish nose, and has no external eyes; the mouth is moderately wide, and furnished with a row of very minute teeth; the legs are about 3 of an inch in length, the fore legs being situated, not immediately behind the frontal fins, and the feet furnished with three toes, without any appearance of claws; the hind legs are situated at a great distance backwards, towards the commencement of the tail, and are of the same appearance with the fore legs; but the feet have only two toes, which, like those of the fore feet, are destitute of claws. The motions of the animal, when taken out of the water, are, in general, extremely slow and languid, as is also the case when kept in a vessel of water; but when in its native lake, it is sometimes observed to swim pretty briskly, waving its body in a serpentine direction in the manner of a locust.

3. **Siren pisciformis, fish-formed siren.** This animal in its natural size is supposed to be the native of Mexico, and though perhaps no other than the larva or tadpole of some large American salamander, sea or river, a lively, quick, and curious animal than the siren lacertina.

In its general appearance it bears some resemblance to the larva of the rana paradoxora, but is furnished with gills, opening externally in the upper part of the head, which is very large, and the operculum or external flap is continued from the sides of the head across the throat beneath, so as completely to insulate the head from the breast; the gills themselves consist of four semicircular bones or cartilaginous arches, which are dentilculated or serrated on their internal or concave part, like those of fishes; on the operculum or external flap are situated large very large and elegant branchial fins or ramified parts, divided or subdivided into a vast number of slender or capillary processes. In these particulars it resembles the sire lacertina, except that in that animal the external opening to the gills is very small; the mouth is furnished in front with a row of extremely minute teeth; the tongue is large, smooth, and rounded at the tip; the rictus, or gape, when the mouth is closed, appears considerably larger than that of any other than the sire lacertina; it is situated in a hollow, or valley, surrounded by rocky and woody mountains, in which are vast caverns, and is principally supplied by eight rivulets running into it from the adjoining mountainous region.
ish claws; the fore feet have four, and the hind five toes. Exclusive of the general colour of the animal, the whole body in the minutely examined, appears to be scattered over with very minute white specks, resembling those on the surface of the siren lacerina. This is a very remarkable characteristic, since the body is marked by several strong rugae or furrows, and the spots of the lateral line or sulcus is continued from the gills to the tail.

SIREX, a genus of insects of the hymenoptera order. The generic character is, mouth with one labrum, two maxillae; feelers two, truncated; antennae filiform, with more than twenty-four joints; piercer exerted, stiff, serrated; abdomen sectional, pointed; wings lanceolate, flat in all.

The larvae of these insects are of a lengthened, cylindrical appearance, living in the decayed parts of trees, on the substance of which they feed; the chrysalis, as in the tenthredo, exhibits the limbs of the perfect insect in a contracted state.

The largest species is the srix gigan of Linnaeus, which surpasses a hornet in size, and is principally observed in the neighbourhood of pines and other coniferous trees; it is of a black colour, with the eyes, the base, and the middle third of the abdomen, bright orange yellow; the thorax violet, and the wings of transparent yellowish brown; the sting or a terminal tube is very conspicuous. The larva, which measures about an inch and a quarter in length, is of a yellowish white colour, and oval in shape; at first view it bears some resemblance to the larva of the beetle tribe, but is thinner in proportion, and furnished at the tip of the abdomen with a short black spine or process. It changes to a chrysalis in July, first enveloping itself in a slight silken web of a whitish colour. If the change to chrysalis takes place in summer, the fly proceeds from it in the spaces of about three weeks; but if at the close of autumn, the animal continues in chrysalis the whole winter, emerging in the following spring. The male insect is considerably smaller than the female, and may be further distinguished by the want of the caudal tube or process, so conspicuous in the female insect; the tip of the abdomen is also of a black colour. The eggs, which are deposited by the female in the decayed parts of the tree above mentioned, are very small, and a flattened ovate shape with pointed extremities.

Sirex columbia is an American species, and is distinguished by its black body, marked by testaceous bands.

Sirex pygmaeus is one of the smallest of the European species, being, according to Linnaeus, about the size of a gnat, with a black abdomen, marked by three yellow bands, the middle of which is interrupted. It is found in Sweden. There are seven species.

SIRIUS, the dog-star. See Astronomy.

SIRIUM, a genus of plants belonging to the class of tetraandria and order of monogynia. The calyx is quadriradiate; there is no corolla and the anther is quadrathyllous, and crowning the throat of the calyx; the gemma is below the corolla; the stigma is tridid, and the berry trilocular. There is only one species, the myrtifolium.

SIROCO. The sirocco (so called by the Italians because it is supposed to blow from Syria, and in the south of France the Levant wind) is the most destructive of the harmattan, but differs from it in being extremely insidious. It sometimes blows for several days together, to the great annoyance of the whole vegetable and animal creation; it thickens the air, makes it unfit for vegetation and twelve degrees; it is fatal to vegetation and destructive to mankind, and especially to strangers; it depresses the spirits in an unusual degree; it suspends the powers of digestion, so that those who venture to eat a heavy supper while this wind prevails, are commonly found dead in their beds the next morning, of what is called "an indigestion. The sick, at that afflicting period, commonly sink under the pressure of their diseases; and it is customary in the morning, after this wind has continued a whole night, to inquire who is dead.

We shall now insert an account of this baleful wind, from an interesting work on the present state of Sicily.

"The evil most to be dreaded in traversing these regions is, perhaps, the sirocco, or south wind, which it is imagined blows from the burning deserts of Africa, and is sometimes productive of dangerous consequences to those who are exposed to its fury. During the continuance of this wind all nature appears to languish, vegetation withers and dies, the beasts of the field droop, the animal spirits seem to be much exhausted to admit of the least bodily exertion, and the spring and elasticity of the air appear to be lost. The heat exceeds that of the most fervid weather in Spain or Malta, and is felt with peculiar violence in the city and neighbourhood of Palermo.

"The sensation occasioned by the sirocco wind is very striking and wonderful. In a moment the air becomes heated to an excessive degree, and the whole atmosphere feels as if it was inflamed; the pores of the body seem at once opened, and all the fibres relaxed. During its continuance the inhabitants shut their doors and windows to exclude the air; and where there are no window-shutters, wet blankets are hung on the inside of the window, and the servants are kept continually employed in sprinkling the apartments with water. No creature, whose necessities do not compel him to the exertion, is to be seen while this tremendous wind continues to blow, and the streets and avenues of the city appear to be nearly deserted.

"The sirocco generally continues so short a time in Sicily, that it seldom produces those complaints which are the consequence of its scourching heats in several parts of Italy, though its effects in those countries is much inferior to what is felt in this island. Here it seldom endures longer than thirty-six or forty hours; a time not sufficient to heat the ground, or the walls of the houses, in a very intense continued degree. It is commonly succeeded by the tramontane, or north wind, which in a short time restores the exhausted powers of animal and vegetable life, and nature soon assumes her former appearance. The calamities of this wind have been frequently attempted to be explained, but the different hypotheses are perhaps more to be admired for their ingenuity and fancy than for being very satisfactorily explained. The superior intenseness of this scourching wind at Palermo, may perhaps be accounted for from the situation of that city, which is almost surrounded by hills, the ravines and valleys of which are parched and almost burnt up in summer. The numberless springs of warm water must also greatly increase the intensity of the air; and the practice of burning boughs and heaths on the neighbouring mountains, during the warm season, must undoubtedly tend to increase the heat of the wind in passing over the country of Sicily, though it had previously been disarmed of one of the principal causes of its intensity over the sea which divides Sicily from Africa."

Whether the fatal effects of the sirocco depend entirely upon the degree of fever which is produced by the extreme heat which accompanies it, or whether it is really charged with any quantity of mephitic gas, we have never been sufficiently informed; but wish that any intelligent traveller would examine the state of the air by the eudiometer, and by other tests, during the prevalence of this wind. Should it be found laden with carbo-nic acid, its effects are obviated by suspending in the different apartments, cloths dipped in lime-water; but from the present state of the evidence we are disposed to think that all its evil consequences depend upon a sudden increase of the temperature only.

An extraordinary blasting wind is felt occasionally at Falkland's islands. Happily its duration is short; it seldom continues above twenty-four hours. It cuts the herbage down as if fires had been made under them; the leaves are parched up, and crumble into dust. Fowls are seized with cramps so as never to recover. Men are oppressed with a stopped perspiration, heaviness at the breast, and sore throat; but usually recover with care.

This account is extracted from the travels of Mr. Ives over land to the East Indies. Its fatal effects, if the statement is perfectly correct, evidently proceed from a certain portion of extremely putrid air, which is thus conveyed to us, and we suspect it only happens when a strong wind chance to blow over some very putrid and stagnant lake which is not far distant; travellers, however, are on such occasions commonly in a state of too much alarm to note circumstances with accuracy, and too much of their accounts is collected upon hearsay evidence. This wind, after all, may only consist of a mephitic vapour which destroys life when inhaled, and the putridity which is said so rapidly to take place, may depend more upon the climate than the nature of the wind.

SISON, bastard stone-parsley: a genus of plants belonging to the class of pentadactyla, and to the order of digynia; and in the natural system arranged under the 43th order, umbellata. The root is egg-shaped and streaked; the involucre are subtrichyphyllous. The annulus, inaudatum, segetum, calamum, and annim. The three first are natives of Great Britain. 1. The annamom, common bastard parsley, or field stone-wort, is a biennal herb, of the white, yellow, or red, growing wild in many places of Britain. Its leaves are small, striated, of an oval figure and brown colour. Their taste is warm and aromatic. Their
whole flavour is extracted by spirit of wine, which elevates very little of it in distillation; and hence the spirituous extract has the flavour in great perfection, while the watery extract has a fainter smell and a less agreeable taste. A mixture of the two extracts with pure spirit is of a green colour. The seeds have been esteemed aperient, diuretic, and carminative; but are little regarded in the present practice. 2. The mandarin, head工资watersuit; it grows in ditches and ponds. 3. Segetum, corn parsley or honeywort: it grows in corn-fields and hedges.

SISYMMHRIUM, water-cresses, a genus of plants belonging to the class of tetradaephyra, and to the order of siliquea, and in the natural system ranged under the 39th order, siliquea. The siliqua, or pod, opens with valves somewhat straight. The calyx and corolla are expanded. There are fifty-three species, of which eight are natives of Britain: the nasturtium, common water-cress; sylvestre, water-rocket; amphiabium, water-radarish; terestrius, annual water-radarish; mosneuse, sophia, filxweed; iris, broad-leaved water-cress, and so forth.

SISYRRICHUS, a genus of plants belonging to the class of monadphilia, and order of triandria; and in the natural system ranked under the 6th order, ensato. The spatha is displayed on the petals. The capsule is trilocular and inferior. There are ten species, natives of North America and the Cape.

SITTA, nut-hatch, a genus belonging to the class of aveae, and order of paseriformes: thus characterized by Dr. Latham: The bill is for the most part straight; on the lower mandible there is a small angle; nostrils small, covered with bristles reflected over them; tongue short, horny at the end, and jagged; toes placed three forward and one backward, the middle toe joined closely at the base to both the outmost; tail as long as the middle one. There are fourteen species: the europea, camadensis, carolinensis, jamaicensis, pallasia, major, majorix, siliqua, purpurea, castanea, cajrta, longisora, and chloris. The europea, or nut-hatch, is in length near five inches three-quarters, in breadth nine inches, the bill is strong and very straight, about three inches long; the crown of the head, back, and coverts of the wings, of a fine bluish grey; a black stroke passes over the eye from the mouth; the cheeks and chin are white; the belly is warm orange-colour. The female is like the male, but less in size, and weighs commonly five or at most six drams. The eggs are six or seven in number, of a dirty white, dotted with russet: these are deposited in some hole of a tree, frequently one which has been deserted by a woodpecker, on the rotted wood mixed with a little moss, &c. If the entrance is too large, the bird nicely stops up part of it with clay, leaving only a small hole for itself to pass in and out by. While the hen is sitting, if any one puts a bit of stick into the hole, she hisses like a snake, and is so attached to her eggs, that she will sooner suffer any one to pluck off her feathers than fly away. During the first part of incubation, the male supplies her with sustenance.

The bird runs up and down the bodies of trees, like the woodpecker tribe; and feeds not only on insects, but all kinds of roots, in which it lays up a considerable provision in the hollows of trees. Dr. Plott tells us, that this bird, by putting its bill into a crack in the bough of a tree, can make such a violent sound as it was rending asunder, so that the noise may be heard at a distance of twenty yards.

SIUM, water parsnip, a genus of plants belonging to the class of peptandria, and order of digynium, and in the natural system ranging under the 43rd order, umbellifera. The fruit is a little broader than streaked. The involucrum is polyphyllous, and the petals are heart-shaped. There are nineteen species; three are natives of Britain: 1. The latifolium, or great water parsnip, which grows spontaneously in many places both of England and Scotland, on the sides of lakes, ponds, and rivulets. Cattle are said to have run mad by feeding upon this plant. 2. The angustifolium, or narrow-leaved water-parsnip, grows in ditches and rivulets, but is not common. 3. The nodilorum, reclining water-parsnip, grows on the sides of rivulets.

The sium siciurn, or skirret, is a native of China, but has been for a long time cultivated in Europe, and particularly in Germany. The plant is densely foliaceous; each of which is about as thick as a finger, but very uneven, covered with a whitish rough bark, and has a hard core or pit running through the centre. Skirrets come to maturity at any of the excellent roots, both for flavour and nutritive qualities. They are rather sweeter than the parsnip, and therefore to some few palates are not altogether so agreeable. Mr. Margraf extracted from half a pound of skirret-root an ounce and a half of pure sugar.

SIXTH, in music, an interval formed of six sounds, or five diatonic degrees. There are four kinds of sixths, two consonant and two dissonant. The consonant sixths, are first, the minor sixth, composed of three tones and two semitones major. Secondly, the major sixth, composed of four tones and a major semitone. The dissonant sixths are, first the diminished sixth, composed of two tones and three major semitones. Secondly, the superlunis, composed of four tones, a major semitone, and a minor semitone.

SIZE, the name of an instrument used to find the likeness of fine round pearls. It consists of a thin plate of about two inches long and half an inch broad, fastened together at one end by a rivet. In each of these are round holes drilled of different diameters. Those in the first leaf serve for measuring pearls from half a grain to seven grains; those of the second, for pearls from eight grains or two carats, to five carats, &c.; and those of the third, for pearls from six carats and a half to eight carats and a half.

SKELETON. See Anatomy.

SKELETON. See Anatomy.

SKIMMIA, a genus of the monocotyledon order, in the tetradria class of plants, and in the natural method ranking under the 40th order, verbenaceae. The calyx is quadrangular; the corolla consists of four concave petals; and the berry contains four seeds. There is only one species, viz. the japonica.

SKIN, See Cutis.

SKINNER, one who works in skins. Skinner's work is very delicate, and shall retain any journeyman, &c. to work in their trade, except they themselves have served seven years as apprentices thereto, on pain of for-
stone, earth, &c. serving to retain and raise the water of the sea, a river, &c. and on occasion to let it pass; such is the sluice of a mill, that conducts the water of a rivulet, &c. in order to discharge it at length, in greater plenty, upon the mill-wheel; such are those used in drains, to discharge water of lands; and such are the sluices of Flinders, &c. which serve to prevent the waters of the sea overflowing the lower lands, except when there is occasion to drain them. See Canal.

Construction of sluices. The construction of sluices ought to be conducted by an able engineer, who is well acquainted with the action of fluids in general; and particularly with the situation of the place, the nature of the soil, &c., where the sluice is to be erected; if on the seashore, he ought to be perfectly well acquainted with the effects of the sea on that coast, and the seasons when it is calm or stormy, that he may be able to prevent the fatal accidents thence arising; and if it be a river, it is necessary to know whether it usually overflows its banks, and at what seasons of the year its waters are highest and lowest. The machines for driving the piles should be placed about forty yards from the sides of the sluices, above and below. As to the depth of sluice, it must be regulated by the uses for which they are designed; thus, if a sluice is to be erected at the entrance of a basin for shipping, its depth must correspond with the draught of water of the largest ship that may, at any time, have occasion to enter by it. The rule usually observed, is to make the surface of the bottom of the canal on a level with the low-water mark; but if the bottom of the harbours or canal is such as to be capable of becoming deeper by the action of the water, Belidor very justly observes, that the bottom of the sluice-work should be made deeper than either.

When a sluice is to be placed at the bottom of a harbour, in order to wash away the fill which may gather in it, by means of the waters of a river or canal; in this case the bottom of the sluice-work should be two feet or eighteen inches higher than the bottom of the harbour, that the water may run with the greater violence.

An engineer ought always to have in his view, that the faults committed in the construction of sluices are almost always irreparable. We shall therefore lay down some rules, from Belidor, for avoiding any of these kinds: 1. In order to adjust the level of the sluice-work with the utmost exactness, the engineer ought to determine how much the water must be than a fixed point; and he should mark down in his draught, in the most precise terms possible. 2. When the proper depth is settled, the foundation is next to be examined; and here the engineer cannot be too cautious, lest the apparent goodness of the soil deceive him; if the foundation is judged bad, or insufficient to bear the superstructure, it must be secured by driving piles, or a grate-work of carpentry. 3. There should be engineers enough provided for draining the water; and these should be entirely under the direction of the engineer, who is to take care that they are so placed as not to be an obstacle to the work; and also that the trenches be cut, to convey the water clear from the foundation. 4. When the sluice is to be built in a place where the workmen will be maximally incommoded by the waters of the sea, &c. all the stones for the sluice-work, as well as the timber for that of carpentry, must be prepared beforehand; so that when a proper season offers for beginning the work, there remains nothing to be done, but to fix every thing in its place.

Sluices are made different ways, according to the use they are intended for; when they serve for navigation, they are shut with two gates, presenting an angle towards the stream; but when made near the sea, there are two pair of gates, one to keep the water out, and the other to keep it in, as occasion requires; the pair of gates next the sea present an angle that way, and the other pair the contrary way; the space inclosed by these gates is called a chamber.

When sluices are designed to detain the water in some parts of the ditch of a fortress, they are made with shutters to slide up and down in grooves; and when there are made to cause an inundation, they are shut by means of square timbers let down into culverts, as to lie close and firm.

SMAL'T, a fine glaze, of a dark-blue colour, which, when-levedaged, appears of a most beautiful colour; and if it could be made sufficiently fine, would be an excellent succedaneum for ultramarine, as not only resisting all kinds of weather, but even the most violent fires. It is prepared by melting one part of oxide of cobalt with two of flint-powder, and one of potas. At the bottoms of the crucibles in which the smelting is conducted, we generally find a regulus of a whitish colour inclining to red, and extremely brittle. This is melted afresh, and when cold, separates into two parts; that at the bottom is the cobaltic regulus, which is employed to make more of the small; the other is linament.

SMARAGDITE, in mineralogy. This stone was called smaragdite by M. Sanssure, from some resemblance which it has to the emerald. Neverfigh, we generally find a regulus of a whitish colour inclining to red, and extremely brittle. This is melted afresh, and when cold, separates into two parts; that at the bottom is the cobaltic regulus, which is employed to provide the small; the other is linament.

SMELT, See Salm. See Smelting, in metallurgy, the fusion or melting of the ores of metals, in order to separate the metallic part from the earthy, stony, or other parts. See Smelting, or the art of fusing the ores after roasting, is the principal and most important of metallic operations, all the other being preliminary or preparative to this. The whole attention of the art is directed towards this process; to this all his efforts are applied, because it affords the truly useful product to which his hopes are directed. Though it consists in general in fusing the roasted ore to extract the metal, and in this point of view it seems to present a simple and unvaried operation, in practice, it is by no means the case; many operations are required to bring the metal to its full perfection; and in this sense, Smelting is a science.

SMILAX, rough bindweed, a genus of plants belonging to the class of dicot and order of hexandria; and in the natural system ranging under the 11th order, ranunculacea. The male calyx is hexaphyllous, and there is no corolla; the female calyx is also hexaphyllous, without any corolla; there are three styles, a trilocular berry, and two seeds.

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"This species (says he) has stems of the thickness of a man's finger: they are jointed, jointed, and hooked spines. The leaves are alternate, smooth and shining on the upper side: on the other side are three nerves or costae, with sordid small crooked spines. The flower is yellow, mixed with red. The fruit is a black berry, containing several brown seeds."

SARSAPARILLA, in medicine, a species of herb, the root of which is considered as a tonic, and is employed for the treatment of certain diseases.

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road, has roundish, prickly-stalked and red berries, and is a native of China and Japan. The pseudo-china, or occidental species, has rounder smooth stalks, and black berries, grows wild in Jamaica and Virginia, and bear the costly of our own climate. At present the China root is very rarely made use of, having for some time given place to sarsaparilla, which is more efficacious and thrifty. Prosper Alpinus informs us, that this root is in great esteem among the Egyptian women for procuring fitness and plumpness.

Smithery, or Smithing, a manual art, by which an artificial lump of iron is wrought into an intended shape.

Smitha, a genus of the decandra order, in the diadelphus class of plants; and in the natural method ranking under the 32d order, papilionaceae. The calyx is many, yellow and bilatrated; the corolla winged; the stamens in number, with three or four joints, and containing as many seeds, which are smooth, compressed, and kidney-shaped. There is only one species, viz. the sepiaria, an annual one of North America.


Smoke-jack. See Jack.

Smut. See Husbanry.

Smyth. See Sugdeny.

Snowdrop. The snowdrop is a genus of plants belonging to the class of peonia, and to the order of digyza; and in the natural system ranging under the 4th order, umbellifera. The fruit is oblong and striated; the petals having a sharp point, and are keel-shaped. There are seven species: 1 The perfoliatum, or perfoliate alexanders, which is a native of Candia and Italy; 2. The Erythraenum; 3. The aurum, or golden alexanders, which is a native of North America; 4. The integerrimum; 5. The oclusum, common alexanders, a native of Britain; 6. The leaves of which are curule, ternet, petiolated, and serrated. It grows on the shore of the Channel, and in Devonshire, North Britain. Since the introduction of celery into the garden, the alexanders is almost forgotten. It was formerly cultivated for salading, and the young shoots or stalks blanched were eaten either raw or stewed. The leaves were also used in broths and soups. It is a warm comfortable plant to a cold weak stomach, and was in much esteem among the monks, as may be inferred by its still being found in great plenty by old abbeys, &c. Laterate. 7. Aphrodite.

Snaile. See Helix, and Limax.

Snares. See Angle.

Snake. See Scapox.

Snailfish. See Pteronectes.

Snow. See Meteorology.

Snowdrop. See Galanthus.

Snowdrop-tree. See Chionanthus.

Snowy. A powder chiefly made of tobacco, the use of which is too well known to need any description here. See Nicotiana.

Snapdragon, in botany. See Antirrhinum.

Soap. The fixed oils have the property of combining with alkalis, earths, and metatellite, to form soaps; and this is a class of compounds which have received the name of soaps. As these soaps differ from each other very materially, according as their base is an alkali, an earth, or an oxide, it will be proper to consider each set separately.

Soaps, alkaline. As there are a great number of fixed oils, all or most of which are capable of combining with alkalis, earths, or oxides, it is natural to suppose that there are as many genera of alkaline soaps as there are oils. That there are differences in the nature of soaps corresponding to the oil which enters into their composition, is certainly true; but these differences are not of sufficient importance to require a particular description. It will be sufficient, therefore, to divide the alkaline soaps into as many species as there are alkalis, and to consider those soaps which have the same alkali base, but must in their oil, as varieties of the same species.

Soap of soda, or hard soap. The word soap (sapon.) first occurs in the works of Pliny and Galen, and is evidently derived from the old German word, sepe. Pliny informs us that soap was first discovered by the Gauls; that it was composed of tallow and ashes; and that the German soap was reckoned the best.

Soap may be prepared by the following process: a quantity of the soaps of commerce, if pounded, and mixed in a wooden vessel, with about a fifth part of its weight of lime, which has been slaked and passed through a sieve immediately before. Upon this mixture is a quantity of water is poured, considerably more than is sufficient to cover it, and allowed to remain on it for several hours. The lime attracts the carbonic acid from the soaps, and the water becomes strongly impregnated with the pure alkali, which is, in that manner, at once precipitated in the form of lime, and at the same time, the soap is drawn off by means of a stop-cock, and called the first ley. Its specific gravity should be about 1.200.

Another quantity of water is then to be poured on the soaps, which, after standing two or three days, is worn to sediment. Off by means of the stop-cock, and called the second ley.

Another portion of water is poured on; and after standing a sufficient time, is drawn off like the other two, and called the third ley. This water is still more sedentary, and is to be poured on, in order to be certain that the whole of the soaps is dissolved; and this weak ley may be put aside, and employed afterwards in forming the first ley in subsequent operations.

A quantity of oil, equal to six times the weight of the soaps used, is then to be put into the boiler, together with a portion of the third or weakest ley; and the mixture must be kept boiling and agitated constantly, by means of a wooden instrument. The whole of the third ley is to be added at intervals to the mixture; and after it is consumed, the second ley must be added in the same manner. The oil becomes milky, combines with the alkali, and after some hours it begins to acquire consistence. A little of the first ley is then to be added, not forgetting to agitate the mixture constantly. Portions of the first ley are to be added at intervals; the soap substance acquires greater consistence, and at last it begins to separate from the watery part of the mixture. A quantity of common salt is then to be added, which renders the separation much more complete. The boiling is to be continued still for two hours, and then the first ley is to be withdrawn, and the liquor must be no longer agitated. After some hours reposes, the soap separates completely from the water, and swells upon the surface of the liquor. The watery part is then to be drawn off; and as it contains a quantity of carbonat of soda, it ought to be reserved for future use.

The fire is then to be kindled again; and, in order to facilitate the melting of the soap, a little water, or rather weak ley, is to be added to it. As soon as it boils, the remainder of the first ley is to be added to it at intervals. When the soap has been brought to the proper consistence, which is judged by taking out small portions of it and allowing it to cool, it is to be withdrawn from the fire, and the watery part separated from it as before. It is then to be heated again, and a little water mixed with it, that it may form a proper paste. After this let it be poured into the vessels proper for cooling it; in the bottom of which there ought to be a little chalk in powder, to prevent the soap from adhering. In a few days, the soap will acquire sufficient consistence to be taken out, and formed into proper cakes.

The use of the common salt in the above process, is to separate the water from the soap; for common salt has a stronger affinity for water than soap has.

Olive-oil has been found to answer best for making soap, and next to it perhaps tallow may be used; but a great variety of other oils may be employed for that purpose, as appertains from the experiments of the French chemists. They found, however, that linseed-oil and whale-oil were not proper for making hard soaps, though they might be employed with advantage in the manufacture of soft soaps. Whale-oil has been long used by the Dutch for this last purpose. Soap may also be made without the assistance of heat; but in that case a much longer time and a larger proportion of alkali are necessary.

Manufacturers have contrived various methods of sophisticating soap, or of adding ingredients which increase its weight without increasing its value. The most common substance used for this purpose, which may be added in considerable quantities, especially to soap made with tallow (the ingredient used in this country), without diminishing its consistence. This fraud cannot be readily detected, or the bait so placed as to lie for some time exposed to the air. The water will evaporate from it, and its quantity will be discovered by the diminution of the weight of the soap. As soap sophisticated in this manner would lose its water by being kept, manufacturers, in order to prevent this, keep their soap in saturated solutions of common salt; which do not dissolve the soap, and at the same time, by preventing all evaporation, preserve, or rather increase, the weight of the soaps. Darcet, Lejeune, and Pelletier, took two pieces equal in weight of soap sophisticated in this manner, and placed the one in a dry place in the open air, and the other in a saturated solution of common salt; after a month the latter had lost 0.36 of its weight, the other had gained about 0.10 parts. Various other methods have been fallen upon to sophisticate soap; but as they are not generally known, it would be doing an injustice to the public to describe them here.

Different chemists have analysed soap, in
Soap is soluble both in water and in alcohol. Its properties as a detergent are too well known to require any description.Soap made with tallow and soda has a white colour, and is therefore known by the name of white soap; but it is usual for soapmakers, in order to lower the price of the article, to mix a considerable portion of resin with the tallow; this mixture forms the common yellow or turpentine soap of this country.

Soap of potash, or soft soap. Potash may be substituted for soda in making soap, and in that case precisely the same process is to be followed. It is remarkable, that when potash is used, the soap does not assume a soapy smell. Its consistence is never greater than that of hog's lard. This is what in this country is called soft soap. Its properties as a detergent do not differ materially from those of hard soap, but it is not so convenient for use. The alkali employed by the ancient Greeks and Romans in the formation of soap was potash; hence we see the reason that it is described by the Romans as an unguent. The oil employed for making soft soap in this country is white-oil. A little tallow is also added, which, by peculiar management, is dispersed through the soap in fine white spots.

Some persons have affirmed that they knew a method of making hard soap with potash. Their method is this: After forming the soap in the manner now described, they add to it a large quantity of common salt, boil it for some time, and the soap becomes solid when cooled in the usual way. That this method may be practised with success, has been declared by Messrs. Darcey, Lelievre, and Pelletier; but then the hard soap thus formed does not contain potash but soda; for when the common salt (muriate of soda) is added, the potash of the soap decomposes it, and combines with its muriatic acid, while at the same time the soda of the salt combines with the oil, and forms hard soap; and the muriate of potash formed by this double decomposition is dissolved in water, and drawn off along with it.

Chapital has lately proposed to substitute wool in place of oil in the making of soap. The ley is formed in the usual manner, and made boiling hot, and shreds of wooden chopp of any kind are gradually thrown into it; they are soon dissolved. New portions are to be added sparingly, and the mixture is to be constantly agitated. When no more cloth can be dissolved, the soap is made. This soap is said to have been tried with success. It might doubtless be substituted for soap with advantage in several manufactures provided it can be obtained at a cheaper rate than the soap at present employed.

Some time ago a proposal was made to substitute the muscles of fish instead of tallow or oil for common soap; but the experiments of Mr. Jamieson have demonstrated that they do not answer the purpose.

**Soap of ammonia.** This soap was first particularly attended to by Mr. Berthollet. It may be made by dissolving carbonate of ammonia on soap of lime. A double decomposition takes place, and the soap of ammonia swins upon the surface of the liquor in the form of an oil; or it may be formed with still greater ease by pouring a solution of muriat of ammonia into common soap dissolved in water.

It has a more pungent taste than common soap. Water dissolves a very small quantity of it; but it is easily dissolved in alcohol. When exposed to the air, it is gradually decomposed. The substance called volatile emulsion, which is employed as an external application in rheumatism, colds, &c. may be considered as scarcely any thing else than this soap.

All the alkaline soaps agree in the properties of solubility in water and alcohol, and in being powerful detergents.

Soaps, early. The earthy soaps differ essentially from the alkaline in their properties. They are insoluble in water, and incapable of being employed as detergents. They may be formed very readily by mixing an earthy substance with a solution of an earthy salt. The alkali of the soap combines with the acid of the salt, while the earth and oil unite together and form an earthy soap. Hence the reason that all waters holding an earthy salt are unfit for washing. They decompose common soap, and form an earthy soap insoluble in water. These waters are well known by the name of hard waters. Hence the early soaps have been examined by Mr. Berthollet only.

**Soap of lime.** This soap may be formed by pouring lime-water into a solution of common soap. It is insoluble both in water and alcohol. Carbonat of fixed alkali decomposes it by its solubility. It melts with difficulty, and requires a strong heat.

**Soap of barytes and of strontium resemble almost exactly the soap of lime.**

**Soap of magnesia may be formed by mixing together the solutions of common soap and sulphat of magnesia.** It is exceedingly white. It is unctuous, dries with difficulty, and preserves its whiteness after desiccation. It is insoluble in boiling water. Alcohol and fixed oil dissolve it in considerable quantity. Water renders its solution in alcohol milky. A moderate heat melts it; a transparent mass is formed, slightly yellow, and very brittle.

**Soap of alumina may be formed by mixing together the solutions of alum and of common soap.** It is a flexible soft substance, which retains its suppleness and tenacity when dry. It is insoluble in alcohol, water, and oil. Heat easily melts it, and reduces it to a beautiful transparent yellowish mass.

**Metallic soaps** are formed by combining with oils by two different processes: 1. By mixing together a solution of common soap with a metallic salt. 2. By uniting the metallic oxide with the oil directly, either cold or hot. The first of these combinations is called a metallic soap; the second a plaster. See PLASTER.

**SOAPS, metallic.** These soaps have been examined by Mr. Berthollet; who has proposed some of them as paints, and others as varnishes; but it does not appear that any of them has been hitherto applied to these purposes.

1. Soap of mercury may be formed by mixing together a solution of common soap and corrosive muriat of mercury. The liquor becomes milky, and the soap of mercury is gradually precipitated. This soap is viscid, not easily dried, loses its white colour when exposed to the air, and acquires a slate-colour, which gradually becomes deeper, especially if exposed to the sun or to heat. It dissolves very well in oil, but sparingly in alcohol. It readily becomes soft and fluid when heated.

2. Soap of zinc may be formed by mixing together a solution of sulphat of zinc and of soap. It is of a white colour, inclining to yellow. It dries quickly, and becomes inible.

3. Soap of cobalt, made by mixing nitrat of cobalt and common soap, is of a dull leaden colour, and dries with difficulty, though its parts are not conducted.

Mr. Berthollet observed, that towards the end of the precipitation there fell down some green muriat of copper consistent than soap of cobalt. These he supposed to be a soap of nickel, which is generally mixed with cobalt.

4. Soap of tin may be formed by mixing common soap with a solution of tin in nitric acid. It is white. Heat does not fuse it like other metallic soaps, but decomposes it.

5. Soap of iron may be formed by means of sulphat of iron. It is a reddish-brown colour, tenacious, and easily fusible. When spread upon wool, it sinks in and dries. It is easily soluble in oil, especially of turpentine. Berthollet proposes it as a varnish.

6. Soap of copper may be formed by means of sulphat of copper. It is of a green colour, has the feel of a resin, and becomes dry and brittle. Hot alcohol renders its colour deeper, but scarcely dissolves it. Ether dissolves it, and renders its colour deeper and more beautiful. It is very soluble in oils, and gives them a pleasant green colour.

7. Soap of lead may be formed by means of acetite of lead. It is white, tenacious, and very adhesive when heated. When fused it is transparent, and becomes somewhat yellow if the heat is increased.

8. Soap of silver may be formed by means of nitrat of silver. It is at first white, but becomes reddish by exposure to the air. When fused, its surface becomes covered with a brilliant iris; beneath the surface it is black.

9. Soap of gold is formed by means of muriat of gold. It is at first white, and of the consistence of cream. It gradually assumes a dirty purple colour, and adheres to the skin.

10. Soap of manganese is formed of sulphat of manganese. It is at first white, and then by absorbing oxygen it becomes red.

**SOCAGE,** an ancient tenure, by which lands were held on condition of ploughing the lord’s lands, and doing the operations of husbandry, at their own charges.

**SOCCUS,** a kind of high shoe, reaching above the ankle, worn by...
SODA, or SOFFIT, in architecture, any platurn or ceiling formed of cross beams of flying cornices, the square compartments or panels of which are enriched with sculpture, painting, or gilding.

SOIL, or SOD, a French coin made up of copper mixed with a little silver, value the 25th part of our shilling.

SOL, or SOL, in music, the fifth note of the gamut, ut, re, mi, fa, sol. See Gamut.

SOL, or SOIL, See HUSBANDY.

SOIT fàit comme il est désiré, be in done as it is desired, a form used when the king gives the royal assent to a private bill preferred in parliament.

SOL, in music, the fifth note of the gamut, ut, re, mi, fa, sol. See Gamut.

SOL, or SOIL, in the old chemistry, is gold.

SOLON, a genus of plants belonging to the class of pentandria, and to the order monogynia. The calyx is bursting; the corolla elevate, tube-formed, very large; berries are round, and the species is grandiflora. This genus was first named solandra in honour of Dr. Solander, by Murray, in the 14th edition of the Systema Vegetabilium. In Jamaica it is called the peach-coloured trumpet-flower.

SOLANUM, a genus of the monogynia order, in the pentandria class of plants, and in the natural method ranking under the 28th order, lurida. The calyx is inferior; the corolla is rotund and monopetalous; the fruit a berry; and the seeds are small and flat seeds. Of this genus there are 93 species, most of them natives of the East and West Indies, the most remarkable of which are the following:

1. The dulcamora, woody nightshade a native of Britain and of Africa, is a slender climbing plant, rising to six or more feet in height. The leaves are generally oval, pointed, and of a deep-green colour; the flowers are small and white, and divided into five pointed segments. The calyx is plicate, persistent, and divided into five; the berry, when ripe, is red, and contains many flat yellowish seeds. It grows in hedges well supplied with water, and flowers about the end of June. On pouring the roots, we first feel a bitter, then a sweet taste: hence the name. The berries are said to be poisonous, and may easily be mistaken by children for currants. For young branches are directed for use, and may be employed either fresh or dried; they should be gathered in the autumn. This plant is generally given in decoction or infusion. Several authors take notice, that the dulcamara portentous of the malicious powers of the nightshade, joined to a cold and aconiacous quality; hence it promotes the secretions of urine, sweat, the menses, and lochia; also in some obstinate cutaneous diseases.

2. The nigron, garden nightshade, common in many places in Britain about houses, and in waste places.

3. In height. The stalk herbaceous; the leaves alternate, irregularly oval, indented, and clothed with soft hairs. The flowers are white; the berries black and shining. It appears to possess the seeds of the other nightshades in a very high degree, and even the smell of the plant is said to cause sleep. The berries are equally poisonous with the leaves, causing cardiaque and delirium, and violent distortions of the limbs in children. Mr. Getaker, in 1757, recommended its internal use in old sores, in scorbutic and cancerous ulcers, cutaneous eruptions, and in dropsy. He says, that one grain of this seed, in an ounce of water, sometimes produced a considerable effect; that in the dose of two or three grains it seldom failed to evacuate the first passages, to increase very sensibly the di-charges by the skin and kidneys, and sometimes to occasion head-ache, drowsiness, giddiness, and diarhœa of sight. Mr. Brompton declares, that in cases in which he tried the solanum they were much aggravated by it; and that in one case they were entirely fatal to one of his patients; therefore he contends its use is prejudicial. This opinion seems tacitly to be confirmed, as it is now never given internally. In ancient times it was employed externally, to anoint, and anodyne in some cutaneous affections, tumefactions of the glands, ulcers, and disorders of the eyes. The solanum nigron rubrum, a native of the West Indies, is called ganna by the negroes. It is so far from having any deleterious quality, that it is daily served up at table as greens or spinach. It has an agreeable bitter taste.

4. The lupercum, the love-apple, or tomato, cultivated in gardens in the warmer parts of Europe, and in all tropical countries. The stalk is herbaceous; the leaves pinnated, ovate, pointed, and deeply divided. The flowers are on simple racemes; they are small and yellow. The berry is of the size of a plum; they are smooth, shining, soft; and are either of a yellow or reddish colour. This tomato is in daily use: being either boiled in soups or broths, or served up boiled as garnishes to fish.

5. Melongena, the egg plant, or vegetable egg. This is also cultivated in gardens, particularly in Jamaica. It seldom rises above a foot in height. The fruit is as big as, and contains many flat yellowish seeds. It grows in hedges well supplied with water, and flowers about the end of June. On pouring the roots, we first feel a bitter, then a sweet taste: hence the name. The berries are said to be poisonous, and may easily be mistaken by children for currants. For young branches are directed for use, and may be employed either fresh or dried; they should be gathered in the autumn. This plant is generally given in decoction or infusion. Several authors take notice, that the dulcamara portentous of the malicious powers of the nightshade, joined to a cold and aconiacous quality; hence it promotes the secretions of urine, sweat, the menses, and lochia; also in some obstinate cutaneous diseases.
very like, the egg of a goose. It is often used boiled as a vegetable along with animal food or butter, and supposed to be aphrodisiac and to cure sterility.

5. Longum. This plant is also herbaceous, but grows much ranker than the foregoing. The flowers are blue; and the fruit is six or eight inches long, and proportionally thick. It is boiled and eaten at table as the egg-plant.

6. Tuberosum, the common potato. It was introduced by Sir Walter Raleigh, and first cultivated in Ireland about the year 1600. Cuient forms have been made of the culture of potatoes at Westmian in Essex.

SODANELLA, in botany, a genus of plants of the class of pantennaria, and order of monogyna, and in the natural system arranged under the 21st order, precie. The coccus is campulatus; the border being very finely cut into a great many segments. The capsule is unilocular, and its apex polypetale. There is one species.

SOLDER, SODER, or SODER, a metallic or mineral composition used in soldering or joining other metals. Solders are made of gold, copper, tin, and lead. The composition usually observed, that in the composition there shall be some of the metal that is to be soldered mixed with some higher and finer metals. Goldsmiths usually make four kinds of solder, viz. solder of eight, where to seven parts of silver there is one of brass or copper; solder of six, where only a sixth part is copper; solder of four, and solder of three. It is the mixture of copper in the solder that makes raised plate come always cheaper than flat.

As mixtures of gold with a little copper are found to melt with less heat than pure gold itself; these mixtures serve as solders for gold; two pieces of fine gold are soldered by gold that has a small mixture of copper; and gold alloyed with copper is soldered by such as is alloyed with more copper. The workmen add a little silver as well as copper, or more of the one than of the other, so as to make the colour of the solder correspond as nearly as may be to that of the piece. A mixture of gold and copper is also a solder for fine copper as well as for fine gold. The quantity of copper deposited, or to unite with iron, proves an excellent solder for the finer kinds of iron and steel instruments.

The solder used by plumbers is made of two pounds of lead of one block-in. Its goodness is tried by melting it, and pouring the size of a crown piece on a table; for, if good, there will arise little bright shining stars in it. The solder for copper, is made like that of lead, and copper or tin; and for very nice works, instead of tin, they sometimes use a quantity of silver. Solder for tin is made of two-thirds of tin and one of lead, or of equal parts of each; but where the work is any thing delicate, as in organ-pipes, where the tin, bismuth, and silver are so finely divisible, it is made of one part of bismuth and three parts of pewter. The pewterers use a kind of solder made with two parts of tin and one of bismuth; this composition melts with the least heat of any of the solders.

Silver solder is that which is made of two parts of silver and one of brass, and used in soldering those metals. Spelter solder is made of one part of brass and two of spelter or zinc, and is likewise used for the braziers and other vessels for the heating of iron, or for use of oven, and is also made of zinc and copper. The composition called Bismuth solder is made of one part of bismuth, and three of tin; this is used in soldering pewter, brass, and brassed objects.

SOLUCES, among the Romans, a kind of sandals or slippers which covered only the sole of the feet, and were bound on with thongs of leather, instead of which the women and the eminential ones of the other sex tied them on with purple-coloured ribbons, or such as were variously adored with gold and silver.

SOLECISM, soloezicus, in grammar, a false manner of speaking contrary to the use of language and the rules of grammar, either in respect of declension, conjugation, or syntax.

SOLEN, sector sheath, or knife-handle sheath, a genus belonging to the class of vermes, and order of testacea. The animal is an ascidian. The shell is oblong, and opening at both sides; the hinge has a tooth shaped like an awl, bent back, often double, not inserted into the opposite shell; the rim at the sides somewhat worn away, and has a prominence without. There are 23 species; three of them, viz. the silicus, vagina, and esius, are found on the British coasts, and lurk in the sand near the low-water mark in a peculiar direction. When in want of food, they elevate one end a little above the surface, and protrude their bodies far out of the shell. On the approach of danger they dart deep into the sand, sometimes two feet at least. Their place is known by a small dimple on the surface. Sometimes they are dug out of the sand; at other times they are taken by striking a barbed dart suddenly into them. When the sea is down, these fish usually run deep into the sand, and to bring them up, the common custom is to throw them into the holes, on which the fish raises itself, and in a few minutes appears at the mouth of its hole.

When half the shell is discovered, the fisherman has nothing more to do than to take hold of it with his finger, and draw it out; but he must be cautious not to lose the occasion, for the creature does not continue a moment in that state; and if by any means the fisherman has touched it, and let it slip away, it is gone forever; for it will not be decoyed again out of its hole by salt; so that there is then no way of getting it but by digging under it, and throwing it up with the sand. The fish has two pipes, each composed of four or five rings or portions of a hollow cylinder, of unequal lengths, joined one to another; and the places where they join are marked by a number of fine streaks.

The reason why the salt causes these creatures to come out of their holes, is, that it gives them violent vitality, and even corrodes these pipes. This is somewhat strange, as the creature is nourished by means of salt water; but it is very evident, that if a little salt is spread upon these pipes in a fish taken out of its habitations, it will corrode the joinings of the rings, and often make one or more joints drop off; the creature, to avoid this mischief, arises out of its hole, and throws off the sand, and then retires back again. The use of these pipes to the animal is the same with that of many other pipes of a like kind in other shell-fish; they all serve to take in water; they are only a continuation of the outer membrane of the fish, and serve indifferently for a sinuous and throwing out the water, one receiving and the other discharging it, and either answering equally well to their purpose.

This fish was used as food by the antiques; and Athenaeus, flor. Sophron, speaks of it as a great delicacy, and particularly grateful to widows. It is often used as food at present, and is brought up to table fried in eggs.

SOLING, or SOLISATION, the art of sounding the note, together with the corresponding syllables of the gamut. This
SOL preparatory exercise, so necessary to sight-singing, and which, by uniting in the mind of the practitioner the ideas of the different syllables with those of the intervals, facilitates the recollection of the several sounds, was of very antient adoption.

Guido having substituted his hexachord in place of the tetradchord, adopted at the same time for his solmization six other syllables, ut, re, mi, fa, sol, la, taken from the hymn of St. John the Baptist.

Of the seven notes in the French scale, only four are used, as ut, re, fa, sol, la; but now we, as well as the Italians, employ the first six, with the exception of shaking ut for do, as a softer and more vocal syllable. By applying these syllables to the several notes, the practitioner not only utters the sound with more fulness, ease, and freedom, but, by the association of ideas, attains a ready recollection of the places of the tones and semitones, and by feeling the relation between the syllabic and the musical sounds, acquires the power of expressing them with truth and certainty.

SOLICITOR, a person employed to take care of, and manage, suits depending in the courts of equity, and those of the lower sort, with the advice of the damage of the people, and the increase of chancery and maintenance.

Solicitors are within the statute to be sworn and admitted by the judges, before they are allowed to practise in our courts, in like manner as attorneys.

SOLID. Geometrarians define a solid to be the third species of magnitude, or that which has three dimensions, viz. length, breadth, and thickness or depth.

A solid may be conceived to be formed by the revolution, or direct motion, of a superficies of any figure whatever, and is always terminated or contained under one or more planes or surfaces, as a surface is under one or more lines.

Solids are commonly divided into regular and irregular. The regular solids are those terminated by regular and equal planes, and are only the figures of the better sort, which consists of four equal triangles: the cube, or hexahedron, of six equal squares; the octahedron, of eight equal triangles; the dodecahedron, of twelve; and the icosahedron, of twenty equal triangles. See TETRAHEDRON, CUBE, &c.

SOLID OF LEAST RESISTANCE. Sir Isaac Newton, in his Principia, shews that if there is a curve figure, as DNFG, (Plate Miscell. fig. 218.) of such a nature, that from any point, as N, taken in its circumference, a perpendicular NM is let fall on the axis AB; and if from a given point, as G, there is drawn the right line GR, parallel to a tangent to the curve in the point N, cutting the axis produced, and taking all the proportion then is, as NM:GR::GR:4BG X GR; the solid generated by the revolution of this curve about its axis AB, when moved swiftly in a rare and elastic medium, will meet with less resistance in the medium, than any other circular solid whatever, of the same length and breadth.

SOLID ANGLE, is that formed by three or more planes meeting in a point, like the point of a dice, well cut.

SOLID NUMBERS, are those which arise from the multiplication of a plane number, by any other whatever: as 18 is a solid number made of 6 (which is plane), multiplied by 3; or of 9 multiplied by 2.

SOLID PROBLEM, in mathematics, is one which cannot be geometrically solved unless by the intersection of a circle and a conic section; or by the intersection of two other conic sections. The receptacle is naked; the pappus simple; the radii are commonly five; the scales of the calyx are imbricated, and curved inward. There are 30 species. Among these there is only one which is a native of the virginia, or common golden rod, which grows frequently in rough mountainous pastures and woods. There is a variety of this species called cambria, to be found on rocks, from six inches to a foot high.

SOLIDITY is that property of matter, by which it excludes all other bodies from the place which itself possesses.

SOLITARIES, a denomination of nuns of St. Peter of Alcantara, instituted in 1676, the design of which is to lead a severe religious life, but thus they are to keep a continual silence, never to open their mouths to any body; employ their time wholly in spiritual exercises, and leave the temporal concerns to a number of nuns, who have a particular superiority in a separate part of the monastery; they always go barefooted, without sandals; gird themselves with a thick cord, and wear no linen.

SOLO, in music, a term used in pieces consisting of several parts, to mark those that are to perform alone: it is sometimes denoted by S.

When two or three parts play, or sing, separately from the grand chorus, they are called a duo, trio, or soli.

SOLSTICE. See Astronomy.

SOLUTION, in chemistry, denotes an intimate mixture, or perfect union, of solid bodies with fluids, so as seemingly to form one homogenous liquor. The dissolving fluid is termed the solvent or menstruum. A solution is distinguished from a mixture by being perfectly clear, though not always colourless, and from the parts not separating when set at rest. See CHEMISTRY.

SOLUTION, in algebra and geometry, is the answering a question, or the resolving any problem proposed.

SOLUTION OF CONTINUITY, in surgery, is the separation of the natural cohesion of the solid parts of the body, by a wound.

SONOMET, a mineral named from the mountain Sonnena, where it was first found. It is usually mixed with volcanic productions. It crystallizes in prisms, sometimes terminates by pyramids. Colour white, and somewhat transparent. It cuts glass. The specific gravity is 3.37. Insoluble by the blowpipe: and according to Vaquerin, it is composed of

<table>
<thead>
<tr>
<th>Elements</th>
<th>Percentages</th>
</tr>
</thead>
<tbody>
<tr>
<td>49 alumina</td>
<td></td>
</tr>
<tr>
<td>46 silica</td>
<td></td>
</tr>
<tr>
<td>2 line</td>
<td></td>
</tr>
<tr>
<td>1 oxide of iron</td>
<td></td>
</tr>
</tbody>
</table>

SONATA, in music, a piece, or composition, intended to be performed by instruments only; in which sense it stands opposed to cantata, or a piece designed for the voice.

There are several kinds of sonatas. The Italians, however, reduce them principally to two: the sonata da camera, or chamber sonata; and the sonata da chiesa, or church sonata. The sonata, of whatever kind, generally opens with an adagio; and after two or three movements of various descriptions, concludes with an allegro, or a presto. This definition of a sonata, however, rather belongs to what is called the antient than to the modern music, in which the sonata is chiefly composed as a lesson or exercise for a single instrument.

SONORMUS, sax-thesis, a genus of plants belonging to the class of syngezenia, and to the order of polynomia epipeps, and in the natural system ranged under the 40th order, composites. The receptacle is naked; the calyx is imbricated, bellish, and conical; the crown of the seed is simple, sessile, and very soft; the seed is oval and pointed. There are 19 species; four of these are natives of Britain: 1. Pulistris, marsh sax-thistle. 2. Arvensis, corn sax-thistle. 3. Geranium, common sax-thistle. 4. Alacantara, rare sax-thistle. All of them noxious weeds.

SONG, in poetry, a little composition, consisting of easy and natural verses, set to a tune in order to be sung. See POETRY.

SONG, in music, is applied in general to a single piece of music, whether contrived for the voice or an instrument.

SONG OF BIRDS, is defined by the honourable Daines Barrington to be a succession of three or more different notes, which are continued without interruption, during the same interval, with a musical bar of four crotchets in an adagio movement, or whilst a penitum swings four seconds. It is affirmed by this authoress that the notes of birds are not more innate than language in man, and that they depend upon imitation, as far as their organs will enable them to imitate the sounds naturally and their adhering so steadily, even in a wild state, to the same song, is owing to the nestlings attending only to the instruction of the parent bird, whilst they disregard the notes of all others that may perhaps be singing round them.

Birds in a wild state do not commonly sing above 10 weeks in the year; whereas birds that have plenty of food in a cage, sing
Mr. Barrington has observed, that in the nightingale, which is a very capital bird, began so like the actions of graters, reserving its breath to swell certain notes, which by these means had a most astonishing effect. This writer adds, that the notes of birds, which are annually imported from Asia, Africa, and America, both singly and in concert, are not to be compared to those of European birds.

The following table, formed by Mr. Barrington, agreeing to the idea of M. de Filis, in which the notes of the most beautiful, is designed to exhibit the comparative merit of the British singing birds; in which 20 is supposed to be the point of absolute perfection.

<table>
<thead>
<tr>
<th>Bird</th>
<th>Note Quality</th>
<th>Spirituality</th>
<th>Purity</th>
<th>Expression</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nightingale</td>
<td>19</td>
<td>14</td>
<td>19</td>
<td>19</td>
</tr>
<tr>
<td>Sky-lark</td>
<td>4</td>
<td>13</td>
<td>10</td>
<td>8</td>
</tr>
<tr>
<td>Wood-lark</td>
<td>18</td>
<td>14</td>
<td>17</td>
<td>12</td>
</tr>
<tr>
<td>Tit-lark</td>
<td>12</td>
<td>12</td>
<td>12</td>
<td>12</td>
</tr>
<tr>
<td>Linnet</td>
<td>12</td>
<td>16</td>
<td>12</td>
<td>16</td>
</tr>
<tr>
<td>Goldfinch</td>
<td>4</td>
<td>4</td>
<td>12</td>
<td>8</td>
</tr>
<tr>
<td>Chaffinch</td>
<td>4</td>
<td>4</td>
<td>12</td>
<td>8</td>
</tr>
<tr>
<td>Greenfinch</td>
<td>4</td>
<td>4</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td>Hedge-sparrow</td>
<td>6</td>
<td>6</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td>Barred, or siskin</td>
<td>6</td>
<td>6</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td>Reed-bunting</td>
<td>6</td>
<td>6</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td>Blackcap</td>
<td>4</td>
<td>4</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td>Reed-bun.</td>
<td>4</td>
<td>4</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>Song-thrush</td>
<td>4</td>
<td>4</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>Wren</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Reed-sparrow</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Black-capped</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Mock-nighting</td>
<td>12</td>
<td>12</td>
<td>14</td>
<td>14</td>
</tr>
</tbody>
</table>

SONNERTIA, a genus of plants belonging to the class of icossana, and to the order of monogynia. The calyx is cut into six segments; the petals are six; the capsule is multilocular and succulent; and the cells contain many seeds. The only species is the acida, a tree of New Guinea.

SONNET. SEE POETRY.

SOOT, a substance deposited from the flame of combustibles. It consists chiefly of carbon, which, for want of complete contact with the air, could not be consumed, and is partly carried off mechanically with the smoke, and partly precipitated.

SOPHORA, a genus of plants belonging to the decamerr monogynia class, with a papilionaceous flower: its fruit is a very long and slender unilocular pod, containing a great many roundish seeds. It agrees in every thing with the didepida and papilionaceous plants, except that its stamina are distinct and separate. There are 25 species, all foreign shrubs.

SORBUS, service-tree, a genus of plants belonging to the class isossana, and to the order of trigynia. The calyx is quinquelobed; the petals are five; the berry is below the flower, soft, and containing three seeds. There are three species; the aucuparia, domestic, and hebrida.

1. The aucuparia, mountain-ash, quicken-tree, quick-beam, or roso-tree, rises with a straight upright stem and regular branches: resem- bles the blackthorn, as well as in compass and variety, is only second to the nightingale. The nightingale also sings (if the expression may be allowed) with superior judgment and taste, flowers at the sides and ends of the branches, succeeded by clusters of small red berries, ripe in autumn and winter. There is a variety with yellow-striped leaves. This species grows wild in many parts of this island, in mountainous places, woods, and hedge-rows, often going to the size of a small tree, and is admitted into our ornamental plantations, for the beauty of its growth, foliage, flowers, and fruit.

2. The domestia, or cultivated service-tree, with cattail fruit, grows with an upright stem, branching 30 or 40 feet high, or more, having dark bark, and the young shoots in spring covered with a newly down: pinnaed leaves of eight or ten pairs. This tree is a native of the southern warm parts of Europe, where its fruit is used at table as a dessert; it is cultivated here in many of our gardens as a fruit-tree, and as an ornament to diversify hardy plantations.

3. The hebrida, or mongrel service-tree of Gothland, grows 20 or 30 feet high; it has half pinnaed leaves, very downy beneath; and clusters of white flowers, succeeded by bunches of round reddish berries in autumn.

SOROLL, moss-chats, is a genus of quadrupeds of the order tereo. The generic character is, from the upper jaw two, long, bird; in the lower, two or three, the intermediate ones shorter; canine teeth, several on each side; grinders cuspidated.

The genus soroll, of which there are 17 species, in its general appearance bears a great resemblance to the mouse tribe; but the structure, number, and situation of the teeth prove it to constitute a very different set of animals, which are evidently rather carnivorous. It is more closely allied to the genus talpa; though this has two teeth in the upper jaw, the soroll is entirely destitute of teeth connected by each other intermediate species, which in habit resemble the one genus, and in teeth the other. It is owing to this circumstance that Mr. Linnaeus, in the twelfth edition of the Systema Naturae, has given two genuine species of talpa in the genus soroll. The most common species of soroll in this country is the S. aranatus, commonly known by the name of the shrew-mouse.

SOREX ARANUS. This little animal, which is perhaps the smallest of the European quadrupeds, is a very common inhabitant of our fields and gardens, and measures about two inches and a half, and the tail one and a half. Its colour is nearly similar to that of a mouse, but of a somewhat more ferruginous tinge; and the animal is readily distinguished by its long and sharp snout; the eyes are small, and almost hid in the fur. It feeds on roots, grain, insects, and almost any kind of neglected animal substance. It has a very strong and unpleasant smell; and it is remarkable that cats will kill but not eat it. Mr. Pennant observes that there seems to be an annual mortality among these little animals every autumn; numbers of them being found dead at this season by paths and in the fields. It inhabits most parts of Europe, and is also said to be found in Siberia and Kamtschatka. It breeds in March, in the leafless moss, &c., and is said to produce several young at a time.

2. Sorex muschelius, musk-shrew. This is a very singular species, which, though ex-
tremely common in some of the northern parts of Europe and Asia, does not seem to have been very distinctly understood by modern naturalists.

According to Dr. Pallas, it chiefly inhabits the river Wolua and the adjacent lakes, from Novgorod to Saratof; and is not found in Russia, nor does its existence in Lapland seem well ascertained. It is said to be very seldom seen on land; confined itself to lakes and rivers, in the banks of which it occasionally burrows to a great distance. The general length of the animal is about seven inches from nose to tail, and of the tail eight inches; but it is sometimes found of a larger size. The tail, except at its base, is perfectly naked, marked out into scaly divisions, and is of a brown colour; it is also of a laterally compressed form, and gradually tapers to the extremity; near the base of the tail are situated several small ridges, or glandular receptacles, in which is secreted a yellowish fluid, resembling in smell the strongest civet; of this substance about the quantity of a scrip may, it is said, be obtained from each animal.

These creatures are said sometimes to be seen on the surface of the water in considerable numbers on the surface of lakes and rivers, and may often be heard to snap their mouths with a sound not unlike that of a duck; feeding on worms, leeches, water-insects, &c. as well as occasionally on vegetable substances. In some particulars this animal makes a distant approach to that most singular of quadrupeds, the platypus.

The musk-shrew is a slow-paced animal and cautious; it is accidentally found on land. The skins are said to be sold in Russia to put into chests in order to drive away moths; and so common is the animal in the neighbourhood of Niznym Novogorod, that the peasants are said to bring five hundred apiece to market, where they are sold for a shilling per hundred.

In the twelfth edition of the Systema Naturae this animal is placed in the genus casor or beavers of Castor muschatus. See Plate Nat. Hist. fig. 368.

3. Sorex radius, Canada shrew. This animal may with great propriety be termed sorex radius, since the snout, which is long and slaty, takes up the entire extremity, furnished with a circular series of sharp-pointed processes or soft tendrils, disposed in the manner of the rays in a spur. The whole animal is of a long form, and its habit immediately pronounces it to belong to the genus sorex, and not to that of talpa. Its body is longish, and covered with black coarish hair; the feet far less than those of a mole; the eyes hide under the skin; the snout either takes up the entire extremity, or the radiated tentacula at the end of the nose are of a bright rose-colour, and moveable at the pleasure of the animal, so as either to be brought together into a tubular form, or expanded in the form of a star.

It is said to inhabit Canada, but not to be very common there. It occasionally burrows somewhat in the manner of a mole, but far less strongly, or more slowly, and is said to pass through the depth of its burrow beneath the surface of the snow.

4. Sorex cretaceus, perfuming shrew, measures from nose to tail near eight inches; and the tail is about three inches and a half long. This animal diffuses a musky smell, however, these parts presently regain the position in which they were before the bell was struck; but as they return with an accelerated force, they generally go beyond the point where they ought to rest. The part a, the lower border of the sound, and is said to be directed towards s, and the parts b and d towards k and l; and whence it happens that the bell, at first of a circular form, really becomes alternately elliptic in two distinct times; it follows then, that in those parts where the curvature is the greatest, their exterior points depart from each other.

The same circumstance happens to the musical chord of a harp, or other stringed instrument, when it is touched; for, in order to become angular, as BCD or BDE (fig. 220) it is necessary that the string be stretched or lengthened, and consequently its particles be in some measure removed from the point of contact.

There are then two vibrations which take place in sonorous bodies: the general vibration, which changes the form of the body; and the particular vibration, which affects the minute particles, in consequence of the former. M. de la Hire has proved, that the sound is not owing to the natural vibration, but rather to the vibration of the particles; for whenever the two vibrations can be separated, it is found that the former produces no sound; but when the general vibration is accompanied with a vibration of the particles, it is the latter that regulates the duration, the force, and the modulation of the sound; if, on the contrary, these vibrations are stopped or interrupted by touching the sonorous body, the sound immediately ceases. On this account clock-makers attach to the hammer which strikes the bell of the clock a small spring, which elevates it again the moment it has struck, and prevents it from remaining upon the bell, which would considerably deafen or destroy the sound.

Acute sounds are produced, when the vibrations of the sounding body are more frequent; grave or deep sounds, when they are less so; no medium between acute and grave sounds can be found; and some sounds are said to be in unison when they vibrate with the same frequency; when one vibrates twice as fast as the other, they differ by an octave; and other ratios, with respect to the quickness of vibration, are distinguished by other names. Chords which are short and tightly stretched, produce acute sounds, those which are long and lax, grave sounds.

The motion or vibration of bodies at a distance to would not affect our sense of hearing without the medium of some other body, which receives an impulse from this motion, and communicates the vibration to our organs. Thus a hard blow upon an anvil or upon a bell could not be heard by us, even at a very small distance, if there was not a medium between those objects and us capable of transmitting the vibrations to our auditory nerves. Elastic fluids are the most effective mediums for this purpose, and consequently the air is the most common vehicle of sound; which is very easily proved by ringing a bell under the receiver of an air-pump, the sound it affords being found gradually to diminish as the air becomes exhausted, till at length it ceases to be heard.
at all. That the air is capable of being agitated with great force, appears from the violent concessions produced by explosions of gunpowder, as well as from the power, which some persons are known to possess, of breaking drinking-glasses, by means of their vocal organs, when sounded in unison with the note which the glass would have produced when struck. The tremulous motion excited in the air by sounding bodies, has been supposed analogous to the successive rings which are produced in a liquid by disturbing the surface of the water. This hypothesis, however, was disproved by the observation that sounds, whether weak or loud, always travel with the same velocity, which does not hold true with respect to the rings on the surface of water, since these move faster or slower according to the force of the cause which excited them.

Every sound is rendered stronger or weaker, and may be heard at a greater or less distance, according to the density or rarity of the elastic fluid by which it is propagated. According to Mr. Hanksbee, who has made deep researches into this branch of philosophy, when air has acquired twice its common density it transmits sound twice as far as in the case of rare air; whereas he reasonably concludes, that sound increases, not only in direct proportion to the density of the air, but in proportion to the square of this density.

If sound was propagated in an elastic fluid more dense than air, it would be carried proportionally farther. I have proved this, says M. Brison, by putting a sonorous body into carbonic acid or fixable air, the density of which is about one-third more than that of air; but the consequence was, that at that time, and in that situation, the sound was very considerably increased. For the same reason, the dryness of the air, which increases its density, has a considerable effect in rendering sound louder and more audible. Sound is also much increased by the reverberation of the pulses of the air from those surrounding bodies against which they strike, whence it happens that music is so much better heard in a close apartment than in the open air.

Elastic fluids are, however, not the only medium through which sound may be transmitted; for it may be propagated by means of water and other liquids, which may be proved by immersing a sonorous body in water; but it must be observed, that in this case the sound will be less perceptible, and will not extend to so great a distance; the cause of this diminution is, because mediums for the transmission of sound should be elastic, and that a property which water and other liquids possess only in a very restricted degree.

Sound is also transmitted by solid bodies; provided they possess a sufficient degree of elasticity to produce this effect. Light, we have already seen, is projected or reflected with incredible velocity; but sound is transmitted much more slowly, and its progression is very perceptible to our senses. The flash from a cannon, or even a musket, may be seen some seconds before the sound reaches our ears. As the motion of light, therefore, is instantaneous with respect to moderate distance, this has been the common means employed as acertaining the progress of sound. Sir Isaac Newton observes that "all sounding bodies propagating their motions on all sides by successive consecutive vibrations, if it be, is, by an alternate progression and return of the particles; and these vibrations, when communicated to the air, are termed pulses of sound. All pulses move equally fast. This is proved by experiment; and it is found that they pass through two hundred and forty-two feet in a second, whether the sound is loud or low, grave or acut.

Some curious experiments were made, relative to the propagation of sound, by Messeurs De Thury, Maraldi, and De la Caille, upon a line fourteen thousand six hundred and thirty-six fathoms in length, having the tower of Montmartre at the other extreme of that distance: their observations were placed between those two objects. The results of their observations were these: 1st. That sound moves one hundred and seventy-three fathoms, French, in a second, when the air is calm. 2d. That sound moves with the same swiftness whether it is strong or weak; for these gentlemen observed, that the dischgre of a box of half a pound of gunpowder exploded at Montmartre was heard at mount Liveri in the same space of time, as the report of a great gun charged with nearly six pounds of powder. 3d. That the motion of sound is uniform; that its velocity neither accelerates nor diminishes through all the intervals of its progress, as is the case with almost every other species of motion. The velocity of sound is the same, whether it is placed towards the person who hears its report, or turned in a contrary way; in other words, a great gun fired from the Tower of London eastward, would be heard at Westminster in the same interval of time as it was discharged towards the latter place. And if the gun was discharged in a direction perpendicular to the horizon, it would be heard as soon as discharged in a right line towards the hearer. By other experiments, however, the progress of sound appears to be impeded by a strong wind, so that it travels at the rate of about one mile slower in a minute, than it would have done in a vacuum.

A knowledge of the progression of sound is not an article of mere sterile curiosity, but in several instances useful; by this we are enabled to determine the distance of ships or other moving bodies. Suppose, for example, a vessel fires a gun, the sound of which is heard five seconds after the flash is seen: as sound moves 1142 English feet in one second, this number multiplied by 5, gives the distance of 5710 feet. The same principle has been applied to the lightning and thunder, as to calculating the distance of it from us. See Electricity.

The waves or pulses of sound being flexible in their course when they meet with an extended solid body of a regular surface, an ear placed at the passage of these reflected waves will perceive a change from the original sound, which will seem to proceed from a body situated in a similar position and distance behind the plane of reflection, as the real sounding body is before it. It is thus that we hear an echo, which, however, cannot take place at less than fifty-five feet; because it is necessary that the distance should be such, and the sound repeated by returning sound so long in arriving, that the ear may distinguish clearly between that and the original sound.

Reflected sound may be magnified by much the same contrivances as are used in optics respecting light: hence it follows, that sounds uttered in one focus of an elliptical cavity are heard much magnified in the other focus. The whispering-gallery at St. Paul's cathedral in London, is of this description; a whisper uttered at one side of the dome is reflected to the other, and may be very distinctly heard, and ear trumpets are constructed on this principle. The best form for these instruments is a hollow parabolic conoid, with a small orifice at the top or apex, to which the mouth is applied when the sound is to be magnified, or the ear when the hearing is to be facilitated.

The structure of the ear is one of the most complicated and difficult subjects of physiology; and the reader is, therefore, referred to that article for what concerns this branch of acoustic science.

Sound, Musical. Sounds of such qualities and dispositions as to produce that agreeable and appreciable effect upon the ear which we call melody, or harmony. We shall at present confine our observations to that affection of sound which it becomes distinguished into acute and grave.

This difference has hitherto appeared to have no other causes than the different velocities of the vibrations of the sounding bodies; in fact, the tone or pitch of a sound seems to have been discovered, by an abundance of experiments, to depend on the nature of these vibrations, whose difference we can conceive no otherwise than as having different velocities; and since it is proved, that all the vibrations of the same chord are performed in equal time; and that the tone of a sound, which continues for some time after the stroke, is the same from first to last; it follows, that the tone is necessarily connected with a certain time in making each vibration; and it is from this principle that all the phenomena of tone are deduced.

If the vibrations are isochronous, the sound is called musical; and is said to be acute, or higher, than any other sound whose vibrations are slower and graver, or lower than any other sound whose vibrations are quicker.

From the same principle arise what we call concords, &c. which are resolvable into the frequent unions and coincidences of the vibrations of two sonorous bodies, and consequently the undulations of the air which they occasion. On the contrary, the result of less frequent coincidences of those vibrations is what we call discord.

Another consequence of the union of musical sounds is, that by which they are denominated long and short; not with regard to the sonorous body's retaining a motion, once received, a longer or lesser time, but to the continuation of the impulse of the efficient cause on the sonorous body for a longer or shorter time; as in the notes of a violin, &c. which are made longer or shorter by strokes of different length or quickness.

This continuity is, properly, a succession of short sounds, or the union of several distinct strokes, or repeated impulses, on the sonorous body, so quick that we may judge
It one continued sound, especially if it is continued in the same degree of strength; and hence arises the doctrine of measure and time.

Sounds again are distinguished by musicians into simple and compound.

A simple sound is the single product of one voice, or one instrument.

A compound sound consists of the sounds of several distinct voices or instruments, all united in the same individual time and measure of duration, that is, all striking the ear together, whatever may be their other differences.

The natural compound is that proceeding from the manifold reflections of the first sound from adjacent bodies, when the reflections are not so sudden as to occasion echoes, but are all given at the same moment, as well as in the same tone, or pitch, with the first note.

The artificial compound, which alone comes under the musician's province, is that mixture of several different sounds, which being produced by art, the ingredients are separable, and distinguishable from one another.

In this sense the distinct sounds of several voices or instruments, or several notes of the same instrument, are called simple sounds, in contrast-those of the compound ones, in which, to answer the purposes of music, the simples must have such an agreement in all relations, chalybes to acuteness and gravity, as that the ear may receive the mixture with pleasure.

Sound, in geography, denotes in general any striving, or inlet, of the sea, between the two headlands.

Sound-board, in an organ, is a reservoir into which the wind, drawn in by the bellows, is conducted by a port-and-vent, and hence distributed into the pipes placed over holes in its upper part; this wind enters them by vales, which open by pressing upon the stops or keys; after drawing the registers, which prevent the air from entering any of the pipes, except those it is intended to.

Soundings, in navigation, the act of trying the depth of the water, and the quality of the bottom, by a line and plummet, or other appliances.

At sea there are two plumbets used for this purpose, both shaped like the frustum of a cone or pyramid. One of these is called the hand-lead, weighing about eight or nine pounds; and the other the deep-sea lead, weighing from 25 to 50 pounds. The former is used in shallow waters, and the latter at a great distance from the shore. The line of the hand-lead is 25 fathoms in length, and marked at every two or three fathoms, in this manner, viz. at two and three fathoms from the lead there are marks of black leather; at five fathoms a white rag, at seven a red rag, at ten and at thirteen black leather; at fifteen a white rag, and at seventeen a red one.

Sounding with the hand-lead, which the seamen call heaving the lead, is generally performed by the helmsman in the main-chains to windward. Having the piece of lead ready to run out, without interrupting it, he holds it nearly at the distance of a fathom from the plummet; and having swung the latter towards him for three or four times, in order to acquire the greater velocity, he swings it round high and then...

SPAR. See Fracture of lime.

Spar, in mineralogy, a name given to those earths which break easily into rhomboidal, cubical, or laminated fragments with polished surfaces, and which are composed of one or more of the following substances: quartz, stones of different kinds, without any regard to the ingredients of which they are composed, some additional term must be used to express the constituent parts as well as the figure; for instance, calcareous spar, gypsum, conchaneous spar, &c. The spar found in Britain and Ireland are of four different species, opake, refracting, diaphanous, and strata.

1. The opake spar is rhomboidal, hexagonal, and triangular, of various colours, and is found in mines in Wales, Derbyshire, &c. and at Ovens near Cork.

2. The refracting spar is rhomboidal, shows objects seen through it double, and sometimes S, L or other images at once. It is frequent in the lead-mines of Derbyshire, Yorkshire, &c.

3. Diaphanous spar is rhomboidal, triangular, hexagonal, pyramidal or columnar; and is found in mines, quarries, and caverns, in the so-called Stalactitic spar, or stalactites, which are formed by the running or dropping of water, containing a large proportion of calcareous earth. It is opaque, generally laminated, but from accidental circumstances it sometimes forms various forms. It occurs at Knaresborough in Yorkshire, and at Ovens near Cork.

A new species of spar has lately been found in the East Indies, which, from its extreme hardness, approaching to that of a diamond, is called adamantine spar. It was discovered by Dr. Black of Edinburgh to be a distinct species. Happening one day to visit a lapidary, it was shown to him among other specimens as a stone that was used in the East Indies for polishing guns, and grinding other hard substances. Dr. Black immediately singled out a specimen, which he sent to Mr. Greville, who requested M. Klaproth to analyse it.

There are various varieties of this spar; one of them comes from China, and crystallizes in hexagonal prisms without pyramids, the length of the sides varying from six to twelve lines; their breadth being about nine, of a grey colour, and with different species for their hearts, and sides up to the height of a yard, and the rest being made of brick, the hearth by the force of the fire is continually growing wider, so that it at first contains as much metal as will make a sowe of six or seven hundred weight, it will at last contain as much as will make a sowe of 2000 weight.

SOWANS. See STARCH.

SOWNE, a term used in the exchequer, where estreats that sowne not, are such as the sheriff by his care and diligence cannot levy, wherefore they are not regarded; and the estreats that sowne, are such as he may levy.

SPA. See Water, mineral.

SPACE, in geometry, denotes the area of any figure, or that which fills the interval or distance between the lines that terminate it.

SPACE, in mechanics, the line a movable body, considered as a point, is conceived to describe.

SPAN, a measure taken from the space between the thumb's end and the tip of the little finger, when both are stretched out. The span is estimated at 3 hand's-breadths, or 9 inches.
to the order of triandria, and in the natural system ranged under the 3rd order, Catar.

The aequinome of the male flower is furnished with two triangular stamens and there is no corolla. The aequinome of the female flower resembles that of the male. The stigma is bifid; the fruit is a dry berry containing one seed. There are three species, all of them native of Great Britain and Ireland, and growing in pools and lakes.

SPARMAIANA, a genus of plants belonging to the class of polynandra, and to the order of monogynia. The corolla consists of five petals, and is hemispherical. The stamens are numerous, and swell a little; the calyx is quadrangularly; the capsule is angulated, quinquelocular and echinate. There is only one species, the africanus, a shrub of the Cape.

SPARROW. See Fringilla.

SPARROW-HAWK. See Falco.

SPARTIUM, a genus of plants belonging to the class of diadephi, and order of decandria, and in the natural system arranged under the 32d order, papilionaceae. The flowers are gathered in the form of a long spike, and from the stipules, the adheres to the germin.

The calyx is produced downwards. There are 27 species. All these, except the scoparium, are races, chiefly from Spain, Portugal, Sicily, and Italy. The calyx, or common brown, is used for a variety of purposes.

It has been a great benefit sometimes in droppal complaints. The manner in which Dr. Cullen administered it was this: he ordered half an ounce of fresh brown, to be boiled in a pound of water till one-half of the water was evaporated. He then gave two tablet-spoonfuls of the decoction every hour till it operated both by stool and urine. By repeating these doses every day, or every second day, he says some droppies have been cured. Dr. Mead relates, that a droppal patient, who had taken the usual remedies, and been tapped three times without effect, was cured by taking half a pint of the decoction of quenb-brown tops, with a spoonful of white mustard-seed, every morning and evening. *An infusion of the seeds drunk freely (says Mr. Withering) has been known to produce much effect; but whoever expects these effects to follow in every droppal case will be greatly deceived.* I knew them succeed in one case that was truly deplorable; but out of a great many of cases in which the medicine had a fair trial, this proved a single instance.*

The flower-buds are in some countries pickled, and eaten as capers; and the seeds have been used as a bad substitute for cacao. The branches are used for making besoms, and tanning leather. They are also used instead of thatch to cover houses. The old wood furnishes the cabinet-maker with beautiful materials for veneering. The tender branches are in some places used in brewing, and the macerated bark may be manufactured into cloth.

SPARGELSTEIN, a mineral found in Spain, where it forms whole mountains, in different parts of Germany, and in Cornwall. It is sometimes amorphous, and sometimes crystallized. The primitive form of its crystals is a regular six-sided prism. Its integrant molecule is a regular triangular prism, whose base is the right angle. 

\[ \sqrt{2} \]

Sometimes the edges of the primitive hexagonal prism are wanting, and small faces in their place; sometimes there are small faces instead of the edges, which terminate the prism; sometimes these two varieties are united.

SPARUS, a genus of fishes of the order thoracis: the generic character is, the teeth strong; front teeth in some species disposed in a single row, in others in a double, triple, or quadruple row; graders (in most species) convex, smooth, and disposed in ranges, forming a kind of pavement in the mouth; lips thick; gill-covers unarmed, smooth, sally. The genus sparus is extremely numerous, there being more than 40 species, and as the greater number are exotic, very little is known of their history; a general survey is therefore all that can be expected; it may be observed that they are much allied to the labrus, and that the distinction between these two genera is not, in all cases, so clear as might be wished; in the Systema Naturae of Linneus an evident confusion takes place with respect to the characters of both.

Sparus aurata. Gill-head sparus. General, a fish of fifteen inches, but occasionally found of far larger size; body broad and thin, the back rising into a carina: native of the Mediterraneum, Atlantic, and Indian seas, and held in considerable esteem as a food, not only by the ancient Greeks and Romans, and by the former nation consecrated to Venus.

SPATHELIA, a genus of plants belonging to the class of pentandria, and order of decandria; the flowers are small, umbelas on the peduncle; the petals are pale; the capsule is three-edged and trilocular; the seeds solitary. There is only one species, the simplex, which is a native of Jamaica, and was introduced into the botanic garden of this country in 1778 by Dr. Wright, late of Jamaica.

SPASM. See Medicine.

STABULA, an instrument used by surgeons and apothecaries for spreading plasters, &c.

SPECIES, in algebra, the characters or symbols used of to represent quantities.

SPECIFIC, in medicine, a remedy whose virtue and effect is peculiarly adapted to some form of disease; and expuits its whole force immediately thereon.

SPECIFIC, in philosophy, that which is peculiar to any thing, and distinguishes it from all others.

SPECIOUS ARITHMETIC, the same with algebra.

SPECLARIS LAPIIS, in natural history, a genus of talcs, composed of large plates visibly separate, and of extreme thinness; and each fuscus again separated into a number of plates still finer. (See Talc.) Of this genus there are three species: 1. The white shining specularis, with large and broad leaves, commonly called iksinglass and Masscova glass; its fanacles, or leaves, are extremely thin, elastic, and transparent; it makes sometimes not the least effervescence with aquafortis, and is not easily calcined in the fire. It is imported in great quantities; the mineralogists suppose from the pictures with which they represent it; the glass-makers use it instead of horn; and minute objects are usually preserved between two plates of it, for examination by the microscope. 2. The bright-brown specularis, with broad leaves, resembling a great part of white arsenic. The 3. The purple bright specularis, with broad leaves, the most elegant of all the takes, and as beautifully transparent as the first kind.

SPECULUM, or looking-glass or mirror, capable of reflecting the rays of the sun, &c. See Optics: see also Foliating looking-glasses, vol. i. p. 738.

SPECULUM, in surgery, an instrument for disturbing a wound, or the like, in order to examine it attentively.

SPECULUM for reflecting telescopes, is made of a kind of white copper consisting of 32 parts of fine red copper, one of brass, fifteen of glass-tin, and inferior arsenic. The process, as given by the late J. Edwards, who was rewarded by the board of longitude for disclosing it to the public, was published in the Nautical Almanack for 1787, and is as follows: Melt the copper in a large crucible, employing some black flux, composed of two parts of tartar and one of niter; when melted, add to it the brass and silver. Let the pure tin be melted into another crucible, also with some black flux. Take them both, and put the melted tin into the fused mass in the large crucible. Stir the whole well with a dry spatula of birch; and pour off the fused metal immediately into a large quantity of water. The copper will cause the fluid metal to divide into an infinite number of small particles, which will cool instantly. 2. If the copper is completely saturated, the fracture of one piece of this mixed metal will be made up of a glossy look, resembling the face of pure quicksilver. But if it is a brown reddish colour, it wants a little more tin. To ascertain the required proportion, melt a small quantity, know by weight, of the mixed metal, with a known very small part of tin; and, if necessary, repeat the trial with different doses, till the fracture of the new mixture looks as already described. Having now ascertained the necessary addition of tin that is required, proceed to the last melting of the whole metal, together with the additional proportional dose of tin; fuse the whole, observing the same cautions as before, and you will find that the mixture is not with a truth of that for the first fusion. Have ready as many ounces of white arsenic in coarse powders as there are pounds in the weight of metal; wrap up the arsenic in a small paper, and put it, with a few pounds, into the crucible; stir it well with the spatula, retaining the breath to avoid the arsenical fumes or vapours (which however are not found to be hurtful to the lungs) till they disappear; take the crucible off the fire, clear away the dust from the top of the metal; pour in about one ounce of powdered rosin, with as much nitre, in order to give the metal a clean surface, and pour out the metal into the moulded flask. 3. The speculum should be moulded with the concave surface downwards, and many small holes should be made through the sand upwards, to discharge the air. The moulding-sand from Highgate near London, used by the founders, as is good, as any for casting these metallic mirrors. The cast metal should be taken out from the sand of the flasks whilst it is hot, or else it may happen to crack it left to cool within.

SPEEDWELL. See Veronica.

SPELTER. See Zinc.

SPELT. In the sea-language, signifies the same as broken.
SPERMULA, a genus of plants belonging to the class of cryptogams, and the order of psyllids, and in the natural system arranged under the 42d order, carophyllaceae. The calyx is pentaphyllous; the petals five, and ovuliferous ovary, or ovary, and being of a dark or white color, and containing five values. There are seven species, five of which are British:—

1. The arvensis, corn-spernum, has linear furrowed leaves, from eight to twenty in a whorl. The flowers are small, white, and terminal. It is frequent in corn-fields. In Holland it is cultivated as food for cattle, and has the advantage of growing on the poorest soils, but does not afford a great deal of food. Poultry are fond of the seeds; and the inhabitants of Finland and Norway make bread of them when their crops of corn fail. Horses, sheep, goats, and swine, eat it. Cows refuse it. 2. The nodosa, knotted spernum. 3. Pentandra, small spernum. 4. Laricina, larch-leaved spernum. 5. Sagittoides, pearwood spernum.

SPERMACETI. This peculiar oily substance is found in the cranium of the Physycter monocerophulus, or spermaceti-whale. It is obtained also from other species; first it is mixed with some liquid oil, which is separated by means of a woollen bag. The last portion is removed by an alkaline ley, and the spermaceti is afterwards purified by filtration. This obtained it is a beautiful white substance, usually in small scales, very brittle, has scarcely any taste, and but little smell. It is distinguished from all other fatty bodies by the crystalline appearance which it always assumes, when molten, according to the experiments of Bostock, at the temperature of 117°. When sufficiently heated it may be distilled over without much alteration; but when distilled repeatedly, it loses its solid form, and becomes a liquid oil. It is soluble in boiling alcohol, but separates again as the solution cools. About 150 parts of alcohol are necessary to dissolve it. Either dissolves it cold, and very rapidly when hot; on cooking it into a solid mass. It dissolves also in hot oil of turpentine, but precipitates again as the liquor cools.

The acids have hardly any action upon it, but it unites with the pure alkalis. With hot ammonium it forms an emulsion which is not decomposed by cooling nor by water. It dissolves sulphur, and is dissolved by the fixed oils.

SPERMACEOCE, button-wood, a genus of plants belonging to the class of Psilocyceae, and order of monomyceae, and in the natural system arranged under the 47th order, sel-laticae. The corolla is monopetalous and funnel-shaped, and there are two bidentate seeds. The species are 20, all store plants from warm climates.

SPERMACEUS. See Spermaceti.

SPHERANTHUS, a genus of plants belonging to the class of Syngenesia, and to the order of Polygonaceae; and in the natural system arranged under the 49th order, compositae. Each stalk of the calyx contains eight florets; the florets are tubular, the female being scarcely distinguishable. The receptacle is scaly; and there is no pappus. The species are four, the indicus, the alicuea, the cinnamomum, and another.

SPHERIA, a genus of the class and order Cryptogamia funga. The fructifications are mostly spherical, opening at the top; while young filled with jelly, when old with blackish powder. They grow on the bark or wood of other plants. There are 29 species.

SPHEROCARPUS, a genus of the Cryptogamia class of plants, and order alge, consisting of follicular matter, expanded on the ground, and producing very large and obvious fructifications. Dr. Hilt thinks it probable, that the male flowers are produced on separate plants from the female, and have not been discovered to belong to the same species: no male parts of fructification are described to us; the female parts consist of a tubulated and inflated vagina, within which is contained a large globular capsule, containing a great number of small loose seeds.

SPHAGNUN, bog-moss, a genus of plants belonging to the class of cryptogams and order of musci. The anthere are globose; the mouth entire, and closed by an operculum; the calyptra is wanting. There are several species, the unmun, and arboreum. 1. The palustre, common bog-moss, grows on our bogs in wide patches, so as frequently to cover a large portion of their surface. The stalks are from two inches to foot long, long-stalked, set with numerous, conical, pendant branches, and terminated with a rotaceous cluster of erect short ones. It is generally believed, that the roots and decayed stalks of this moss constitute a principal part of that useful bituminous substance called peat, which is the chief fuel of the northern regions. The Lapland nations are well acquainted with this moss. They dry and lay it in their cradles, to supply the place of bed-clothes, and every covering; and, being changed night and morning, it keeps the infant remarkably clean, dry, and warm. It is sufficiently soft to yield, but the tender mother, not satisfied with this, frequently covers the moss with the dry hair of the rein-deer; and by that means makes a most delicate nest for the young babe.

2. The alpinum, green bog-moss. Its branches are subulate and erect on the surface of mountain bogs in South Britain.

3. The arboreum, creeping bog-moss, is branched; the anthere are numerous, sessile, hairy, and grow along the branches chiefly on one side. It is found on the trunks of trees.

SPHENOIDAL SUTURE. See Anatomy.

SPHENOIDES. See Anatomy.

SPHERE, a solid contained under one uniform round surface, such as would be formed by the revolution of a circle about a diameter thereof as an axis. See Geometry.

Sphere, properties of the, are as follow:

1. A sphere may be considered as made up of an infinite number of pyramids, whose common altitude is equal to the radius of the sphere, and all their bases form the surface of the sphere. And therefore the solid content of the sphere is equal to that of a pyramid whose altitude is the radius, and its base is equal to the surface of the sphere, that is, the solid content is equal to the product of its radius and surface.

2. A sphere is equal to of its circumscribing cylinder, or of the cylinder of the same height and diameter, and therefore equal to the cube of the diameter multiplied by 3/4, or of the sphere of the same base and height. Hence all of different spheres are one another as the cubes of their diameters, and their surfaces as the squares of the same diameters.

3. The surface or superficies of any sphere, is equal to four times the area of its great circle, or of a circle of the same diameter as the sphere.

4. The surface of the whole sphere is equal to the area of a circle whose radius is equal to the diameter of the sphere. And, in this manner, the curve surface, whether greater or less than a hemisphere, is equal to a circle whose radius is the chord line drawn from the vertex of the segment to the circumference of its base, or the chord of half its arc.

5. The curve surface of any segment or zone of a sphere, is also equal to the curve surface of a cylinder of the same height with that portion, and of the same diameter with the sphere. Also the surface of the whole sphere, or of a hemisphere, is equal to the curve surface of its circumscribing cylinder. And the curve surfaces of their corresponding parts are equal, that are contained between any two places parallel to the base. And consequently the surface of any segment or zone of a sphere, is as its height or altitude.

Most of these properties are contained in Archimedes's treatise on the sphere and cylinder. And many other rules for the surfaces and solidities of spheres, their segments, zones, frustums, &c., may be seen in Bonnycastle's Mensuration.

Hence, if d denotes the diameter or axis of a sphere, s its curve surface, c its solid content, and a = 7.853 the area of a circle whose diameter is 1; then we shall, from the foregoing properties, have these following general values or equations, viz.

\[ s = \frac{4}{3} \pi d^2 \]
\[ c = \frac{4}{3} \pi d^3 \]
\[ a = \pi d^2 \]

Sphere, in astronomy, that conceve orb, or expanse, which invests our globe, and in which 't heavenly bodies appear to be fixed, and stand an equal distance from the eye.

Sphere, armillary. See Armillary Sphere.

Spherics, the doctrine of the sphere, particularly of the several circles described on its surface, with the method of projecting the same on a plane. See Projection of the Sphere.

A circle of the sphere is that which is made by a plane cutting it. If the plane passes through the centre, it is a great circle; if not, it is a little circle.

The pole of a circle, is a point on the surface of the sphere, equidistant from every point of the circumference of the circle. Hence every circle has two poles, which are diametrically opposite to each other; and all circles that are parallel to each other have the same poles.

Properties of the circles of the sphere.

1. If a sphere is cut in any manner by a
plane, the section will be a circle; and a great circle when the section passes through the centre, otherwise it is a little circle. Hence all great circles are equal to each other; and the line of section of two great circles of the sphere, is a diameter of the sphere; and therefore two great circles intersect each other in points diametrically opposite; and make equal angles at those points; and divide each other into two equal parts; also any great circle divides the whole sphere into two equal parts.

2. If a great circle is perpendicular to any other circle, it passes through its poles. And if a great circle passes through the pole of any other circle, it cuts it at right angles, and into two equal parts.

3. The distance between the poles of two circles is equal to the angle of their inclination.

4. Two great circles passing through the poles of another great circle, cut all the parallels to this latter into similar arcs. Hence, an angle made by two great circles of the sphere, is equal to the angle of inclination of the planes of these great circles. And hence also the lengths of those parallels are to one another as the sizes of their distances from their parallel great circle. Consequently, as radius is to the cosine of the altitude of any point on the globe, so is the length of a degree at the equator, to the length of a degree in that latitude.

5. If a great circle passes through the poles of another, this latter also passes through the poles of the former; and the two cut each other perpendicularly.

6. If two or more great circles intersect each other in the poles of another great circle; this latter will pass through the poles of all the former.

7. All circles of the sphere that are equally distant from the centre, are equal; and the farther they are distant from the centre, the less are they.

8. The shortest distance on the surface of a sphere, between any two points on that surface, is the arc of a great circle passing through those points. And the smaller the circle is that passes through the same points, the longer is the arc of distance between them. Hence the proper measure, or distance, of two places on the surface of the globe, is an arc of a great circle intercepted between the same. See Theodosius, and other writers on spheres.

SPHEROID, a solid body approaching to the figure of a sphere, though not exactly round, but having one of its diameters longer than the other.

This solid is usually considered as generated by the rotation of an oval plane figure about one of its axes. If that is the longer or transverse axis, the solid so generated is called an oblate spheroid, and sometimes prolate, which resembles an egg, or a lemon; but if the oval revolves about its shorter axis, the solid will be an oblate spheroid, which resembles an orange, and in this shape also is the figure of the earth, and of the other planets.

The axis about which the oval revolves, is called the fixed axis, and the other is the revolving axis, whichever of them happens to be the longer.

When the revolving oval is a perfect ellipse, the solid generated by the revolution is properly called an ellipsoid, as distinguished from the spheroid, which is generated from the revolution of any oval whatever, whether it be an ellipse or not. But generally speaking, in a common acceptance, the term spheroid is used for an ellipsoid; and therefore, in what follows, they are considered as one and the same thing.

Any section of a spheroid by a plane, is an ellipse (except the sections perpendicular to the fixed axis, which are circles); and all parallel sections are similar ellipses, or having their transverse and conjugate axes in the same constant ratio; and the sections parallel to the fixed axis are similar to the ellipse from which the solid was generated.

For the surface of the spheroid, whether it is oblong or oblate,

Let $f$ denote the fixed axis, and $r$ the revolving axis,

$$ e^2 = \frac{a^2}{b^2} - 1, \quad \text{and} \quad f = \frac{b}{r}; \quad \text{then will be expressed by the following series, using the upper signs for the oblong spheroid, and the undetermined for the oblate one, viz.}

$$

$$

The term \( \cos \theta \) is equal to the area of the generating ellipse, which appears that the surface of the oblong spheroid is less than 4 times the generating ellipse; but the surface of the oblate spheroid is greater than 4 times the same; while the surface of the sphere falls in between the two, being just equal to 4 times its generating circle.

Huygens has given two elegant constructions for describing a circle equal to the superfluities of an oblong and an ovate spheroid, which he says he found out towards the latter end of the year 1657.

Of the solidity of a spheroid. Every spheroid, whether oblong or oblate, is, like a sphere, exactly equal to two-thirds of its circumscribing cylinder. So that, if $f$ denotes the fixed axis, and $r$ the revolving axis, and $a = 7834$; then $\frac{4}{3}fr^2$ denotes the solid content of either spheroid. Or, which comes to the same thing, is done by the transverse and $c$ the conjugate axis of the generating ellipse; then $\frac{4}{3}c^2$ is the content of the oblate spheroid, and $\frac{4}{3}a^2$ is the content of the oblate spheroid.

Consequently, the proportion of the former solid to the latter, is as $c$ to $a$, or the less axis to the greater.

Further, if about the two axes of an ellipse are generated two spheres and two spheroids, the four solids will be continued proportionals, and the common ratio will be that of the two axes of the ellipse; that is, as the greater sphere, or the sphere upon the greater axis, is to the oblate spheroid, so is the oblate spheroid to the oblong spheroid, and so is the oblong spheroid to the less sphere, and so is the transverse axis to the conjugate.

SPHEROID, universal, a name given to the solid generated by the rotation of an ellipse about some other diameter, which is neither the transverse nor conjugate axis.

SPIFIEX, a genus of insects of the order hymenoptera. The generic character is, mouth with jaws, without tongue; antenna of ten joints; wings flat-inclined (not more than six in a line) united. As the insects of the genus spinex deposit their eggs in the bodies of other living insects, so those of the genus spicex deposit theirs in dead ones, in order that the young larvae, when hatched, may find their proper food.

1. Thus the spinex fugitus of Linnaeus, having found some convenient cavity for the purpose, seizes on a spider, and having killed it, deposits it at the bottom: then laying her egg in it, she closes up the orifice of the cavity with clay: the larva, which resembles the maggot of a bee, having devoured the spider, spins itself up in a dusky silken web, and changes into a chrysalis, out of which, within a certain number of days, proceeds the complete insect, which is of a black colour, with a slightly foot-stalked abdomen, the edges of the several segments being of a brighter appearance than the rest of the body. It should be noted that the female spinex prepares several separate holes or nests as before mentioned, in each of which she places a dead insect and an egg: each cell costing her the labour of about two days. See spinex fugitus of Linnaeus, which is of a black colour and slightly hairy, with brown wings, and the fore part of the abdomen ferruginous with black bands, seizes or tries in a similar manner, burying one in the ground, in which she deposits an egg, and then closes up the cell.

2. Spicex sabulosus Lin. is a black and hairy species, with the second and third joints of the abdomen ferruginous. It inhabits sandy and gravelly places, in which the female digs holes with her fore-feet, working in the manner of a dog, in order to form the cavity, in which she places either a spider or a caterpillar; after which she closes up the cavity, having first laid her egg in the dead insect. Linnaeus, in his description of this insect, contradicts the generic character, since he observes that it has a retractile snout containing the tongue.

3. One of the extra-European sphinx are insects of a very considerable size. The whole genus is very much allied to those of vespa and apis. There are 3 species. See Plate Nat. Hist. fig. 369.

SPHINX, the hawk moth, a genus of insects of the order lepidoptera. The generic character is, antennae thickest in the middle, subtrisymmetric, and attenuated at each extremity; wings delicately; slight, strong, and commonly in the evening or morning. The insects of this genus have in general a large thorax and thick body, commonly tapering towards the extremity. The male sphinx is applied to the genus on account of the posture assumed by the larva of several of the larger species, which are often seen in an attitude much resembling that of the Egyptian sphinx, viz. with the fore parts elevated, and the rest of the body applied flat to the surface.

1. One of the most elegant insects of this genus is the sphinx ligustri, or privet hawk moth. It is a large insect, measuring nearly four inches and a half; its head and wings a foot and a half long; the revolving axis of the ellipse about some other diameter, which is neither the transverse nor conjugate axis.
and body are of a fine rose-colour, banded with transverse black stripes. The caterpillar, which is very large, is smooth, and of a fine green, with seven oblique purple and white stripes along the ventral surface of the body, or top of the last joint, a horn or process pointing backwards. This beautiful caterpillar is often found in the months of July and August feeding on the privet, the lilac, the poplar, and some other trees, and generally changes to a chrysalis in August or September, retiring for that purpose to a considerable depth beneath the surface of the ground, and, after casing its skin, continuing during the whole winter in a dormant state, the sphinx emerging from it in the succeeding June.

2. The sphinx ocellata is perhaps still more beautiful: it is rather a smaller insect than the preceding, and has the upper wings and body brown, the former finely clouded with different shades, while the lower wings are of a bright rose-colour, each marked with a large ocellated black spot with a blue interior circle, and black bands of irregular width. It perhaps emerges from a green caterpillar of a rough and shagreen-like surface, marked on each side by seven oblique yellow-white streaks, furnished, like the preceding, with a horn at the tail. It has a curious appearance, the abdomen rises under green, in order to undergo its change into the chrysalis state, in the month of August or September; and in the following June appears the complete insect.

3. Both the foregoing, with that which is the most remarkable, if not the most beautiful European insect of this genus, is the sphinx atropos of Linnaeus, see Plate Nat. Hist. fig. 376, which very considerably exceeds in size both the species already mentioned. The upper wings are of a fine dark-grey colour, with a few slight variegations of dull orange and white; the under wings are of a bright orange-colour, marked by a hair of transverse black bands; the body is also orange-coloured, with the sides marked by black bars, while along the top of the back, from the thorax to the tail, runs a broad blue-grey stripe; on the top of the thorax is a very large patch of most singular appearance, the shape of an irregular, oblong figure of a skull or death's-head, and of a pale grey, varied with dull ochre-colour and black. When in the least disturbed or irnted, this insect emits a sulphurous, something like the smell of the male European mouse; and from this circumstance, as well as from the mark above-mentioned on the thorax, is held in much dread by the vulgar in several parts of Europe, its appearance being regarded as a kind of ill omen, or harbinger of approaching fate. We are informed by the celebrated Réaumur, that the members of a female convent in France were thrown into great consternation at the appearance of one of these insects, which happened to fly in during the evening at one of the windows of the dormitory. The caterpillar from which this curious sphinx proceeds is in the highest degree beautiful, and far surpasses in size every other European insect of the kind; measuring sometimes near five inches in length, and being of a very considerable thickness: its colour is a bright yellow, the sides marked by a row of seven most elegant broad stripes, or bands, one of which is purple, the other orange; the body is covered with a fine hair, and the head has a distinct mandible or hook. This caterpillar is principally found on the potato and the jessamine, those plants being its favourite food. It usually changes into a chrysalis in the month of September, retiring for that purpose pretty deep under the surface of the earth; the chrysalis state continues from the following June or July. The sphinx aitropos is generally considered as a very rare insect; and as the caterpillar feeds chiefly by night, concealing itself during the day under leaves, &c., it is not often detected.

We shall not conclude the survey of the genus sphinx without observing, that it contains some species of a smaller size, and of a somewhat different habit from the kinds above described. Among these is the beautiful sphinx filipes nudula, or dropwort sphinx, common in meadows towards the decline of summer, and which is distinguished by having the upper wings of an oblong-oval shape and of a dark shining green colour, with blood-red spots, and the lower wings red with a dark green edging; the caterpillars of a pale yellow, with rows of squarish black spots, and often seen feeding on various meadow-plant and grasses. The body is perfectly rounded, but not much broader than long, and encloses itself in an oval shining yellow web of silk, attached to the stem of some grass, &c. In this it changes into a chrysalis, out of which in about the space of three weeks appears the complete insect. See Plate Nat. Hist. fig. 371.

Others of the smaller sphingies are remarkable for having the wings in a considerable degree transparent; of this kind is the sphinx filipes, a variety of which is at first sight more resembling that of a wasp or hornet than of a sphinx, the wings being transparent with merely a slight edging of brown, and the thorax and abdomen varied with black and yellow. The caterpillar inhibits the hollows of poplar, sallow, willow, and lime trees, feeding on the substance of the bark; changing to a chrysalis in April, and the fly appearing in the month of June.

Sphinx crathorniformis is so much like the former as scarcely to be distinguished from it, and inhabits the hollows of the sallow and other willows, feeding on the wood: it changes to a chrysalis in May, and the fly appears in the month of July.

SPICA VIRGINIS, a star of the first magnitude, in the constellation Virgo. SPIDER. See ARAEAE. SPIDER'S WEB. See Silk. SPIDER'S WEBS. See Poisons. SPIELMANNIA, a genus of the diynamia angioperipera class and order. The calyx is five-cleft; corolla bearded at the throat, with five-cleft border; drupe with a twocelled, two-seeded nut. There is one species, a shrub of the Cape. SPIES, in war, are persons employed to give intelligence of what the enemy is doing. By making a proper use of the necessary creatures, the most secret designs of an enemy may be discovered, the positions his army are to take, the stations of his fleets, and even the manner in which the former is to be secured by masked batteries, or the latter be kept firm with chain-moosings, was the case of Boulogne in 1800. If they are apprehended, they immediately suffer death.

SPIGELLA, worm grasses, a genus of plants belonging to the class of pentandria, and order of the Cleridae, a family of the Blandine system arranged under the 47th order, stellate. The corolla is funnel-shaped; the capsule is bicylous, bilocular, and polyspermous. There are two species, the antheochis and maestrichtia. 1. The antheochis, see Plate Nat. Hist., fig. 179, the European worm-grass, growing in the months of July and August, in quite dry situations, and the greatest heights are found. This plant is generally found in low dry lands, after they have been turned up some months, and after great rains; its taste is herbaceous, and somewhat cliening; its growth is soft and flexible; its stalk hollow, smooth, and roundish. Its medicinal qualities are highly spoken of by Dr. Brown. 2. The maestrichtia, perennial worm-grass, or Indian pink. Its stem is four-cleft, and all the leaves opposite. Dr. Garden gave it in what he calls continued or remitting low worm-fivers, and found its efficacy promoted by the addition of rad, sesquiterp. virg.

SPIKING up the ordnance, a sea-phrase, used for fastening a quoin with spikes to the deck close to the breach of the carriages of great guns, that they may keep close and firm to the ship's sides, and not get loose when the ship rolls, and by that means endanger the breach of the head of the ordnance. SPILANTHUS, a genus of plants belonging to the class of syngeanis, and to the order of polygamia equales. The common calyx is ointment; the leaflets numerous, sub-oval, and obtuse, the two exterior leaves longer than the rest. The calyx is almost equal; down two-toothed, rectangular, conical, cleft. There are nine species, annuals of hot climates. SPINACIA, spingus, a genus of plants belonging to the class of dicrcea, and to the order of pentandria; and in the natural system arranged under the 12th order, holocarceae. The male calyx is quinqupartite; there is no corolla; the female calyx is quindrid; no corolla; there are four styles, and one seed within the indurated calyx. There are only two species, the ocearea and fera. 1. The ocearea, common spingus, has sessile fruits and sagittated leaves. It has been cultivated in Britain since 1568, but it is not known from what country it was originally brought. When intended for winter use, it should be sown on an open spot of ground in the last week of April, and the sowing should be done. If possible, when the weather is rainy. The way of gathering it to advantage is only to take off the longest leaves, leaving those in the centre to grow bigger; and at this rate a bed of the wild spingus will give a good crop a whole winter, till the spingus sown in spring is become fit for use, which is commonly in April. 2. The fera, wild spingus, produces its fruit on footstalks.

SPIN.C See Botany. SPINALIS. See Anatomy. SPINDLE. See Anatomy. SPINDELLE, in the sea language, is the smallest part of a ship's capstan, which is blessed the two decks. The spindle of the jero capstan has wheel to leave the wheel. The axis of the wheel of a watch or clock is also called the spindle. Among miners, the spindle is a piece of wood fastened into either stone-blade.

SPINDE-SHELL. See Buccinum. SPINE. spina dorsi. See Anatomy. SPINEL. This stone, which comes from the island of Ceylon, is usually crystallized. The form of its integral particles is the tetrahedron, the primitive form of its crystal, and a regular octahedron, composed of two four-sided pyramids applied base to base, each of
the sides of which is an equilateral triangle.
In some cases two opposite sides of the pyramids are broader than the other two; and sometimes the edges of the octahedron are wanting, and narrow faces in their place. For figures of this description, and others of various and other species of these crystals, the reader is referred to Romé de Lisle and the Abbé Estener. It occurs also in tetrahedrons, in rhomboids whose faces have angles of 120° and 60°, in rhomboidal dissociations, and in four-sided prisms terminated by four-sided pyramids.

The texture of the spinel is foliated. Fracture conchoidal. Its lustre is 3. Transparency 2 to 4. It causes a single reflection. Hardness 13. Specific gravity 3.570 to 3.625. Colour red, of various shades; sometimes also blue, green, and yellow. The constituents of the spinel are, according to Lessing.

<table>
<thead>
<tr>
<th>Mineral</th>
<th>Formula</th>
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<tbody>
<tr>
<td>Spinel</td>
<td>Al₂(SiO₄)₃</td>
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<tr>
<td>Garnets</td>
<td>Ca₃(Al₂Si₃O₁₂)</td>
</tr>
<tr>
<td>Peridot</td>
<td>Mg₂(Al₂Si₂O₆)</td>
</tr>
<tr>
<td>Diopside</td>
<td>Ca₂Mg₃Si₅O₁₈</td>
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SPINIFEX, a genus of plants belonging to the class of polygonia and order of dicotia. The hemaphroditic flowers have a calyx with bivalved bilocular glumes, the vallvettes being parallel to the rachis; the corolla is bivalved and awned; there are three stamens and two styles. In the male flowers the calyx is common with the hemaphroditic; the corolla and stamina are similar. There is only one species, the Squarrosum, a grass of the East Indies.

SPINNING, the act of reducing silk, flax, hemp, hair, wool, or other matter, into thread. Spinning is either performed on the wheel, or by a distaff and spindle, or with other machines proper for the several kinds of working. Hemp, flax, nettle-thread, and other like vegetable matters, are to be wadded in spinning: silks, wools, &c. are spun as in the preceding. The threads are not to stand in need of water; there is, however, a way of spinning or reeling silk as it comes off the cases or balls, where hot, and even boiling, water is to be used. The vast variety, and importance of these branches of our manufactures, which are produced from cotton, wool, and flax, spun into yarn, together with the cheapness of provisions, and the low price of labour, in many foreign countries, which are the rivals of our trade, have occasioned many attempts at home to render spinning more easy, cheap, and expeditious. Mr. Arkwright has carried the invention to a high degree of perfection. He not only contrived methods for spinning cotton, but obtained a patent for making cotton, flax, and wool, into yarn.

SPINSTER, in law, an addition usually given to all unmarried women from a viscount's daughter downwards.

The principal genus of vermes of the order mollusca. The generic character is, body projecting from a tube, jointed, and furnished with dorsal fins; peduncles or feet rough with bristles, and placed towards the back; heads two, long, simple; eyes two, oblong.

There are two species, viz. 1. The seticornis, which inhabits the ocean where there is a clayey bottom, is about three inches long: the tube is composed of agglutinated particles of earth, thin, erect, and three as long as the body. In this the animal projects its capillary white feeders, in search of food, which consists of marine worms. 2. Filicornis, that inhabits the Greenland seas: tube fragile, erect, greenish, from which it projects its feeders in search of planaria and other small marine worms.

SPIRACULA, in entomology, holes or pores on each side of every segment of the abdomen, through which insects breathe.

SPIRA-l, in geometry, a curve line of the circular kind, which, in its progress, recedes from its centre.

A spiral, according to Archimedes, its inventor, is thus described: If a right line, as AB (Plate Misc. fig. 222), having one end fixed at B, is usually moved round, so as with the other end A to describe the periphery of a circle; and, at the same time, a point is conceived to move forward equally from B to A, in the right line BA, so that the point describes that line, while the line generates the circle: then will the point, with its two motions, describe the curve-line B 1, 2, 3, &c. which shall be the helix a 1, 2, 3, &c. of the spiral line; and the plane space, contained between the spiral line and the right line BA, is called the spiral space.

If also you conceive the point B to move twice as slow as the line AB, so that it shall get but half-way along the line BA when that line shall have formed the circle; and then you imagine a new revolution to be made of the line carrying the point, so that they shall end their motion at last together: there will be given a second spiral line, and the twined a second series of spatial spaces, as you see in the figure. From the genesis of this curve, the following corollaries may be easily drawn. 1. The lines B 1, B 11, B 10, &c. making equal angles with the first and second spirals (as also B 12, B 10, B 8, &c.), are in arithmetical proportion.

2. The lines B 7, B 10, &c. drawn by the first spiral, are to one another as the arches of the circle intercepted between BA and those lines. 3. Any lines drawn from B to the second spiral, as B 18, B 22, &c. are to each other as the aforesaid arches, together with the whole periphery added on both sides. 4. The first spiral space is to the second spiral space as 1 to 3. And 5. The first spiral line is equal to half the periphery of the first circle; for the radii of the sectors, and consequently the arches, are in a simple arithmetical progression, while the periphery of the circle contains as many arches equal to the greatest; whereas the periphery to all those arches is to the spiral lines as 2 to 1.

SPIRAL, in architecture and sculpture, implies a curve that ascends, winding about a cone or spire; so that all the points thereof continually approach the axis. It is distinguished from the helix, by its winding about a cone, whereas the helix winds in the same manner round a cylinder.

SPIRALS, proportional, are such spiral lines as the rhomboid-lines on the terrestrial globe, which because they make equal angles with every meridian, must also make equal angles with the meridians in the stereographic projection on the plane of the equator; and therefore will be, as Dr. Halley observes, spontaneous spirals about the polar point. See RIBBON.

SPIRITS, ardent. See ALCOHOL. SPIRITUALITIES of a bishop, are the profits that he receives as a bishop, and not as head of parliament; such are the duties of his vocation, presentation-money, what arises from the institution and ordination of priests, the income of his jurisdiction, &c. See SPIRIT, or CUCKOW SPTT. See CADE.

SPLENUM, a genus of plants belonging to the class of cryptothalia, and order of muscit. The anthere are cylindrical, and grow on a large coloured apophysis or umbiliculum. The calyptra is caducous. The flower-stalk grows on a short peduncle. There are six species, the rubrum, luteum, sphericum, ampullaceum, vasculoso, angustatum. See SPIRIT. See SALVIA. See SPILEN. See SPLEEN.

SPlicing, in the sea-language, is the twisting the ends of two cables or ropes, and working the several strands into one another by a field, so that they become as strong as if they were but one rope, &c.

SPONDEE, spoudaine, in ancient poetry, a foot consisting of two long syllables, as omnes. Some give the appellation spodinai to verses composed wholly of spondees, or at least end with two spondees; as, Const., alique occults Pythia aganna circumspect.

SPONDIAS, hog-plum, a genus of the decandria pentagynia class of plants, the flower of which consists of five ovated, plane, and patent petals; and its fruit is an oval berry, containing four nuts in each cell. It is called mombin by Pliny. There are four species, trees of the West Indies.

SPONDYLYUS, a genus of testaceous mussels. The generic character is, a mollusc; shell tetthy; shell hard, solid, with unequal valves; one of the valves convex, the other rather flat; hinge with two recurved teeth, separated by a small hollow. There are four species. The gregarious, which has a shell slightly curved and spinous, inhabits the Indian and other seas, and is found in infinite varieties as to size, thickness, and colours; sometimes entirely purple, orange, white, or bluish-green; sometimes striped with various streaks. See Plate Nat. Hist. fig. 373.

SPONGIA, sponge, in natural history; a genus of animals belonging to the class of vermes, and order of zoophyta. It is fixed, flexible, and very torpid, growing in a variety of forms, composed either of reticulated fibres, or masses of small spines interwoven together, and clothed with a living gelatinous flesh, full of small mouths or holes on its surface, by which it sucks in and abstracts its nourishment.

Fifty species have already been discovered, of which 10 belong to the British coasts. 1. Oenula, see Plate Nat. Hist. fig. 374, or branched sponge, is delicately soft and very much branched; the several branches are covered with a greenish, prickly, and often united to
SPONGES, or EQUIVOCALE GENERATION. See EQUIVOCALE GENERATION.

SPROUT, or EQUIVOCALE GENERATION. See EQUIVOCALE GENERATION.

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in immense pressure; while the heat may be continued to a considerable degree in the cavity, without doing any alteration in the formable phenomenon of a volcanic fire. It must be acknowledged that it is in volcanic regions, that tepid waters are found in the greatest quantity; and it is in these that they display the most striking phenomena. At Laugavarn, a small lake, two days journey from mount Hecla, in Iceland, there are hot spouting springs, one of which throws up a column of water to the height of twenty-four feet. A mixture of mud and some-almost solid are always boiled to pieces, in six minutes, in one of these springs. At Geyser in the same island, there are forty or fifty spouting springs within the compass of three miles; in some the water is impregnated with clay, and white in its appearance; in some, where it passes through a fine ochre, it is as red as scarlet; in some it spouts forth in a continued stream; in others, at intervals like an artificial jet-d'eau. The largest which Von Troll observed had an aperture nineteen feet in diameter, through which the water spouted, at intervals, nine or ten times a day; round the top of it is a basin, which, together with the pipe, is in the form of a cauldron; the margin of the basin is nine feet higher than the conduit, and its diameter fifty-six feet. The water was thrown up in an immense column, at different times, to the height of from thirty to sixty feet, and returned to the height of ninety-two feet; previously to this explosion the earth began to tremble in three different places, and a noise was heard like a battery of cannon.

Another writer states, that at Geyser, in Iceland, there springs up a hot water, which upon cooling, deposits silicious earth; and that of this very water it has formed for itself a crater, in which columns of water, of a stupendous bulk, after they have been thrown to the height of ninety feet and upwards, fall, and are again received. The heat of the water during the explosion cannot be measured; but after it has risen and fallen through a stratum of earth, it is thick enough to raise the water to 212°, which evinces that the heat in the bowels of the earth must be much more intense; and at this we shall cease to wonder when we consider, that in some parts of Africa a subterraneous fire acts upon the water in caverns closed up by very thick strata of stones, so apparatus far more effective than Papin's digester.

The crater was at first unobstructed, and is daily strengthened, by silicious earth, which quits the monument on its being cooled, falls down, and, being in somewhat like a soft state, concretes. About sixty yards from the shore of the island of Hecla, at a place called St. Angler, a column of boiling water bubbles on the surface of the sea with great force, and communicates its heat to the water of the sea near it. It boils in winter and summer, and is of great use to the inhabitants in boiling their planks for ship-building, &c. The fishermen also frequently employ this curious cauldron to boil their fish.

Near the shore of this island sir William Hamilton found, when bathing in the sea, many spots where the sand was as thin as tinfoil, and under his feet as to oblige him hastily to retire.

There is also a boiling spring near Viterbo, in the Roman state, called the Ballicante. It is a circular pool of about sixty feet in diameter, in the middle of which there is a conical figure of which the water is constantly boiling. It is situated in a plain surrounded by volcanic mountains. A stone concretion floats on the surface of the pool, which being carried off by the superfluities of water, is deposited, and is constantly forming a tub of tuffa, of which the soil all around the pool is composed.

These fountains are best accounted for by supposing the pipe or conduit to communicate with a large reservoir of water, which being subject to the influence of the volcanic fire, the steam generated in the reservoir by the boiling of the water acts forcibly on the water in the shaft or pipe, and ejects it by its elastic force in the form of a fountain, which will act with more or less vigour according to the degree of heat, and according to the resistance which the water encounters in its passage.

The most singular circumstance is the number of these springs which are found in almost every country; and even in those countries which have long ceased to be volcanic. England itself has its tepid springs, and those of Bath, Buxton, &c, are well known. Camden mentions, a well near Wigan, in Lancashire, which was called the burning well. It is said, when it is in its suface, a flame was excited like that of ardent spirits set on fire, and the heat and inflammation thus excited would continue sometimes for the space of a whole day, and were sufficient to boil eggs, and cause the water to evince the well as having lost its inflammable property in his time; but he notices two other of a similar description, one in the same neighbourhood, and another in Shropshire. Should, then, the fact be as it is related by Camden, the philosophic reader will not find it difficult to explain the cause. The country where the well is, or was shutted, abounds in coal. The well is therefore impregnated with naphtha, or some bituminous vapour; this, upon the application of an ignited body, is capable of inflammation, and can even communicate a considerable portion of heat to the water of the well itself. There is no proof, however, that the Buxton spring above mentioned is impregnated with any bituminous matter, though coals are plentiful in the neighbourhood; and as these waters contain a small portion of iron, there is reason to suppose them to be capable of exciting pyrites, or combustible phosphorus, with a latent subterraneous fire. On the whole we are not sufficiently acquainted with the internal parts of the earth to account satisfactorily for these and other phenomena of a similar kind; and whatever is advanced in the way of theory on these topics should be advanced with becoming diffidence, and rather with a view of exciting the attention and curiosity of others, than for the purpose of establishing a system unsubstantiated by experiment, or building a reputation on the fallible basis of mere hypothesis. See Waters, Mineral.

Spring, in mechanics, denotes a thin piece of tempered steel, or other elastic substance; which, being wound up, serves to put several machines in motion, and several others to keep in action, in endeavour to unbalance itself: such is the spring of a clock, watch, &c.

The spring of a lock, gun, or pistol, is a piece of steel, violently bent; which, being at liberty, heats back the bolt of the lock, or strikes down the cock.

SPRINGING, of a nest, in the sea language, is when it cracks, but is not broken in any part of it; as the partners, bounds, &c.

SPRUCE-BEER, a cheap and wholesome liquor, which is thus made: Take of water sixteen gallons, and boil the half of it. Put the water thus boiled, while in full heat, to the cold part, which should be put into a barrel, or other vessel; then add sixteen pounds of treacle or molasses, with a few table-spoonfuls of the essence of spice, stirring the whole well together: add half a pint spirits, mixtures on each side, let it sit, with thebung-hole open, for two days, till the fermentation is abated. Then close it up, or bottle it off, and it will be fit for being drunk in a few days afterwards. In North America, and perhaps in other countries, where the black and white spruce-tars abound, instead of adding the essence of the spice at the same time with the molasses, they make a decoction of the leaves and small branches of these trees, which is equally good. It is a powerful antiscorbutic, and may prove very useful in long sea voyages.

SPUNGE. See SPONGIA.

SPRUNGING, in gunnery, the cleaning a gun's inside with a sponge, in order to prevent the sparks of fire from remaining in it, which would endanger the life of him who should load it.

SQUALLS, the shark, a genus of fishes of the order nantes. The generic character is; mouth situated beneath the anterior part of the head, with numerous teeth disposed in rows, spirals, or small hooks on each side, in most species five in number, of a semilunar shape. Body oblong, somewhat cylindrical. The animals of this genus are said to be much rarer in the Baltic than in any other sea; they are viviparous, and are observed to produce more young at a time than the rays, but each included, as in those fishes, in a quadrangular capsule or involucrum, each extremity of which is extended into a long, contorted, carinated, and thread of white. Many of the sharks are said to emit a phosphoric light during the night; they are chiefly of a solitary nature, and, in general, devour with indiscriminating voracity, almost every animal, whether in water or land, and some few species however are observed to feed chiefly on fish and other marine vegetables. There are 34 species, the most remarkable of which are,

Squalus carnaries. White shark. The great or white shark, so remarkable for its vast size and its powers of destruction, is an inhabitant of most parts of the globe; though much more frequently seen in the warmer than in the colder latitudes, and is said to reside principally in the depths of the ocean, whence it rises at intervals in order to prowl for prey, and is considered as the most voracious of all the inhabitants of the deep. It arrives at the length of more than thirty feet, and is of a somewhat thicker or broader form than most of the genus: the head is of a deformed shape, and broad; terminating in front in an obtusely pointed snout; the mouth is vast, and furnished on the margin of each jaw with from three to six rows of strong flat, triangular, sharp-pointed, and finely serrated teeth, which are so imbedded in their investing cartilages as to be either raised or depressed at pleasure: the tongue is broad, thick, and
SQUALLUS.

3. Squalus caulator. Spotted shark. Lesser spotted dog-fish. Habit rather slender; length from two to three feet; head large; snout prominent, and slightly pointed; skin rough; body cylindrical; colour pale-brick-red, marked with dusky spots, small, rounded, blackish, or dusky spots; teeth in a shelf of about thirteen young at a time, is very numerous on our own coasts, and very injurious to the fisheries; the liver is said to be highly nutritious, causing long-continued stupor, succeeded by an universal itching, with a total desquamation of the cuticle.

4. Squalus stellaris. Rock shark, or greater spotted dog-fish. The general colour of this animal is a reddish grey, with round, unal, blackish spots scattered over the whole body. The male and female are said to differ in the disposition of the parts, the male of the European seas, generally frequenting rocky places, and preying on various mollusca and crustacea. Its skin is used in commerce for the same purposes as those of other small sharks, and the fish is esteemed somewhat more edible than that of the former species. In Edwaid's figure of the young of this fish, the body is represented as barred across the back with several broad bands.

5. Squalus acudatus. Occelated or barred shark. Length about two feet and a half, colour greyish-brown, with a few scattered dusky spots; back crossed by a few dusky bands; abdomen greenish-grey; teeth numerous, small, sharp, compressed, and dilated at the base; pectoral fins rounded, and of a dusky or blackish colour, edged with white; first dorsal fin situated between the pectoral fins, and the anal fin on each side of the body. Native of the southern Pacific; observed about the coasts of New Holland during the first voyage of Sir Arch. Banks.

6. Squalus acus. Hammer-headed shark. Perhaps the most deformd of all the marine animals. Length from five to fifteen or seventeen feet; habit rather slender; body subcylindrical; head dilated on each side to a great extent; the eyes, which are very large, being placed at each extremity; mouth beneath, as in other sharks; teeth sharp, denticulated on each side, and disposed in three rows in each jaw; first dorsal fin rather large, of a somewhat falcated shape, and placed towards the upper part of the back; the second much smaller, and situated near the tail, which is rather short than long, and lobed beneath, the fin running on nearly as far as the vent; colour brown above, paler or whitish beneath. Native of the Mediterranean and Indian seas, where it is scarcely less voracious and formidable than even the white shark itself; attacking such as are accidentally exposed to its pursuit, and threatening to continue its gain in its neighbourhood. It is observed about the coasts of the southern islands, and particularly of Otaheite, where the natives, trusting to their dexterity in swimming, appear to
hold it in but little dread, since they bathe without hesitation in places known to be infested by it. This fish is said to grow about ten or fourteen young at a birth. See Plate Nat. Hist. fig. 375.

7. Squalus pristis. Sussex-mouthed shark. The snout is a large species of shark, growing to the length of fifteen feet or more: the head is slightly flattened at the top, and is produced in front into a very long, flat, straight, and slightly tapering bony snout, covered, like the rest of the animal, by minute scales; along the edges-project a great number of very strong, large, slightly flattened, and very sharp-pointed toothlike processes: the mouth, as in other sharks, is placed beneath, and is furnished on the edges of the jaws with several rows of small and somewhat blunt teeth, paving the lips, as in some of the rays. The habit of the fish is rather slender; the body convex above, and somewhat flattened beneath; the dorsal fin placed as in the squalus acanthias and several others. The whale is an inhabitant of the Mediterranean and northern seas, and was known to the ancient writers by the title of pristis. In the embryo animal the edges of the snout are observed to be bristled or pointed, but slightly attenuated by the projection of the incipient teeth or processes, which are supposed to be of very quick growth.

SQUARE. See Geometry.

Square number, the product of a number multiplied into itself.

Square, in the military art, a particular formation into which troops are thrown on critical occasions; particularly to resist the charge of cavalry.

Square, solid, is a body of foot, where both ranks and files are equal. It was formerly held in great esteem; but when the prince of Nassau introduced the hollow square, this was soon neglected.

Square, hollow, is a body of foot drawn up, with an empty space in the centre, for the colours, drums, and baggage, facing every way to resist the charge of the horse.

Square, a square which is not at right angles, but represents the figure of an oblong, whose sides are unequal. Thus as eight companies of equal numbers would form a perfect square, ten make an oblong.

Square, a square whose sides are equal and at right angles. The perfect square, in the formation of troops, seems best calculated for military movements and arrangements. Battalions, for instance, which are composed of eight companies, with one hundred rank and file in each, are equal to every species of disposition. It is upon this principle, we presume, that the French have distributed their infantry. British regiments, on the contrary, consist of ten companies, and are so composed that no square of this kind can be formed. This is manifestly a defect in our system. It is indeed remedied by the grenadier and light infantry companies being occasionally detached, or cast into separate battalions; so that the remaining companies, by being told off, are brought to eight equal parts.

Square root. See Algebra, and Arithmetick.

SQUIREL. See Scirrus.

STACHYS, a genus of plants belonging to the class of dianthae, and order of gynohermia; and in the natural system arranged under the 42d order, verticillata. The upper lip of the corolla is arched, the lower lip reflexed, the 4 long and pointed lacinia is margined. The stamine, after shedding the farina, are bent towards the sides. There are 24 species. Four only are natives of Britain; viz. 1. Sylvatica, hedge-nettle. The plant is hairy all over, erect, a yard high, and branched. The whole plant has a strong fetid smell. It grows commonly in woods and shady places, and flowers in July or August. It will dye yellow. 2. Palustris, crown's alliace. The roots are white and succulent. The stalk is branched at the bottom, and two or three feet high. The flowers are red or purple. This plant has a fetid smell and bitter taste, and is reckoned a good vulnerary. It grows on the sides of rivers and lakes, in low moist grounds, and sometimes in corn-fields.

3. Germinaca, base horehound. The stem is downy, and about two feet high. The leaves are white, downy, wrinkled, and indented. The flowers are white, purplish within, and grow in multilobed, wobby. It grows in England. 4. Arvensis, corn-stachys, petty ironwort, or all-heel. The stalk is ten or twelve inches high, square, branched, and hairy. It grows in corn-fields, and grows from June to August.

STADIUM, an ancient Greek long measure, about a furlong.

STELHENIA, a genus of plants belonging to the class of Helenea, and order of polygonia; and in the natural system arranged under the 40th order, composite. The receptacle is paleaceous, the calyx being very short; the pappus is branchy, and the seed is oval. There are 10 species: 1. Graphioides, dubia, arborescens, fruticosa, ilicifolia, corymbosa, chamaemelum, imbricata, spinosa, and laetha.

STAG. See Ceruvi.

STAG-BEETLE. See Lucanus.

STALACTITIF, ostalactagnia, stony concretions resembling icicles, in natural history, or crystalline spars formed into oblong, conical, round, or irregular bodies, composed of various minerals, and usually formed hanging in form of icicles from the roofs of grottoes, &c. See Star.

Of this class there are various species: as the hard, white stalactite; the white, shaggy stalactite; the stalagmite, a soft, shaggy, and the line stalactite. See Plate Nat. Hist. fig. 384.

STALAGMITIS, a genus of the monosee order, in the polygonia class of plants; and in the natural method ranking under the 38th order, triconce. The calyx is either quadriflory or hexaphyllous; the corolla consists of four or six petals; the receptacle is fleshy, and somewhat square-shaped; the filaments are about 30. In the hemaphrodite flower the style is short, thick, and erect; the fruit is a berry of a globular shape, unilocular, and browned with the stylum and stigma: they contain three oblong jointed triangular seeds. Of this there is only one species, viz. the cambo-giodes, a native of the East Indies and of the warmer parts of America. From this plant is obtained the gutta cambugis, or gum gamboge of the shops. See Gum resinis, and Gamboge.

Till very lately botanists were at a loss for the true nature of the plant which yields this gum. Koening, a native of Ireland, and an excellent botanist, travelled over a great part of India, and collected a great number of new plants, and among the rest the stelagmiatis. These he bequeathed to Joseph Banks.

STAMINA. See Botany.

Stamina, in the animal body, are defined to be those simple original parts, which existed first in the embryo. See Physiology.

STAMP DUTIES, a branch of the public revenue, raised by requiring that all deeds or documents, in order to be valid, shall be written on paper or parchment bearing a public mark or seal, for which a tax is paid.

Stamp-duities are said to have originated in Holland, and were introduced into England in 1671, by "an act for laying impositions on proceedings at law" these duties were very numerous, and were at first granted for nine years; they were afterwards continued for three years from 1680, when, in consequence of the unfortunate jealousies between the crown and parliament they were suffered to expire. It was not long, however, before the necessities of the government caused this mode of taxation to be again resorted to as a source more certain than any other of the taxes which then existed: an act was accordingly passed in 1694, for imposing several duties upon vellum, parchment, and paper, which may be considered as the commencement of the present stamp-office, as a particular set of commissioners were then appointed for managing the duties; and about four years after, several new duties were granted, to continue for ever, to which numerous additions have at different times been since made.

The total gross produce of the stamp-duities, in the year 1713, was 107,796l., the charges of management of which amounted to 14,206l., leaving a net produce of only 93,483l. In 1723, the net produce had increased to 130,406l.; and it seldom exceeded this amount till 1757, when some new stamp-duities were imposed, which the produce of this revenue was increased to 267,726l. in 1766 it amounted to 283,666l.; and no material additional were made till towards the conclusion of the American war. In 1785, a number of stamp-duities were imposed on various articles, although not actually collected by means of stamps, was classed with the stamp-duities. In 1784, additional duties were laid on gold and silver plate. In 1758, duties were laid on post-horses, grooms, medicines, gauzences, attorneys' licences, and pawnbrokers; all of which were deemed stamp-duities, and considerably augmented the annual amount. But a far greater increase took place in the course of the war which began in 1793, during which new stamp-duities were imposed on receipts, bills of exchange, attorneys' articles, sea-insurances, licences to wear hair-powder, house-dealers' licences, legges, hats, stage-coaches, deeds, armorial bearings, small notes, medicines, and several other articles, which soon increased this branch of the revenue to more than double its former amount; and it is a mode of taxation which is in general so difficult to evade, and with such a comparatively small expense in collecting, that there can be little doubt that it will be extended as far as possible.

Total gross produce of the stamp-duities of
STAMP DUTIES.

Great Britain, in the year ending 5th January 1800.

England and Wales £3,931,616 8 0
Scotland 266,699 4 3

£4,194,315 12 10

This amount is subject to various deductions, as, the charges of management, discounts, and other parliamentary allowances, the cost of parchment and paper for the country distributors, an allowance to the two universities on almanacs, and many incidental expenses, which reduced the actual nett produce paid into the exchequer to the following sums:

England and Wales £3,675,783 5 2
Scotland 246,170 17 2

3,918,964 2 4

The expense of collection amounted to 3l. 5s. per cent. on the gross revenue, or 3l. 9s. 6d. per cent. on the nett produce, which is considerably less than the management of the bills of the public income amounted to a few years back.

The total gross produce of the stamp-duies of Ireland for the year ending 5th January 1806, was 501,043. 9s. 10d., and the nett sum paid into the exchequer 536,533. 11s. 14d.; the expense of collection amounted to 3l. 0s. 1d. per cent. on the gross produce, or 3l. 7s. 0d. per cent. on the nett produce.

The following are the stamp-duies at present in force:

Actions, entry of, in inferior courts, 40s. and upwards, 1s. 6d. 12 Geo. c. 22.


Adjudications, appraisings, charter, resignation, clare-counter, cognizance of heirs, heritable right, confirmation, novadumas, principal and original instrument of surrender, return, saihne, and service in Scotland, 9s. 6d. 37 Geo. III. c. 90.

Administration. See Probate.

Admiralty, or cinque-ports. Any answer exhibited in these courts, 7s. 41 Geo. III. c. 86.

Any libel, allegation, deposition, or inventory, exhibited in the courts of admiralty or cinque-ports, 5s. 37 Geo. III. c. 90.

Any copy of any citation, monition, or answer, in the courts of admiralty or cinque-ports, 5s. 37 Geo. III. c. 90.

Any copy of any libel, allegation, deposition, or inventory, exhibited in the courts of admiralty or cinque-ports, 5s. 37 Geo. III. c. 90.

Any personal decree, warrant, or monition, in any court of admiralty, or the cinque-ports, or any copy thereof, 10s. 27 Geo. III. c. 90.

Any sentence given in the courts of admiralty or cinque-ports, or any attachment made out by the same, or relaxation thereof, 11s. 37 Geo. III. c. 90.

Any sentence or final decree exhibited in the courts of admiralty or cinque-ports, or any copy thereof, 4s. 37 Geo. III. c. 90.

Admission into corporations or companies, 5s. 37 Geo. III. c. 90.

Admission into any inn of chancery, 4l. 5s. 57 Geo. III. c. 90.

Admission into any of the four inns of court, 10s. 4s. 37 Geo. III. c. 90.

Admittance of fellow of college of physi-
bound to serve as a clerk, in order to his admission as a solicitor or attorney, the additional duties following, viz. For every piece of vellum, parchment, or paper, upon which shall be written any such contract, whereby any person shall become bound to serve as a clerk as aforesaid, in order to his admission as a solicitor or attorney in any of the courts at Westminster, there shall be charged a stamp-duty of 10l.

And in order to his admission as a solicitor or attorney in any of the courts of great session in Wales, or in the counties palatine of Chester, Lancaster, or Durham, or in any court of record in England, holding pleas to the amount of 40l. and not in any of the said courts at Westminster, there shall be charged a stamp-duty of 50l.

Above 30l., and not exceeding 50l., 1s. 6d. 41 Geo. III. c. 10.

Bills of exchange, promissory or other note, draft or order, where the sum amounts to 40l. and does not exceed 6l., 2s. 41 Geo. III. c. 10.

Above 6l., and not exceeding 10l., 10s. 41 Geo. III. c. 10.

Above 10l., and not exceeding 20l., 2s. 6d. 41 Geo. III. c. 10.

Bills and notes not exceeding 200l. value, and for every bill of exchange, promissory or other note, draft or order, payable on demand, or otherwise, where the sum shall exceed 200l., there shall be charged 4s. 41 Geo. III. c. 10.

Foreign bills of exchange, drawn in sets according to the custom of merchants, where the sum shall not exceed 100l., 1s. 6d. 41 Geo. III. c. 10.

Above 100l., and not exceeding 200l., 1s. 6d. 41 Geo. III. c. 10.

And exceeding 200l., 3s. 6d. 41 Geo. III. c. 10.

Bill of lading, 2s. 37 Geo. III. c. 90.

Bill of Middlesex. See Original Writ.

Bills, answers, replications, rejoinders, demurrers, interrogatories, depositions taken by commissions, and other proceedings in courts of equity, 2s. 6d. 23 Geo. III. c. 58.

Bonds (except such as are given as security for money), 15s. 41 Geo. III. c. 86.

Bonds, and bonds on wills or administrations not exceeding 20l., and bonds given by the widow of any soldier or sailor, are exempt from the duty imposed by 37 Geo. III. c. 90.

Bonds given as security for payment of money, if not above 100l., 15s. 41 Geo. III. c. 86.

Above 100l., and under 500l., 37 Geo. III. c. 90.

If of 500l. or upwards, 1l. 10s. 37 Geo. III. c. 90.

When the amount shall be of the value of 100l. or upwards, 2l. 37 Geo. III. c. 90.

When the amount shall be of the value of 200l. or upwards, 3l. 37 Geo. III. c. 90.

When the amount shall be of the value of 500l. or upwards, 5l. 37 Geo. III. c. 90.

**STAMP DUTIES.**

Briefs for collecting charitable beneficence, &c. 4l. 23 Geo. III. c. 58.

Copies writ. See Original Writ.

Cards per pack, 2s. 6d. 41 Geo. III. c. 86.

Catalogue. See Inventory.

Certificate of barrister in any of the courts of Great Britain, 3l. 37 Geo. III. c. 90.

Certificate or docket for drawback. 4s. 37 Geo. III. c. 90.

Certificate of marriage, except of seamen’s widows, 5s. 3 W. III. c. 21.

Certification. See Register, Registry, Sacrament.

Certiiorari, writ of error, or writ of appeal, except to delegates, 10s.

Certificate to kill game, 3l. 8s. See Game.

Certificate of appointment of game-keeper, 10s. 6d.

Certificate for wearing hair-powder, 1l. 1s. 41 Geo. III. c. 69.

Certificate for attorneys. See Attorney.

Certificate. See Adjudication.

Charter. See Deeds.

Chalkey-children’s indulgence. See Apprentice.

Citation or monition, libel or allegation, deposition or inventory, exhibited in any ecclesiastical court, and all copies thereof (except copies of citation or monition, for which see Answer), 2s. 6d. 23 Geo. III. c. 58.

Clare-constat. See Adjudication.

Clerk. See Admittance.

Clerks to attorneys. See Attorneys’ Clerks.

Cognition of heirs. See Adjudication.

Collation, donation, or presentation to any ecclesiastical dignity, promotion, or benefice, of the yearly value of 10l. and upwards in the King's books, 12l. 37 Geo. III. c. 90.

And to any other benediction, dignity, or spiritual or ecclesiastical promotion, 6l. 37 Geo. III. c. 90.

Commission, ecclesiastical, 5s. 10 W. III. c. 23.

Common bail in the courts at Westminster, great sessions, or county palatine, 1s. 6d. 32 Geo. II. c. 35.

Confirmation. See Adjudication.

Contract. See Deed.

Conveyance, surrender, or grants of offices, release, or other deed inrolled in any court of record, or by any custos rotulorum, or clerk of the peace, 1l. 37 Geo. III. c. 90.

Copy of deaths, 3d.

Copy of depositions in chancery, or other court of equity at Westminster, copy of any bill, answer, plea, demurrer, replication, rejoinder, interrogatories, or other proceedings whatsoever, in such courts of equity, 3d. 37 Geo. III. c. 66.

Copies of wills, 6d. 37 Geo. III. c. 90.

Any copy purporting to be a true copy, or attested to be a true copy, of any indenture, lease, or other deed, or any part thereof, for the security or use of any person, being a party to the same deed, and not having the custody of the original, or where such copy shall not be made in lieu of such original, 6s. 6d. 40 Geo. III. c. 72.

And the number of stamps required to be used for such copies of deeds is, one for every ten common law-sheets of 72 words: but if after a calculation of that number, there shall remain a number of words less in the said ten common law-sheets, no further stamp is required for the excess.

And by 39 and 40 Geo. III. c. 72, from August 1, 1800, in lieu of the stamp-duty of 6s. 8d. upon the copy of any deed, when it is for the use of another, other than any of the parties to the same deed, and who shall not have the custody of the original, or where such copy shall not be made in lieu of such original, there shall be paid a stamp-duty of 6d. on every piece of vellum or parchment, or sheet or piece of paper, on which any such copy shall be written.

And the number of stamps to be put upon every copy, is to be calculated according to the next act.

And by 39 and 40 Geo. III. c. 84, copies of indentures or other deeds, liable to the duties granted by 37 Geo. III. c. 90, may be stamped within sixty days after the date of the attestation, or payment of the duty only.

Copy of any surrender of, and admission to, any custom-right estate, not beingcopy- hold, which shall pass by surrender and admission only, and which shall not pass by deed, within England, Wales, and town of Berwick upon Tweed, 12s. 41 Geo. III. c. 86.

Copyhold estate. See Surrender.

Covenant, writ of. See Writ of Covenant.

Debenture for drawback. See Certificate.

Deed. See Indenture, written, joined, rejoinder, demurrer, or other pleading whatsoever, in any court of law at Westminster, or in any of the courts of the principality of Wales, or in any of the counties palatine of Chester, Lancaster, or Durham, and copies thereof, 3d. 32 Geo. II. c. 35.

Declaration, plea, replication, rejoinder, demurrer, or other pleading whatsoever, in any inferior court of law, and copies thereof, 2d. 10 W. III. c. 15.

Decree, personal. See Warrant.

Declinum potestas. See Original Writ.

Deeds. Any indenture (except parish-indentures), lease or deed-poll; and any charter-party, release, contract, or other obligatory instrument; or any procurement of letters of attorney; for every 15 common law-sheets, of 72 words each, 15s. 41 Geo. III. c. 86.

And moreover, by 87 Geo. III. there shall be paid upon every deed which shall be made after August 1, 1797, an additional stamp-duty of 10l. over and above all duties now payable on the vellum or paper wherein such deeds may be engraved (but this is upon the first skin only), the provisions of this act being as follows:

It shall not extend to any bond or letter of attorney, bearing date before Aug. 1, 1797.

Also it shall not extend to any indenture of apprenticeship, where a sum not exceeding 10l. shall be given; nor to any lease for not exceeding twenty-one years, the full and improved value whereof, and rent reserved thereby, shall not be more than 10l. nor to any lease for lives, or years determinable on lives, where the fine shall not exceed 20l., nor the rent reserved 40l.

But by 39 and 40 Geo. III. c. 42, the above duties shall extend to every deed, which by lease may form, or is intended to form, a part of any conveyance of lands or tenements, whereby a greater interest in the same shall be conveyed than a term of twenty-one years, whatever may be the value thereof.

Nor shall any deed be subject to the payment of any greater duty than the sum be
Grant of office or employment above 50l. a year, 6l. 12 Anne c. 9.
If above 100l. (to be calculated on the salary, fees, and perquisites), 12l. 37 G. 3. c. 90.
Habeas corpus, 5s. 5 W. 3. c. 21.
Huts. Duty on every hat of 4s. or under, 3d. 30 G. 3. c. 12.
Above 4s. and not exceeding 7s., 6d. 36 G. 3. c. 12.
Above 7s. and not exceeding 12s., one shilling. 36 G. 3. c. 12.
Above 12s. and upwards, 2s. 36 Geo. 3. c. 12.
Heritable right. See Adjudication. Horses. See Race-horses.
Indenture. See Deed.
Indentures, parish or charity. See Apprentices.
Institution, or licence ecclesiastical, in England, Wales, or Berwick upon Tweed (except licences of any ecclesiastical court or ordinary, appointing any stipendiary curate, in which the annual amount of the stipend shall be inserted), 11. 10s. 37 G. 3. c. 90.
Instrument obligatory. See Deed.
Insurance of ships, or goods from fire, 2s. per cent. 37 G. 3. c. 90.
Insurance upon any ship, goods, or merchandise, when the sum shall amount to 100l. five shillings, 41 G. 3. c. 10, and so progressively for every sum of 100l. insured. And where the sum to be insured shall not amount to 100l. a like duty of five shillings. 41 G. 3. c. 10.
And where the sum to be insured shall exceed 100l. or any progressive sum of 100l. each, by any fractional part of 100l., a like duty for each fractional part of 100l., five shillings. 41 G. 3. c. 10.
And upon every insurance where the premium shall not exceed the rate of 20s. there shall be paid where the sum shall amount to 100l. a duty of 2s. 6d. ; and so progressively for every sum of 100l. so insured. 41 G. 3. c. 10.
And where the sum to be insured shall not amount to 100l. a like duty of 2s. 6d. ; and so progressively for every sum of 100l. so insured. 41 G. 3. c. 10.
Which duties shall be payable by the assured.
This does not extend to any insurance of houses, furniture, goods, wares, merchandizes, or other property, from loss by fire, already subject to duty, nor any insurance on lives. 41 G. 3. c. 10.
Interrogatories. See Bills, copy.
Inventories or catalogue of furniture with reference to any agreement, 5s. 37 Geo. 3. c. 60.
Inventory in ecclesiastical courts. See Citation.
Judgment. See Record.
Lading. See Bill of Lading.
Lattices. See Original Writ.
Lease of land, house, &c. See Deed.
Lease for years, or other profits, not particularly charged, under the great seal, seal of exchequer, duchy or county palatine of Lancaster, or privy seal, 10l. 37 Geo. 3. c. 90.
Of the value of 20l. or under, 2s. 6d. 20 G. 3. c. 28.
Above 20l. and under 100l., five shillings. 50 G. 3. c. 58.
For 100l. and upwards, 17. 20 G. 3. c. 28.
Any other lineal descendant, or the father, or other lineal ascendant, or the husband of the deceased, to pay for a legacy or share of a personal estate.
Of the value of 20l. or under, 5s. 23 G. 3. c. 58.
Above 20l. and under 100l. ten shillings. 23 G. 3. c. 58.
For 100l. two pounds. 23 G. 3. c. 58.
For 200l. three pounds. 23 G. 3. c. 58.
For 300l. four pounds. 23 G. 3. c. 58.
And for every further sum of 100l. two pounds. 29 G. 3. c. 51.
All collateral relations, and strangers, to pay for a legacy or share of a personal estate, under the value of 20l. five shillings. 23 G. 3. c. 58.
Letter of attorney for transfer or disposal of stock, or any other purpose, fifteen shillings. 41 G. 3. c. 86.
Letters of administration. See Probate.
Letters of mart. See Mart.
Letters patent. See Grant.
Libel. See Citation.
Licence ecclesiastical. See Institution.
Licence to pawnbrokers within the bills of mortality, 10l. per annum.
Out of the bills, 5l. per annum. 25 G. 3. c. 48.
Licence for marriage, 5s. 5 W. 3. c. 21.
Licence for selling quack medicines. See Medicines.
Licence for retailing beer and ale, 2l. 2s.
Licences for spiritual liquors, sweets, and wines, to be taken out annually at the excise-office.
Licence for a mad-house, 5s.
Licence to keep lying-in hospitals, 5s.
Licence to keep lottery-office, in London, Edinburgh, or Dublin, 50l. elsewhere 10l.
Mandate. See Original Writ.
Marine Insurance. See Insurance.
Marriage licence. See Licence.
Marriage, letters of, 11. 10s. 37 G. 3. c. 90.
Matriculation in the universities, 8s. 37 G. 3. c. 90.
Medicines. See Quack Medicines.
Middlesex, bill of. See Original.
Monition. See Citation, Warrant.
Newgate, and general circuit pardon, 4l. 23 G. 3. c. 58.
Newspapers. Every newspaper, or paper containing public news, intelligence, or occurrences, contained in half a sheet or less, 3d. 37 G. 3. c. 90.
Being larger than half a sheet, and not exceeding a whole sheet, 4d. 37 G. 3. c. 90.
Nisi prius. See Record.
Notary. See Admittance, and Attorney.
Notarial acts. Any protest or notarial act whatever, 4s. 37 G. 3. c. 90.
Note, promissory. See Bills of Exchange, Novellanus. See Adjudication.
Obligatory instrument. See Bond.
Officer of any court. See Admittance.
Order for payment of money. See Bills of Exchange.
Order in any court of Westminster, and copy, 1s. 6d. 32 G. 2. c. 35.
Original Writ (unless pro capite), subpena, bill of Middlesex, latitut, writ of capias, quo warranto, writ of debitum potestatem, every
other writ, process, or mandate, for 40s, or upwards, 5d. 3d. 35 Geo. 3. c. 30.

Pamphlets of half a sheet, or less, 1d. per sheet, for every sheet in one copy of every pamphlet not exceeding six sheets in octavo, or a less size, twelve sheets in quarto, and twenty in folio, 2s.

Pardon of corporal punishment, crime, fornication, idiocy, or money above 100l., twelve pounds. 37 Geo. 3. c. 90.
Pardon. See Newgate Pardon.

Patent, charter, or liberties. See Appen-

dice.

Passports, 2s. 37 Geo. 3. c. 90.

Patents. See Grant.

Personal decrees. See Warrant.

Plate. All gold plate made or wrought in Great Britain, except watch-cases, for oz-
troy, 10s. 37 Geo. 3. c. 90.

And for every ounce troy of all silver plate, 1s. 37 Geo. 3. c. 90.

Plea at law. See Declaration.

Plea in equity. See Copy.

Pleadings in superior courts. See Bills, Copy, Registration.

Pleadings in inferior courts. See Declaration.

Policy of assurance, on house, goods, or life, on any sum not exceeding 1000l. 6s. 25 Geo. 3. c. 58.

If above 1000l., eleven shillings. 17 Geo. 3. c. 50.

But by stat. 37 Geo. 3. c. 90. the above duties on policies, so far as the same relate to policies for insuring houses, furniture, goods, wares, merchandize, or other property, from loss by fire, are repealed from and after July 5, 1797, and from that period there shall be paid in lieu thereof:

For every policy of insurance, where the sum insured shall not amount to 1000l., the sum of 3s.

And where it shall amount to 1000l. or up-

wards, 6s. These policies are exempted from the additional ten shillings duty on deeds.

Policy of assurance upon ships. See In-

surance.

Postea. See Record.

Prelate to any ecclesiastical dignity, promotion, or benefice, of the yearly value of 10l. and upwards in the king's books; 12l. 37 Geo. 3. c. 90.

And to any other benefice, dignity, or spi-

ritual or ecclesiastical promotion, 6l. 37

 Geo. 3. c. 90.

Probate of wills, or letters of administration, of any estate above 24l. and under 100l., ten shillings.

If the estate is of the value of 100l. and

under 200l., two pounds ten shillings.

If the estate is of the value of 200l. and

under 600l., eight pounds. 37 Geo. 3. c. 90.

If the estate is of the value of 600l. and

under 1000l. fifteen pounds. 41 Geo. 3. c. 86.

If the estate is of the value of 1000l. and

under 2000l. thirty pounds. 41 Geo. 3. c. 86.

If the estate is of the value of 2000l. and

under 5000l. fifty pounds. 41 Geo. 3. c. 86.

If the estate is of the value of 5000l. and

under 10000l. seventy-five pounds. 41 Geo.

3. c. 86.

If the estate is of the value of 10000l. and

under 15000l. one hundred and ten pounds.

41 Geo. 3. c. 86.

If the estate is of the value of 15000l. and

under 20000l. one hundred and sixty

pounds. 41 Geo. 3. c. 86.

If the estate is of the value of 20000l. and

under 30000l. two hundred and ten pounds.

41 Geo. 3. c. 86.

If the estate is of the value of 30000l. and

under 40000l. three hundred and ten pounds.

41 Geo. 3. c. 86.

If the estate is of the value of 40000l. and

under 50000l. four hundred and ten pounds.

41 Geo. 3. c. 86.

If the estate is of the value of 50000l. and

under 60000l. five hundred and ten pounds.

41 Geo. 3. c. 86.

If the estate is of the value of 60000l. and

under 70000l. six hundred and ten pounds.

41 Geo. 3. c. 86.

If the estate is of the value of 70000l. and

under 80000l. seven hundred and ten pounds.

41 Geo. 3. c. 86.

If the estate is of the value of 80000l. and

under 90000l. eight hundred and ten pounds.

41 Geo. 3. c. 86.

If the estate is of the value of 90000l. and

under 100000l. nine hundred and ten pounds.

41 Geo. 3. c. 86.

If the estate is of the value of 100000l. and

upwards, 100l. 41 Geo. 3. c. 86.

And if any person shall assume any per-

sonal estate, without proving the will, or tak-

ing out letters of administration, within six

months after the death of the party, such

person shall forfeit 50l. to be recovered by

action or information. 37 Geo. 3. c. 90.

Proctor. See Admissit.

Quack medicines, by 25 Geo. 3. c. 79.

For every packet, box, bottle, pot, phial, or

other inclosure, containing drugs, herbs, pills,

water, essences, tinctures, powders, or other

preparation or composition whatsoever, used

or applied externally, or internally, as medi-

cines, or medicaments, for the prevention,

cure, or relief, of any disorder or complaint,

incident to, or in any wise affecting, the

human body, which shall be uttered or ven-

ced in Great Britain, there shall be charged a

stamp duty at the rates following, viz.

Where the contents of any such packet, box, &c. shall not exceed the price of 1s., there shall be charged a stamp duty of 1d. Above 1s. and not exceeding 2d. 6d.

4d.

10d. 1s.

20d. 2s.

30d. 3s.

3s. 6d.

5s. 10s.

And above 50s., 20s.

Quo minus. See Original Writ.

Race-horses. For every horse entered to

start or run for any plate, prize, sum of

money, or any thing whatsoever, 2l. 2s.

Receipts. By 31 Geo. 3. c. 25, the follow-

ing stamp duties shall be paid upon re-

ceipts:

For every piece of paper, &c. upon which

shall be written, &c. any receipt, discharge,
or acquittance for money, amounting to 40s.,
and not amounting to 10l., two pence.

Amounting to 10l. and not exceeding 20l. 4d.

20l. 8d.

50l. 1s.

100l. 2s.

200l. 3s.

500l.
The standard is usually a piece of silk one and a half feet square, on which are embroidered, fringed, tufted, or the prince or colored. It is fixed on a lance eight or nine feet long, and carried in the centre of the first rank of a squadron of horse, by the cornet.

**STANDARDS.** Belonging to the cavalry. Standards are posted in the following manner: The king's, with the right squadron; the second with the left; and the third with the centre.

In advancing to the front on foot, the advanced standards and their sergeants must not slacken their pace, or deviate from right to left, as the lieutenant-colonel or leading officer may happen to do; but if he is in their way, they must call to him, because they alone regulate the march.

The standards must always be brought to the parade by a troop, viz. by that which has its private parade nearest to head-quarters. They must be accompanied by as many trumpeters as can conveniently agree with that troop. Swords must be drawn, and the march sounded. The cornets parade, of course, with that troop to receive the standards. The standards are received by the cornets of the squadron, with swords drawn, officers saluting, and the march sounding by the remaining trumpeters. They must march off from head-quarters, and be lodged with the same form.

**STANDING,** in the sea-language, standing part of the ship's bottom, which is made fast to a ring at the ship's quarter. Standing part of a tackle, is the end of the rope where the block is fastened. Standing ropes, are those which do not run in any block, but are set taut or let slack, as occasion serves; as the sheet-stands, back-stands, &c.

**STANGENSPATH,** a sulphur of harytes, in bars: colour sometimes grey, red, or green; always crystalized. The crystals are frequently terminated by two- or four-sided summits, or six-sided prisms terminated by twelve-sided summits. Crystals very long and small, united in clusters. Longitudinal fracture, radiated cross fractures.

**STANNARIES,** the mines and works where tin is dug and purified, &c. in Cornwall, Devonshire, &c. There are four courts of the stannaries in Devonshire, and as many in Cornwall, and great liberties were granted them by several acts of parliament, in the time of Edward I. &c. though somewhat abridged under Edward III. and Charles I.

**STANZA.** See Poetry.

**STAPELLA,** a genus of the pentandria class of plants, the corolla whereof consists of a large, plane, single petal, quinquenced beyond the middle; the fruit consists of two oblong subulate follicles, made up of one valve, and containing one cell; the seeds are numerous, imbricated, compressed, and pappose. See Plate Nat. Hist. fig. 376. Of this very curious genus, there are 49 species; though only two species were known by Linnaeus, when he assembled his Species Plantarum, in 1732. They are all succulent plants of warm climates, and require either a dry store or a very good greenhouse. They should **not** be watered in the winter-season.

STAPES. See Anatomy.

**STAPHYLEA, BLADDER-NUT, a genus of plants, belonging to the class of pentandria, and order of trillium; and in the natural system arranged under the 23rd order, trillitae. The calyx is quinquonate. There are five petals. The capsules are three, inflated, and joined together by a longitudinal suture. The seeds are two, and are globose with a scar. There are three species. The pinna, or bladder-nut tree, is a tall shrub or tree; the leaves are palmated; the pinnae are generally five, oblong, pointed, and notched round the edges. The flowers are white, and grow in whorls on long pendulous footstalks. This plant flowers in June, and is frequent in hedges about Pontefract and in Kent. The trifoliate, or three-leaved bladder-nut is a native of Virginia.

**STAPHYLINUS,** a genus of insects of the order coleoptera; the generic character is antennæ mouthform, wing-sheaths halved, wings, covered; tail in great clusters.

**STARS,** the English term applied to the great order of the British species, is the staphylinus major of Degeer, which is more than an inch long, entirely of a deep-black colour, and when disturbed, sets up the hinder parts of its body, as if in a posture of defence; it is generally found, during the autumnal season, about sunny places, protracting, occasionally and shaggy, and within very forcible jaws. This species has often been quoted as the staphylinus maximus of Linnaeus, but it appears from late observations to be a larger, and totally distinct species from that insect. There are nearly 200 species.

**STAPLE,** primarily signifies a public place for mark, or market; as in Jewish plants, &c. are obliged to bring their goods to this place, whether of the people. Formerly the merchants of England were thus obliged to carry their wool, cloth, lead, and other staple-commodities of this order, in order to sell the same by wholesale: and these staples were appointed to be constantly kept at York, Lincoln, Newcastle upon Tyne, Northwich, Westminster, Canterbury, Chichester, Winchester, Exeter, and Bristol; in each of which a public mart was appointed to be held, and each of them had a court of the mayor of the staple, for deciding differences, held according to the law-merchant in a summary way.

The staple-commodities of this kingdom are said by some to be these: wool, leafer, wool-yards, lead, tin, butter, cheese, cloth, &c. but others allow only the first five to be staple-commodities.

**STAR, See Astronomy.**

**STARS, fading, in meteorology: meteors which dart through the sky in from of a star. See METROKS.**

Mr. John Farey (Monthly Mag. xxi. 144) has given the name SATELLITE, to the numerous masses of aerial matter, which are composed of iron and nickel principally, which are supposed by him to be revolving in all directions round this earth in elliptical orbits; and which, by passing through the highest
parts of the atmosphere, with the immense velocity peculiar to planetary motion, are rendered luminous for a short space, when in perigee, and occasion the appearance of shooting stars. They are found to move in all directions so4 so·nu·mu·lous, that M. Benzenberg, in the space of one night, observed 500 of them (Monthly Mag. xxii. 223). The same masses, when they dip deeper into the atmosphere, color the more heated, are sup·posed to appear as meteors; and, by the increasing resistance of the air in each of their revolutions, to fall at length to the earth in the fragments called meteoric stones, (see that article, where the opinions of different philosophers on the origin of these very curious substances may be seen.) In the same manner that Dr. Herschel uses the term asteroids, to express the planetary bodies revolving round the sun, which are smaller than the anciently known planets; satellitae are bodies, smaller than the moon, revolving round the earth as their centre of gravitation.

STAR. See HERALDRY.

STAR, in pyrotechny, a composition of combustible matters, which, being thrown aloft in the presence of a star, appears as a star. See PYROTECHNY.

STAR-BOARD, in the sea-language, denotes the right-hand side of a ship: thus they say, star-board the helm, or helm a star-board, when he that conds would have the men at the helm, or steering-wheel, put the helm to the right side of the ship.

STAR-FISH. See ASTERIAS.

STAR-SHOT, a gelatinous substance frequently found in fields, and supposed by the vulgar to have been produced from the meteor called a falling-star; but, in reality, is the half-digested food of herons, sea-mews, and the like birds; for these birds, when shot, have been found to digest a substance of the same kind.

STAR-STONE, asteria, in natural history, a name given to certain extraneous fossil stones, in form of short, and commonly somewhat columnar, which are composed of several joints; each resembling the figure of a radiated star, with a greater or smaller number of rays in the different species; they are usually found of about an inch in length, and of the whitish or grayish color; some of them have five angles, or rays, and others only four; and in some the angles are equidistant, while in others they are irregularly so; in some also they are short and blunt, while in others they are long, narrow, and pointed; and some have their angles so very short and obtuse, that at first sight they might be taken for enchoetrocerae. The several joints in the same specimen are usually all of the same thickness; this however is not always the case, but in some they are larger at one end, and in others at the middle, than in any other part of the body; and some species have one of the star-like band, so as to compose a species of a six-rayed kind.

STARCH. If a quantity of wheat-flour is formed into a paste, and then held under a very small stream of water, kneading continually till the water runs off from it colourless, the flour by this process is divided into two distinct constituents. A tough substance of a dirty-white colour, called glutin, remains in the hand; the water at first mildly; but soon deposits a white powder, which is known by the name of starch. A sweet-tasted mucilaginous substance remains dissolved in the water.

The starch obtained by this process is not altogether identical with that which is obtained, by means of the powdered vegetable, by distillation and filtration. In natural starch the process dissolves still more slowly. The solution resembles mucilage of gum-arabic, and still retains the peculiar colour of muriatic acid. When allowed to stand for some time, the solution gradually separates into two parts: a perfectly transparent straw-coloured liquid below; and a thick, muddy, oily, or rather mucilaginous substance, above. When water is poured in, the muriatic smell instantly disappears, and a strong smell is exhaled, precisely similar to that which is perceived in corn-mills. Ammonic occasions a slight precipitate, but too small to be examined.

Nitric acid dissolves starch more rapidly than the other two acids; it acquires a green colour, and emits nitrous gas. The solution is never complete, nor do any crystals of oxalic acid appear unless heat is applied. In this respect starch differs from gum, which yields oxalic acid with nitric acid, even at the temperature of the atmosphere. When heat is applied to the solution of starch in nitric acid, both oxalic and muriatic acid are formed, but the starch substance still remains. When separated by filtration and afterwards colulated, this substance has the appearance of a thick oil, not unlike tallow; but it dissolves readily in alcohol.

Starch is a mixture of acetic acid, and an oil having the smell and the consistency of tallow.

The alkaline dissolve starch; but their action has not been examined with care. In pure potas it swells, and assumes the appearance of a transparent jelly. In this state the solution is soluble in alcohol.

When starch is thrown upon a hot iron, it melts, blazes, froths, swells, and burns with a bright flame like sugar, emitting, at the same time, a great deal of smoke; but it does not explode, nor has it the caloromel smell which distinguishes burning sugar. When distilled, it yields water impregnated with an acid of peculiar odour, and a little tallow. The acid holds in solution gluten somewhat altered, phosphat of lime, and ammonia.

Starch was well known to the antients. Pliny informs us, that the method of obtaining it was first invented by the inhabitants of the island of Chios.

Starch has a fine white colour, and is usually concreted in longish masses; it has scarcely any smell, and very little taste. When kept dry, it continues for a long time uninjured though exposed to the air.

Starch does not dissolve in cold water, but very slowly, and forms with it a kind of emulsion. It combines with boiling water, and forms with it a thick paste. When it is allowed to cool, it assumes the form of a semi-transparent jelly; which, when dried by artificial heat, becomes brittle, and assumes an appearance not unlike that of gum. Hence it is supposed that starch, by being boiled in water, undergoes a certain degree of decomposition, which brings it nearly to the state of gum. When this paste is left exposed to damp air, it soon loses its consistency, acquires an acid taste, and its surface is covered with mould.

Starch is so far from dissolving in alcohol, even when assisted by heat, that it does not even fall to powder.

When starch is thrown into any of the mineral acids, at first no apparent change is visible; but if an attempt is made to reduce the larger pieces, while in acids, to powder, they resist it, and feel exceedingly tough and adhesive. Sulphuric acid dissolves it slowly, and at the same time a smell of sulphurous acid is emitted; and such a quantity of charcoal is evolved, that the vessel containing the mixture may be inverted without spilling any of it. Indeed, if the quantity of starch is sufficient, the mixture becomes perfectly solid. When allowed to stand for some time, the solution gradually separates into two parts: a perfectly transparent straw-coloured liquid below; and a thick, muddy, oily, or rather mucilaginous substance, above. When water is poured in, the muriatic smell instantly disappears, and a strong smell is exhaled, precisely similar to that which is perceived in corn-mills. Ammoniac occasions a slight precipitate, but too small to be examined.

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the following list of plants from the roots of which it may be extracted.

Arctium lappa,
Atropa belladonna,
Polygonum bistorta,
Hypotyl alba,
Phytolacca americana,
Spiraea filifolia,
Ranunculus bulbosus,
Scrophularia nodosa,
Sambucus ebulus,
Orchis morio,
Imperatoria ostruthum,
Hyoscyamus niger,
Rumex obtusifolius,
— aquatics,
Arun maculatum,
Orchis mascula,
Iris pseudacorus,
— tuberosa,
Orobus tuberosus,
Bunium bulbocastanum.

It is found also in the following seeds ;
Oats, Millet, Peas, Rice, Chesnut, Beans, Maize, Horse-chestnut, Acorn.

Indeed the greater number, if not the whole, of the vegetable seeds employed by man as an article of food, consists chiefly of starch. But that substance is always combined with some other which serves to disguise its properties; such as sugar, oil, extractives, &c. It is only by processes similar to those described in the beginning of this article, that it is extracted from these substances in a state of tolerable purity. The following substances, which may be considered as varieties of starch, deserve particular attention:

1. Potato starch. We are not yet in possession of a precise chemical analysis of the potato. When raw, its taste is exceedingly disagreeable, and it is said to be in some degree noxious; but it loses these qualities when boiled. The water acquires a deep brown colour, and the potato itself, when broken, appears to be composed of a congeries of fine soft cotton-like strands, to which it owes its mealy appearance. When exposed to the action of frost, it becomes soft, and acquires a very sweet taste. The nature of this change has not been examined into. When the potato is grated down to a pulp, and placed on a fine sieve, if water is poured on it, a great deal of starch passes through the meshes of the screen, and may be collected in proper vessels. When washed with water and dried, it retains a fine white colour, and possesses all the essential properties of starch. Indeed it goes much farther; a smaller quantity being sufficient to form a thick paste with water than is required of wheat-starch. It has a very perceptible crystallized appearance, and is much heavier apparently than common starch. It is not likely therefore that it could be employed with the same advantage as a hair-powder.

2. Sugar. Sugar is also extracted from the pith of several species of palm in the Moluccas, Philippines, and other East Indian islands. The pith is cut into pieces of five or six feet in length; the woody part is cut off one side, exposing the pith lying in a manner, the hollow of a canoe. Cold water is poured in, and the pith well stirred; by which means the starch is separated from the fibrous part, and passes through with the water when the whole is thrown on a sieve. That part, thus separated, is allowed to settle; the water is poured off; and when it is half dry it is granulated, by being forced through a kind of funnel. It is said to acquire its grey colour while dried in an artificial heat. This substance is employed as an article of food, and its nourishing properties are well known.

3. Salop. This substance comes from Persia; but it is said also to be manufactured in Europe. It is supposed to be the prepared roots of different species of orchis, as the morio, masuila, biolca, pyramidalis. According to Moutl, the bulbous roots of these plants are deprived of their cuticle, baked in an oven for ten or twelve minutes, which gives them their semi-transparent, and then fully dried in a moderate heat. Like sago, salop is used as a nourishing article of food.

4. Cassava is prepared from the roots of the Jatropha manihatti, an American plant. They are peeled, and subjected to a process of washing in kind of large made of rushes. The juice that is forced out is a deadly poison, and is employed by the Indians to poison their arrows; but it deposits gradually a white starch, which when properly washed is innocent. What remains in the bag consists chiefly of the same starch. It is dried in smoke, and afterwards passed through a kind of sieve. Of this substance the cassava bread is made.

5. Sowans. This very nutritious article of food is made in this country from the husk of oats, by a process not unlike that by which common starch is made. The husk of the oat (called seeds) is separated from oatmeal by the sieve. It still retains a considerable portion of parinaceous matter, which forms a very nourishing food.

STALING. See STERNUS.

STATICE, THrift, a genus of plants belonging to the class of pentandria, and order of pentagonia; and in the natural system ranging under the forty-eighth order, aggregate. The calyx is imphomphyllous, entire, folded, and scarious. There are five petals, and the inferior seed-case or ovule is of three, nine species; three of these are British plants.

1. The armoria, thrift, or sea gilly-flower, has a simple naked stem about six inches high. The radical leaves are like grass. The flowers are terminal, pale red, with a round head, and not very large. This plant flowers in July or August, and grows in meadows near the sea. 2. Limonium, sea-lavender. The stem is naked, branched, and about a foot high. 3. Rosibranda, sea-lavender. The stem is prostrate, and terminated by a panicle of flowers. This species is also found on the sea-coast of South Britain.

STATICS, that branch of mathematics which considers the motion of bodies arising from gravity. See Motion.

Statics then is the doctrine, or theory, of motion, considered merely as arising from the weight of bodies; in which sense it is distinguished from dynamics; or the application of the principles of mechanics to machines, &c. Though, it must be owned, that statics and mechanics are frequently confounded. See Mechanics.

For the laws and principles of mechanics, see the articles Gravity, Gravitation.

STATIONARY. See Astronomy.

STATISTICS, a word lately introduced to express a view or survey of any kingdom, country, or parish.

A grand and extensive work of this kind was undertaken in Scotland in the year 1799 by sir John Sinclair, whose patriotic exertions in favour of his country will be gratefully remembered by posterity. The great object of it is to give an accurate view of the state of the country, its agriculture, its manufactures, and its commerce; the means of improvement, of which they are respectively capable; the amount of the population of a state; and the causes of increase or decrease: the manner in which the territory of a country is possessed and cultivated; the nature and amount of the various productions of the soil; the value of the personal wealth or stock of the inhabitants, and how it can be augmented; the diseases to which the people are subject, their causes and their cure: the occupations of the people; where they are entitled to encouragement, and where they ought to be repressed; the condition of the poor, the best means of maintaining them, and of giving them employment; the state of schools, and other institutions, formed for purposes of public utility; the state of the villages and towns, and the regulations best calculated for their police and good government; the state of the manners, the morals, and the religious principles of the people, and the means by which their temporal and eternal interests can best be promoted.

STATUARY, a branch of sculpture, said to be the invention of Dacalus, amidst other productions of ingenious talents: others assert him to have been only the improver of an art known long before his time, and that he was the first who endeavoured to give the appearance of motion and action to figures.

The Punicans are said to have been the first who erected statues in honour of their gods; but, if we believe the accounts generally given of the Punican worship, the religious custom of that nation did not exhibit human forms, but merely pointed stones or other symbolical expressions of their divinities.

STATUES, are figures, representing living or deceased creatures, of whatever species, real or imaginary; and carved, cast, modelled, or moulded, in full relieve, insulated on every part.

Statues are formed with the chisel, of several materials, such as marble, stone, &c.: they are carved in wood; or cast in plaster of Paris, or other matter of the same nature; they are also cast in several metals, as lead, brass, silver and gold.

Statues are divided into Colossal, or considerably exceeding the dimensions of nature; as, for instance, the celebrated statue of Apollo, at Rhodos.

Allegorical, or such as, under human or other symbolical forms, represent subjects of a different kind, as Time, Ocean, Winds, or qualities of an intellectual nature, as Mercy, Justice, &c.

Statues of deities, demi-gods, and heroes were, among the ancients, generally represented somewhat larger than life.

Monumental, either representing the person, the virtues, or the actions of the deceased.
Equestrian, generally of some illustrious person on horseback.

Pedestrian; or on foot.

The most celebrated statues are those of the Egyptians, Grecians, and Romans. Of the Egyptian statues, which have been said under the article sculpture. See SCULPTURE. Of the Grecian and Roman we propose to add some important particulars.

**Statues.** The denomination of ancient statues is applicable to all antique statues, found either in India, Egypt, &c. but is especially given, in preference, to the statues wrought by the ancient Greek and Roman sculptors. The works of the Grecians are considered as the most perfect examples of sculpture. Their statues are eminently admirable for the various beauty of their forms, for characteristic expression and grace. See SCULPTURE.

The Grecian statues of men are generally naked. The Roman are clothed agreeably to the manner of the country, and are distinguished into

1. Palliata (stature), those of emperors with long robes over their armour.
2. Loricae, those of soldiers with cuirasses.
3. Thoricata, those with coats of armour.
4. Togata, those of magistrates with the toga, or robe worn in office.
5. Tribune, those of senators and augurs.
6. Tunicata, those clothed with a plain tunic.
7. Statilia, those of women with long trains.

The antique statues are most particularly remarkable for their systematic representation of the human form. As the principle most apparent in their system is that of proportions, we shall give, first, an account of their general proportions to which they chiefly adhered, and next, an accurate measurement of the various parts of the body, taken at Rome, from some of their most celebrated original statues.

It is to be observed, however, that although the inferior antique possesses little other merit than that of proportion, the excellence of the finer works of Greece is of a much more comprehensive description.

**Proportions of the antique statues.**

Proportion is the basis of beauty, and there can be no beauty without it; on the contrary, proportion may exist where there is little beauty. Experience teaches us, that knowledge is distinct from taste; and proportion, therefore, which is founded on knowledge, may be strictly observed in any figure, and yet the figure have no pretensions to beauty. The antiquists considering ideal beauty as the most perfect, have frequently employed it in preference to the beauty of nature.

It is probable that the Grecian, as well as the Egyptian artists, determined the great and small proportions by fixed rules; that they established a positive measure for the dimensions of length, breadth, and circumference. This supposition alone can enable us to account for the great conformity which we meet with in antique statues. Winckelmann thinks that the foot was the measure which they used in all their great dimensions, and that it was by the length of it that they regulated the measure of their figures by giving to them six times that length. This, in fact, is the length which Vitruvius assigns, L. 3, cap. 1. That celebrated architect thinks the foot is a more determinate measure than the head or the face, the parts from which modern painters and sculptors often take their proportions. This proportion of the foot to the body, which has appeared strange and incomprehensible to the learned Huetius, has been entirely rejected by Perrault, is, however, founded upon experience. After measuring with great care a vast number of figures, Winckelmann found this proportion not only in Egyptian statues, but also in those of Greece. This fact may be determined by an inspection of those statues, the feet of which are perfect; and one may be more fully convinced of it by examining some figures of the Greek divinities, in which the artists have made some parts beyond their natural dimensions. In the Apollo Belvedere, which is a little more than seven heads high, the foot is three Roman inches longer than the head. The head of the Venus de Medici is very small, and the height of the statue is seven heads and a half; the foot is three inches and a half longer than the head, or precisely the sixth part of the length of the whole statue.

Other writers are of opinion, that the following rules form a principal part of the system of Grecian sculpture:

The body consists of three parts, as well as the members. The three parts must bear a certain proportion to one another, as well as to one another. In a well formed man, the head and body must be proportioned to the thighs, the legs, and the feet. The arms also consist of three parts. These three parts must bear a certain proportion to the whole body, but as well as to one another. In a well formed man, the head and body must be proportioned to the thighs, the legs, and the feet, in the same manner as the thighs are proportioned to the legs and the feet, or the arms to the hands. The face also consists of three parts, that is, three times the length of the nose; but the head is not four times the length of the nose, as some writers have asserted. From the face begins to the crown of the head, are only three-fourths of the length of the nose, or that part is to the nose as 9 to 12.

**Measurements taken at Rome from original antique statues.**

**Hercules (Farnese).**

Length of the face as nearly as can be found, 11 inches and a half.

From the pit between the clavicles to the bottom of the belly, 2 feet 10 inches.

From the point of the (right) os ilium to the top of the patella, the same, viz. 2 feet 10 inches.

From the top of the patella to the sole of the right foot, 2 feet 10 inches and a half.

From the top of the head as nearly as can be guessed, to the bottom of the belly, 4 feet 2 inches and a half.

From the bottom of the belly to the sole of the foot, 5 feet 2 inches and three-fourths.

**Colossal Commodus (of the Capitol).**

Length of the face from the top of the forehead to the bottom of the chin, as nearly as can be guessed (the hair being down on the forehead), 3 feet 2 inches.

Flora (Farnese).

From the pit between the clavicles to the bottom of the belly; from the point of the (right) os ilium to the centre of the patella; and from the centre of the patella to the sole of the foot, exactly equal.

From the pit between the clavicles to the right nipple, 14 inches and a half.

From the pit of the belly to the sole of the foot, 5 feet 8 inches.

Length of the leg from the centre of the patella to the sole of the foot, 3 feet 1 inch.

The measurements of the four following female statues, have for their rule the real length of their respective faces, divided into three parts, and those parts subdivided into twelve minutes. See Plate No. 9, (entitled Antiquae Statuae.)

Venus de Medicis.

From the bottom of the right ear to the pit between the clavicles, 3 parts.

From the bottom of the left ditto to the said pit, 2 parts 9 minutes.

From the said pit to the bottom of the sternum, as near as can be found, 3 parts 6 minutes and one-third.

From the said pit to the bottom of the belly, as near as can be found, 9 parts 1 minute and three-fourths.

From the point of the (right) os ilium, as near as can be found, to the centre of the patella, 9 parts 4 minutes and one-third.

From the said pit to the right pap, 3 parts 5 minutes; to the left ditto, 3 parts 6 minutes.

From the centre of the right patella to the sole of the foot, 9 parts 8 minutes and one-third.

From the centre of the said patella to the sole of the foot, 9 parts.

Length of the right foot from the heel to the joint of the great toe, 4 parts 9 minutes and two-thirds.

Length of the left ditto, 4 parts 8 minutes.

Breadth of the face from ear to ear, 2 parts 3 minutes.

From the right ear to the tip of the nose, 2 parts 1 minute and one-third.

Thickness of the neck, measured with the face in front, 1 part 11 minutes and a half.

Distance from pap to pap, 3 parts 11 minutes.

From point to point of the ileum, as near as can be found, 4 parts and half a minute.

Breadth of the shoulder, just below the heads of the humeri, measured obliquely, viz. parallel with the shoulders, 7 parts 9 minutes and a half.

Breadth of the breast, from the point where the pectoral and deltoïd muscles join, 5 parts 5 minutes and one-fourth.

Narrowest part of the body, a little above the navel, 4 parts 9 minutes and a half.

Breadth of the hips, measured upon the ilium under the oblique, descends 6 parts 4 minutes and a half.

Thickest part of the right thigh measured as near as can be across the centre of the rectus, 3 parts 6 minutes.

Thickness of the said knee across the centre of the patella, 1 part 1 minute.

Thickest part of the calf of the said leg, 2 parts 2 minutes and a half.

Small ditto, just above the ankle, 1 part 2 minutes and three-fourths.
Thicknes of the said ancle from centre to centre of each bone, 1 part 5 minutes and one-fourth.

Thicknes of the left knee measured across the patella, 2 parts.

Thicknes of the calf of the left leg, 2 parts 2 minutes.

Small ditto, just above the ancle, 1 part 2 minutes.

From centre to centre of the ancle bones of the left leg, 1 part 4 minutes and one-fourth.

Breadth of the left foot upon the joints, at the roots of the toes, 1 part 9 minutes.

Length from the head of the detoiso to the tip of the left elbow, 7 parts; right ditto, 7 parts 2 minutes.

Length of the lower right arm from the tip of the elbow to the centre of the wrist, 4 parts 11 minutes.

Length of the left ditto, ditto, 5 parts 1 minute, and two-thirds.

Thickest part of the right arm above the elbow, 1 part 11 minutes.

Thickness of the lower arm, measured with the back of the hand in front, 1 part 8 minutes and one-half minute.

Ditto of the said wrist from bone to bone, 1 part three-fourths of a minute.

Thickest part of the left arm, measured in front, 1 part 9 minutes and a half.

Thickness of the lower arm ditto, measured like the former, 1 part 7 minutes and one-fourth.

Thickness of the said wrist from bone to bone, 1 part and one-half minute.

From the middle of the wrist to the root of the middle finger, 1 part 10 minutes.

Length of the middle finger, 1 part 8 minutes and one-fourth.

Breadth of the hand across the joints at the roots of the fingers, 1 part 4 minutes and a half.

Ditto of the body from the most prominent part of the breast bone to ditto of the shoulder behind, measuring and observing the curve of the figure, 4 parts 2 minutes and one-fourth.

Narrowest part of the body, measured from the hollow above the navel, to the most prominent part of the sacro-umbilical, observing the curve of the figure, 3 parts 10 minutes.

Distance from the navel to the bottom of the belly, 4 parts and one-half minute.

Length from the point of the left os ilium, as near as can be found, to the most prominent part of the glutaeus below, 5 parts.

Distance from ditto to ditto of the right side, 4 parts 7 minutes.

Thickest part of the right thigh in profile, from the centre of the rectus, 3 parts 7 minutes.

Thicknes of the said knee in profile from the centre of the patella, 2 parts 4 minutes and two-thirds.

Ditto of the calf of the right leg, in ditto, 2 parts 3 minutes; smallest part ditto, 1 part 5 minutes and one-fourth.

Thicknes of the left thigh from just under the glutaeus to the rectus above in profile, 3 parts 8 minutes.

Ditto of the left knee, in profile, from the centre of the patella, 2 parts 4 minutes.

Thicknes of the said leg above, 2 parts 4 minutes; ditto of ditto at the small, 1 part 5 minutes and one-fourth.

Total length of the figure, allowing 4 parts for the head, and measuring down the centre of the figure, 31 parts 11 minutes and a half.

Flora Festita, or dropt.

From the bottom of the ear to the pit between the clavicles, 2 parts 8 minutes and a half.

Length of the neck from where it joins the bottom of the chin to the said pit, 1 part 4 minutes.

From the said pit to the right nipple, 3 parts 2 minutes and a half; left ditto, 3 parts 2 minutes.

From the pit between the clavicles to the bottom of the belly as near as can be guessed, 11 parts 10 minutes.

From the elbow to the pit, 3 parts 7 minutes and a half.

From the roots of the hair on the forehead to the sole of the foot, 10 faces, or 30 parts 8 minutes.

Length of the leg bent from the top of the patella to the sole of the foot, 9 parts 3 minutes.

Cleopatra of the Belvidere.

From the bottom of the chin to the pit between the clavicles, 1 part 7 minutes.

From the tip of the right ear to the said pit, 3 parts 5 minutes.

From the said pit to the left nipple, 3 parts 4 minutes; right ditto 3 parts.

Total length of the body, as it lies, from the said pit to the bottom of the belly, 9 parts 4 minutes.

From the bottom of the belly to the middle of the patella, as near as can be guessed, 9 parts 2 minutes.

From the middle of the patella to the instep, 9 parts 5 minutes.

From the instep to the sole of the foot within, 1 part 9 minutes.

Length of the left arm underneath, from where it joins to the pectoral, to the point of the elbow, 5 parts 9 minutes.

From the same elbow to the joint of the wrist, 5 parts 6 minutes and a half.

Thickness of the same arm above the elbow, measured from underneath, to about where the deltoid muscle is inserted, 2 parts 5 minutes and one-fourth.

Thickest part of the same arm below the elbow, 2 parts 3 minutes.

Breadth of the wrist from bone to bone, 1 part 5 minutes.

Thickness of ditto from the centre below to the centre above, 9 minutes.

Breadth of the body across the breasts as near as can be measured, 7 parts 3 minutes.

Ditto of ditto, as near, &c. across the belly just below the navel from hip to hip, 7 parts 10 minutes and a half.

Breadth from nippel to nippel, 4 parts 3 minutes.

Thickness of the upper thighs, measured over and across about the middle, 3 parts 10 minutes and a half.

Ditto knee ditto, across the middle of the patella, 2 parts 9 minutes and a half.

Calf of the leg, ditto, 2 parts 10 minutes and a half.

Ankle ditto from bone to bone, 1 part 7 minutes and a half.

Total length of the figure, allowing 1 part above the roots of the hair upon the forehead, and measuring down the middle of the figure, down the centre of the upper thigh and to the sole of that foot, as near as can be known, somewhat less than 30 parts.

Breadth of the right foot from the joint at the root of the great toe to the joint on the other side at the root of the little toe, 2 parts 3 minutes.

Length of the great toe from the centre of the joint, 1 part 7 minutes.

Beautiful daughter of Niohe.

From the chin next the throat to the pit between the clavicles, 1 part 10 minutes.

From the tip of the left ear to ditto, 3 parts 1 minute and a half.

From the tip of the right to ditto, 2 parts 7 minutes and three-fourths.

From the said pit to the left nippel, 2 parts 10 minutes.

From ditto to the right nippel, 3 parts 2 minutes.

From nippel to nippel, as near as can be guessed, 4 parts.

Length of the body from the pit between the clavicles to the bottom of the belly, 9 parts.

From the point of the ilium (guessed) to the centre of the patella, 8 parts 5 minutes.

From the centre of the patella to the sole of the foot, 8 parts 8 minutes and a half.

The measurements of the following male figures, have for their rule, the real length of their respective heads, divided into four equal portions, called fourths, and those fourths subdivided into twelve equal parts.

See the Plate.

Apollon.

From the bottom of the chin next the throat to the pit between the clavicles 1 fourth 9 parts.

From the pit between the clavicles to the pit at the bottom of the breast, 2 fourths 6 parts and one-half.

From ditto to the pit of the right breast, 3 fourths 6 parts and one-half.

From ditto to the pat of the left breast, 2 fourths 8 parts; from pat to pat 1 head.

Whole length of the body from the pit between the clavicles to the bottom of the belly, about 3 faces.

From point to point of the os ilium next the belly, 1 head wanting 2 parts.

From the point of the right os ilium to the middle of the patella, 3 faces.

From the left ditto to the upper edge of the patella, 3 faces.

From the middle of the right patella to the sole of the foot, 3 faces.

Breadth of the face from ear to ear, 9 fourths 3 parts.

Thickness of the neck immediately under the ears, 2 fourths and half a part.

Thickness of the body in a line drawn across the paps, almost 6 fourths.

Narrowest part of the body from the lowest rib to rib, 5 fourths.

Breadth of the body where it joins the thigh, 6 fourths 8 parts.

Umost thickness of the thigh, 3 fourths, 1 part 2 fourths.

Thickness of the knee across the centre of the right patella, 2 fourths nearly.

Thickest part of the calf of the leg in front, 2 fourths 2 parts.

Thickest part of the right ankle, above the ankle bone, 2.4 parts and two-thirds.
Thinnest part of the right instep, below the ankle, 1 fourth 2 parts.
Thickest part of the ankle from the centre to the centre of each bone, 1 fourth 4 parts.
Thickest part of the foot, across the joint at the roots of the toes, 1 fourth 10 parts.
Utmost length of the right foot, 4 fourths 9 parts and a half.
Utmost length of the left arm from the top of the shoulder to the tip of the elbow, 6 fourths 4 parts.
From the same elbow to the joint of the wrist, nearly, 5 fourths.
From the same joint to the root of the middle finger, 1 fourth 9 parts and a half.
Thickest part of the left arm, across the insertion of the deltoid, 1 fourth 11 parts.
Thickest part of the dito below the elbow, 1 fourth 7 parts and a half.
Thickest part of the wrist, measured from above, 1 fourth and two-thirds of a part.
From the elbow to the centre of the right arm, below where the latissimus dorsi passes, as near as can be guessed, 5 fourths and a half.
Thickest part of that arm, measured in front across the biceps, 1 fourth 10 parts.
Thickest part of the body, measured in profile on the left side, from the pit between the breasts to the back in a horizontal direction, 3 fourths.
Thinnest part of the body on the same side, measured just above the navel, 3 fourths 9 parts.
Thickest part of the thigh in profile, measured in a horizontal direction, from the root of the penis to the glutaeus, 4 fourths 6 parts.
Thinnest part, just above the knee, 2 fourths 2 parts and three-fourths.
Thickest part of the right knee, 2 fourths and 3 parts.
Thickest part of the calf of the leg, 2 fourths 3 parts and a half.
Thinnest part of the same leg, just above the instep, 1 fourth 6 parts and one-fourth.
From the centre of the inner ankle to the bottom of the heel, 1 fourth 6 parts.
From the centre of the outer dito to dito, 1 fourth 2 parts.

Apollo Belvedere.
From the tip of the right ear to the pit between the clavicles, 2 fourths 10 parts.
From the bottom of the left ear to the same pit, 3 fourths and half a part.
From the pit between the clavicles to the centre of the pit at the bottom of the sternum, 2 fourths 11 parts and a half.
From the pit between the clavicles to the bottom of the belly, 2 fourths 9 parts and a half.
From the point of the right ilium to the centre of the patella, 8 fourths 11 parts and a half.
From the point of the left dito to the centre of the patella, 9 fourths 3 parts and three-fourths.
Length of the right leg from the centre of the patella to the sole of the foot, 9 fourths 6 parts.

Statues.
From the pit between the clavicles to the right pap, 3 fourths 4 parts.
From ditto to the left pap, 3 fourths 5 parts and one-fourth.
Distance across from pap to pap, 4 fourths 9 parts and three-fourths.
Breath of the body across the paps, 6 fourths and half a part.
Narrowest part of the body, measured a little above the navel, 5 fourths 1 part and one-fourth.
Breath of the hips, measured upon the ilium just under the oblique, descends, 5 fourths 2 parts and a half.
Breath from point to point of the ilium, 3 fourths 10 parts and a half.
Thickest part of the right thigh, measured in front across the head of the rectus, 2 fourths 11 parts.
Thickest part of the left dito, 2 fourths 11 parts and a half.
Thickness of the right knee across the centre of the patella, 1 fourth 10 parts.
Thickness of the left dito, 1 fourth 9 parts and a half.
Thickness of the clavicles, 1 fourth 8 parts.
Thickness of the calves of the legs, taken in front, 2 fourths 1 part and a half.
Small of the right leg just above the ankle, 1 fourth 2 parts and a half.
Ditto of the left leg dito, 1 fourth 1 part.
From centre to centre of the ankle bones of each leg, 1 fourth 4 parts.
Thickness of the instep on the foot immediately under the right ankle, 1 fourth and half a part.
Length of the right foot from the point of the heel to the point of the great toe, 4 fourths 3 parts and one-fourth.
Ditto of the left, 4 fourths 5 parts.
Breath of the right foot on the joints at the roots of the toes, 1 fourth 6 parts and two-thirds.
Length of the right arm from the head of the deltoid to the tip of the elbow, 6 fourths 3 parts.
From the tip of the elbow to the centre of the wrist bone, 4 fourths 10 parts and two-thirds.
Thickness of the right arm, taken in front, 1 fourth 6 parts and one-third.
Ditto in profile about the middle, 2 fourths and one-third of a part.
Thickest part of the right thigh in profile as near as can be taken, 3 fourths 5 parts and three-fourths.
Thickness of the right knee dito to the centre of the patella, 2 fourths and two-thirds of a part.
Thickness of the calf of the leg in profile, 2 fourths 2 parts.
Thickness of the small of the leg in profile, 1 fourth 5 parts and a fourth.
Total length of the Apollo, including four parts to the head, and measuring down the centre of the body, 32 fourths 2 parts.

Borghese Faun.
From the bottom of the right ear to the pit between the clavicles, 4 fourths.
Total length of the body from the pit between the clavicles to the bottom of the belly, 8 fourths 3 parts.
Length of the right thigh from the point of the ilium to the centre of the patella, 9 fourths 2 parts and one-third.
Length of the right leg from the centre of the

Sleeping Faun (Barberini).
Distance from the right ear to the pit between the clavicles, 3 fourths.
Length of the neck from the bottom of the chin to the pit between the clavicles, 1 fourth 9 parts and a half.
From the said pit to the pit at the bottom of the sternum, 2 fourths 6 parts and a half.
Total length of the body from the said pit to the bottom of the belly, 7 fourths 1 part.
Length of the right thigh in its restored state
From the point of the ilium to the top of the patella, 9 fourths 7 parts.
From the top of the patella to the sole of the foot, 8 fourths 10 parts and a half.
Breadth of the face from ear to ear, as near as can be measured, 2 fourths 5 parts and a half.
Breadth of the neck from side to side, 2 fourths 1 part.
Ditto of the breast from pop to pop, 3 fourths 3 parts and a half.
Breadth from point to point of each ilium, 3 fourths 11 parts and one-third.
From the pit at the bottom of the sternum to the navel, 2 fourths 6 parts and a half.
Utmost thickness of the thigh across the head of the rectus, 3 fourths 2 parts and a third.
Utmost thickness of the body across the paps, 6 fourths 4 parts.
Narrowest part of ditto at the bottom of the ribs, 5 fourths 3 parts and a half.
Length of the arm over the head, from the centre of the head of the humerus, as near as can be found, to the tip of the elbow, 6 fourths.
Length of that arm below, from the tip of the elbow to the centre of the wrist, 5 fourths and one-third of a part.
Utmost thickness of the body from the most prominent part of the breast to the trapezius behind below the shoulder, measured in a right line, 4 fourths 8 parts and a half.
From the hollow part of the rectus before, a little above the navel, to the sacro-lumbaris behind, measured in a right line, 4 fourths 7 parts and a half.
Thickness of the arm from the centre of the biceps to the triceps behind, 2 fourths and half a part.
N.B. The tip of the right elbow; all the left arm below the deltoid; all the right thigh and leg, with so much of the left thigh as is between the broadest part of the rectus and its insertion at the knee, (all of which is antique, together with a part of the sartorius, gastrocnemius, and peronei without the leg) and all the other part of that leg and foot, have been restored by Burnini.

Laocoön.

From the bottom of the right ear to the pit between the clavicles, 3 fourths 3 parts and one-third.
From ditto of the left ear to the said pit, 2 fourths 10 parts and a half.
From the said pit to the centre of the pit at the bottom of the sternum, 3 fourths 4 parts.
From the said ditto to the top of the navel in a right line, 3 fourths 4 parts.
From the tip of the navel to the privities, 2 fourths 8 parts.
From the point of the ilium to the centre of the patella of the left thigh, 9 fourths 8 parts.
From the point ditto of the right thigh to the centre of the patella, 9 fourths 2 parts.
From the centre of the left patella to the instep or annular ligament, 8 fourths 2 parts.
From the said point at the instep to the bottom of the heel ditto, 1 fourth 1 part.

From the pit between the clavicles to either pop, 3 fourths 2 parts and three-fourths.
Length of the left arm from the head of the deltoid to the tip of the elbow, 6 fourths 7 parts and a quarter.
From the tip of the said elbow to the centre of the joint of the wrist, 5 fourths 1 part and a half.
Length of the back of the hand from the centre of the wrist to the joint of the middle finger, 1 fourth 4 parts and a third.
Length of the first joint of the middle finger, 1 fourth 1 part.
Thickness of the neck in front, about the middle, 2 fourths 3 parts.
Distance across from pop to pop, 4 fourths 2 parts and two-thirds.
Breadth of the body measured horizontally across the nipples, 6 fourths 5 parts and a half.
Breadth of ditto measured horizontally at the narrowest part across the bottom of the ribs, 5 fourths.
Breadth across on the ilium immediately under the obliquus descendens, 5 fourths 4 parts.
Thickness of the left thigh measured across the centre of the rectus, 3 fourths 3 parts and one-third.
Thickness of the knee measured across the centre of the patella, 1 fourth 11 parts and a half.
Thickness of the right ditto, 1 fourth 11 parts and a half.
Thickness of the calf of either leg, 2 fourths 2 parts.
Thickness of the smallest part just above the ankle, 1 fourth and half a part.
From centre to centre of the left ankle bone, 1 fourth 5 parts; right, ditto.
Narrowest part of the instep just under the ankles, 1 fourth and two-thirds of a part.
Breadth of the foot from the centre of the joint at the root of the great toe to ditto of the little one, 1 fourth 11 parts and one-third.
Thickest part of the left arm measured across the centre of the biceps, 2 fourths 2 parts and one-third.
Ditto of the said arm measured on the supinator just below the elbow, 1 fourth 9 parts and a half.
Breadth across the wrist measured from the centre of the joint, 1 fourth 3 parts.
Breadth of the hand measured upon the joint at the roots of the fingers, 1 fourth 10 parts and two-thirds.
Thickness of the body in profile measured from the centre of the pectoral muscle to the most prominent part of the trapezius behind, 4 fourths 9 parts.
Narrowest part of the body in profile measured just above the navel, 3 fourths 6 parts and a half.
Thickness of the knee from the head of the gastrocnemius to the centre of the patella, 2 fourths 6 parts and a half.
Thickest part of the calf of the right leg in profile, 2 fourths 4 parts.
Thickest part of the small of the left leg in profile, 1 fourth 6 parts.
Length of the left foot from the heel to the top of the great toe, 4 fourths 8 parts.
Total length of the figure of the Laocoön, allowing 4 fourths for the head, and measuring from the bottom of the chin to the pit between the clavicles, and from thence, following with the utmost exactness the line of the centre of the body, then measuring on the centre of the left thigh (after having found the point by laying a rule across from the bottom of the belly parallel with the two points of the ilium), and so down the centre of the patella, and upon the leg to the sole of the foot, 34 fourths.

Laocoön's elder son...

From the bottom of the left ear to the pit between the clavicles, 2 fourths 11 parts.
From ditto of the right ear to the said pitt, 2 fourths 6 parts and a half.
From the said pit to the centre of the pit at the bottom of the sternum, 2 fourths 7 parts and a half.
From the centre of the said pit to the centre of the navel, 2 fourths 7 parts.
From the centre of the navel to the privities, 2 fourths 7 parts.

From the point of the right ilium to the centre of the patella, 8 fourths 7 parts and a half.
From the centre of the patella to the instep, 8 fourths 1 part.
From the said instep to the bottom of the heel, 1 fourth 8 parts and one-third.
From the centre between the clavicles to either pop, 2 fourths 10 parts and three-fourths.
Distance across from pop to pop, 4 fourths 5 parts and one-third.
Ditto from point to point of the ilium, 3 fourths 4 parts.

Length of the left arm measured from the head of the humerus, as near as can be guessed, to the tip of the elbow, 5 fourths 8 parts and two-thirds.

Thickest part of the body measured across the paps, 6 fourths 4 parts.

Narrowest part of ditto measured across the bottom of the ribs, 5 fourths 3 parts.

Breadth of the body measured upon the ilium immediately under the obliquus descendentis, 5 fourths 7 parts and a half.

Thickest part of the right thigh in front, across the centre of the rectus, 2 fourths 7 parts and a half.

Thickness of the knee across the centre of the patella, 1 fourth 11 parts and one-third.

Thickest part of the calf of the leg, 2 fourths 3 parts.

Thickness of the small of ditto just above the ankle, 1 fourth 1 part and a half.

Thickest part of the ankle from the centre of each bone, 1 fourth 4 parts and a quarter.

Breadthest of the right foot across the joints at the roots of the toes, 1 fourth 8 parts.

Thickness of the upper arm in profile across the middle of the biceps, 1 fourth 11 parts and a half.

Ditto of the lower arm just below the elbow; ditto, 1 fourth 0 parts.

Thickness of the right thigh in profile, 3 fourths 4 parts and three-fourths.

Ditto of the knee ditto from the centre of the patella, 2 fourths 6 parts.

Thickness of the calf of the leg ditto, 2 fourths 4 parts.
From the tip of the right ear to the pit between the clavicles, 2 fourths 8 parts.
From the said pit to the pit at the bottom of the sternum, 2 fourths 8 parts.
From ditto to the right pap, 2 fourths 8 parts.
From the pit between the clavicles to the bottom of the belly, 8 fourths.
From the said part to the pit at the bottom of the sternum, 2 fourths 8 parts.
From ditto to the right pap, 2 fourths 8 parts.

Younger son of Laocoon.

From the tip of the right ear to the pit between the clavicles, 2 fourths 8 parts.
From the said pit to the pit at the bottom of the sternum, 2 fourths 8 parts.
From ditto to the right pap, 2 fourths 8 parts.
From the pit between the clavicles to the bottom of the belly, 8 fourths.

Thickening of the body in profile from the most prominent part of the pectoral muscle to the trapezius behind, 4 fourths 3 parts and a half.

Narrowest part of ditto measured a little above the navel, 3 fourths 3 parts.
Total length of the figure measured down the centre, allowing 4 fourths to the head, and following the same method as with the foregoing statue of the father, 30 fourths exact.

Antinous.

From the bottom of the left ear to the pit between the clavicles, 2 fourths 9 parts.

From the pit between the clavicles to the pit at the bottom of the breast, 2 fourths 10 parts and two-thirds.
From ditto to either pap, 3 fourths 4 parts.

Germanicus.

From the bottom of the chin to the pit between the clavicles, 1 fourth and two-thirds of a part.
From the tip of each ear to the said pit, 2 fourths 7 parts and a third.
From the pit between the clavicles to the pit at the bottom of the breast, 3 fourths 3 parts and a half.
From pap to pap, 4 fourths 10 parts.

From point to point of the ilium, 3 fourths 10 parts and one-third.

Breadth of the face from ear to ear, 2 fourths 3 parts and two-thirds.

Thickness of the neck about the middle, 2 fourths 1 part and a half.

Breadth of the temple of the shoulders from deltoid to deltoid, 8 fourths 9 parts and a half.

Narrowest part of the body at the bottom of the ribs, 5 fourths 1 part.

Breadth measured on the ilium immediately under the obliques descendens, 5 fourths 4 parts and a half.

Ditto of the thickest part of the left thigh across the rectus, 3 fourths 1 part.

Ditto of the right ditto, 2 fourths 11 parts.

Thickness of the left knee across the centre of the patella, 1 fourth 11 parts.

Ditto of the right ditto, 2 fourths.

Thickness of the right leg at the thickest part, 2 fourths 3 parts.
From centre to centre of the ankle bones, 1 fourth 4 parts and one-third.

The foot is not antique.

Length from the head of the deltoid to the centre of the right elbow, 6 fourths 9 parts and a half.

From ditto to the centre of the wrist bone, 4 fourths 6 parts and a half.

From the centre of the wrist bone to the joint of the little finger, 1 fourth 6 parts and a half.

Breadth of the body in profile from the shoulder to the most prominent breast, 4 fourths 10 parts and a half.

Narrowest part of the body ditto at the bottom of the ribs, 3 fourths 4 parts and three-fourths.

Thickness of the most prominent part of the gluteus to the head of the rectus, 4 fourths 1 part.

Thickest part of the thigh about the middle of the rectus, 3 fourths 5 parts.

Thickest part of the knee ditto, 2 fourths 3 parts.

Thickness of the arm ditto about the middle of the breasts, 2 fourths 2 parts and one-third.

Melenor.

From the left ear to the pit between the clavicles, 2 fourths 10 parts and a half.
From the right ditto, 2 fourths 9 parts and a half.

From the pit between the clavicles to the bottom of the belly, 9 fourths.

From ditto to the centre of the pit at the bottom of the sternum, 3 fourths.

From ditto to the pap on the right breast, 1 fourth 1 part and a half.
Length of the right thigh from the point of the ilium to the top of the patella, 9 fourths.
From the top of the patella to the sole of the foot ditto, 9 fourths 3 parts.
Distance from pap to pap, 4 fourths 2 parts.

Broadest part of the body measured across the paps, 8 fourths 9 parts and two-thirds.

Narrowest part of ditto measured at the bottom of the ribs, 5 fourths 5 parts.

Breadth of the hips measured on the ilium immediately under the obliques descendens, 5 fourths 7 parts and a half.

Thickest part of the thigh measured in front, 2 fourths 10 parts and one-third.

Thickness of the right knee across the centre of the patella, 1 fourth 10 parts and a half.

Thickest part of the calf of the leg, 2 fourths 1 part and one-third.

Thickness of the small of the leg ditto just above the ankle, 1 fourth.

From centre to centre of each ankle bone, 1 fourth 5 parts.

Length of the right foot from the heel to the tip of the toe, 4 fourths 4 parts.

Broadest part of the said foot from the joint at the root of the great toe to ditto of the little toe, 1 fourth 9 parts.

Breadth of the face from ear to ear in front, 2 fourths 3 parts.

Ditto of the neck ditto in front about the middle, 2 fourths and half a part.

Length of the arm from the head of the deltoid to the tip of the elbow, 6 fourths 11 parts and one-third.

Thickest part of the arm measured in front across the biceps, 1 fourth 7 parts and a half.

Thickness of the arm in profile from the biceps to the triceps behind, 2 fourths 1 part and three-fourths.

Ditto of the body measured from the most prominent part of the pectoral muscle to the trapezius, 4 fourths 6 parts and one-third.

Narrowest part of the body in profile ditto, just above the navel, 3 fourths 7 parts and one-third.

Thickest part of the thigh on the rectus just under the gluteus, 4 fourths 4 parts and one-third.

Thickness of the knee in profile on the centre of the patella, 2 fourths 2 parts.

Thickest part of the calf of the leg in profile, 2 fourths 2 parts and three-fourths.

Smallest of ditto, 1 fourth 4 parts.

Breadth from point to point of the ilium, 3 fourths 9 parts and two-thirds.

Total length of the figure, allowing 4 fourths to the head, and measuring down the line of the centre of the body, then laying a line parallel with the points of the ilium, and measuring down the middle of the thigh to the sole of the right foot, 31 fourths 4 parts.
From ear to ear measured across the face, 2
fourths 3 parts and a half.
Thickest thickness of the neck in front, 2
fourths 1 part.
From the pit between the clavicles to the back of the shoulder measured horizontally, 4
fourths 4 parts.

From the great trochanter of the left thigh to the most prominent part of the right thigh measured horizontally, 5
fourths 9 parts and one-half.

Thickest part of the right thigh measured horizontally across the middle of the rectus, 3
fourths.

Ditto of the left ditto continuing the same horizontal line, 2
fourths 8 parts.

Right knee across the centre of the patella, 1
fourth 10 parts; left ditto, ditto.
Thickest part of the calf of the right leg, 2
fourths 1 part and a half; ditto of the left, 2
fourths and a third of a part.

Thickest part of the ankle of the left leg, 1
fourth 1 part and a fourth; right, ditto.

Thickest part of the ankles from the centre of bone to bone, 1
fourth 2 parts and three-fourths.

Thickest part of the right foot from the joint at the root of the great toe, 1
fourth 9 parts.

Ditto, ditto of the left foot, 1
fourth 8 parts.

From the head of the deltoid muscle to the tip of the right elbow measured within, in
front, 6
fourths 2 parts.

From the tip of the elbow to the centre of the ulna at the right wrist, 4
fourths 4 parts, and a half.

From the head of the deltoid to the left elbow, 5
fourths 9 parts and a half.
Thickest part of the body from the most prominent part of the pectoral muscle before, to the most prominent part of the scapula, taken horizontally in profile, 4
fourths 10 parts and a half.

Narrowest part of the body measured just above the navel, 3
fourths 6 parts.

From the hollow of the thigh at the head of the rectus before, to the most prominent part of the gluteus behind, 4
fourths 2 parts.

Thickest part of the right thigh measured below the gluteus, 3
fourths 5 parts and a half.

Thickest part of the right knee in profile from the centre of the patella to the hollow below, 2
fourths 2 parts and a half.

Thickest part of the calf of the right leg in profile, 2
fourths 2 parts; ditto above the ankle, 1
fourth 5 parts.

Length of the right foot, 4
fourths 4 parts and three-fourths.

Thickest part of the right arm from the biceps to the triceps, 1
fourth 11 parts and a half.

Broadest part of the wrist from bone to bone, 1
fourth 2 parts.

Thickest part of the neck taken in profile, 2
fourths.

For the greatest number of the so much admired Grecian statues lay, for a long series of years, buried under the ruins of Rome.

The following is a brief account of the
Discovery of several of the most celebrated statues, or groups, in various parts of Rome.  

I. The equestrian statue of M. Aurelius was found on the Caelian hill, near the pre-

ent church of St. John Lateran, in the por-
ticate of Sixtus IV. (1471 to 1484) who placed it in that place. About the year 1540 it was removed to the capitol, under the di-
rection of Michel Angelo.

II. The torso of Hercules in the Vatican, was found in the Campo de’ Fiori, in the time of Julius II.

III. The group of the Laocoön was discovered in the vineyard of Guiltieri, near the baths of Titus, by Felix de Fredis, in 1512, as recorded on his tomb in the church of Ara Coeli.

IV. In the reign of Leo X: the Antinous, or Mercury according to Visconti, was found on the Esquiline hill, near the church of St. Martin.

V. Leo was likewise successful in recovering from oblivion the Venus called de Medicis. It was found in the portico of Octavia, built by Augustus, near the Theatre of Marcellus, in the modern Pesciera. Removed to the gallery at Florence by Cosmo III. in 1676.

VI. The colossal Pompym of the Spada palace, was found during the pontificate of Leo XIII. (1559 to 1554) near the church of St. Lorenzo in Damaso.

VII. The Hercules, and the group of Dirce, Zethus, and Amphion, called "Il toro," now at Naples, were dug up in the baths of Caracalla, and placed in the Farnese palace, about the middle of the sixteenth century.

VIII. The Apollo Belvidere, and the Gla-
diator of the Villa Borghese, were taken from under the ruins of the palace and gardens of the Antium, 40 miles from Rome, when the Casino was made there by cardinal Borghese, during the reign of Paul V. (1605 to 1612).

IX. Soon afterward, the sleeping Faun, now in the Barberini palace, was found near the mausoleum of Hadrian.

X. The Mirmillo Expirans, or Dying Gladi-
diator of the capitol, was dug up in the gardens of Salust, on the Ficinan hill, now in the Villa Borghese, was purchased by Benedict the 14th, of cardinal Lodovisi.

XI. The small Harpocrates and the Venus of the Capitol were found at Tivoli in the same reign.

 XII. The Meleager, once in the Picchini collection, now in the Vatican, was found near the church of St. Bibiena.

STATUTE, in its general sense, signifies a law, ordinance, decree, &c. Statute, in our laws and customs, more immediately signifies an act of parliament made by the three estates of the realm; and such statutes are either public, of which the courts at West-
minster must take notice, without pleading a new cause; or they are special and private, which last may be pleaded. It is held, that a public
statute, made in affirmation of the common law, extends to all times after the making thereof, although it mentions only a re-
medy for the present; and where a thing is given or granted by statute, all necessary in-
cidents are at the same time granted with it.

The most natural exposition of a statute is, to construe one part by another of the same statute, because that best expresses the intent of the legislature. In general, it is, or ought to be expounded in suppression of the mischief, and for the advancement of the remedy desired by any statute, yet so that
to innocent person may suffer or receive any damage thereby. It is held, that statutes will continue in force, though the records of them are destroyed. &c. But if a statute is against reason, or impossible to be performed, the same is void of its own nature.

When a statute is repealed, all acts done under it, while it was in force, are good; but if it is declared null, all these are void. Jenk. 333, pl. 6.

Here a statute, before perpetual, is continued by an affirmant statute, for a time, this does not amount to a repeal of it at the end of that time. Lord Raym. 397.

Where two acts contradictory to each other, are passed in the same session, the latter only shall take effect. 6 Mod. 287.

STATUTE MERCHANT, is a bond of record, acknowledged before one of the clerks of the statute merchant, and lord mayor of the city of London, or two merchants of the said city, for that purpose assigned, or before the mayor or warden of the town, or other discreet men for that purpose appointed. This recognizance is to be entered on a roll, which must be double, one part to remain with the mayor, and the other with a clerk, who shall write with his own hand a bill obligatory, to which a seal of the king for that purpose appointed, shall be annexed, together with the seal of the
debtor. 2 Inst. Abr. 331.

The design of this security was to promote and encourage trade, by providing a sure and speedy remedy for merchant-servers, as well as natives, to recover their debts at the day assigned for payment.

But though the statute-merchant seems first to be introduced, and wholly calculated, for the ease and benefit of merchants, as the name itself imports; yet they were not long engrossed by them: for other men finding from their own observation, that they have much of the same nature with judgments in Westminster-hall, but obtained with less trouble and expense, out of regard to their own interest and quiet, easily fell into this way of contracting, and by degrees it came into the nature of a custom, and was improved into an absolute assurance, as we find it at this day. Winch. 83. See Insur-

ANCE.

STATUTE STAPLE, is a bond of record, acknowledged before the mayor of the staple, in the presence of all or one of the constables. But now statute staple, as well as statute merchant, are in a great measure become obsolete.

STATUTES, of Statutes sessions, other-
wise called petit sessions, are a meeting in every hundred, of all the shires in England, where by custom they have been used, whereunto the constables and others, both house-
holders and servants, repair for the debating of differences between masters and servants, the rating of servants’ wages, and bestowing such people in service, as being fit to serve, either refuse to seek or get masters. Stat. 5 Eliz. c. 5.

STAVES, in music, the five horizontal and parallel lines on and between which the notes are placed.

Guido, the great improver of the modern music, is said by some to have first used the stave; but others give an earlier date to its introduction. Kircher affirms, that in the Jesuit’s library at Messina he found a Greek manuscript of hymns more than seven hun-
dred years old, in which some of the music
was written on slaves of eight lines, marked at the beginning with eight Greek letters; the notes, or rather points, were on the lines, but no use was made of the spaces. This, however, at most, only deprives Guido of the original invention of the stave, and still leaves him the credit of its great improvement by reducing it to five lines, and employing both lines and spaces.

**STAUROLITE, in mineralogy.** This stone has been found at Andreasberg in the Harz. It is crystallized, and the form of its crystals has led mineralogists to give to the name of cross-stone. Its crystals are two-sided, flattened prisms, terminated by four-sided pyramids, intersecting each other at right angles; the plane of intersection passing longitudinally through the prism. Sometimes these prisms occur solitary. Primitiv form, an octahedron with isosceles triangular faces. The faces of the crystals striated longitudinally.

The texture is foliated. Its lustre glassy. Brittle. Specific gravity 2.33 to 2.36. Colour milk-white. When heated slowly, it loses 0.15 or 0.16 parts of its weight, and falls into powder. It effervesces with borax and microcrystalline of charcoal, and is esteemed to a greasy opaque mass. With soda it melts into a frothy white enamel. When its powder is thrown on a hot coal, it emits a greensh-yellow light.

A specimen analysed by Westrum was composed of:

- 44 silica
- 20 alumina
- 20 barytes
- 16 water

100.

Klaproth found the same ingredients, and nearly in the same proportions.

A variety of staurolite has been found only once, which has the following properties:

Its lustre is pearly. Its transparency 2.50. Colour a brownish-grey. With soda it melts into a purplish and yellowish frothy enamel. It is composed, according to Westrum, of:

- 47.5 silica
- 12.0 alumina
- 20.0 barytes
- 16.0 water
- 4.5 oxides of iron and manganese

100.0.

**STEEL, a carburet of iron, or that metal combined with a small portion of carbon. See Iron.**

**STEERING, on board a ship, that part of the ship next below the quarter-deck, before the bulkhead of the great cabin, where the steersman stands in most ships of war. See the next article.**

**STEERING, in navigation, the directing of a vessel from one place to another by means of the helm and rudder. He is held the best steersman who causes the least motion in putting the helm over to and from it, and who keeps the ship from making yaws, that is, from running in and out. There are three methods of steering:

1. By any mark on the land, so as to keep the ship even by it.
2. By the compass, which is kept fixed on the ship's head, and is reduced to a rhumb or point of the compass as best leads to port.
3. To steer as one is bidden or conned, which, in a great ship, is the duty of him that is taking his turn at the helm.**

**STELLARIA, stellwort, a genus of plants belonging to the class of dicotandria, and order of trignia, and in the natural system arranged under the 220rd order, caryophyllae. The calyx is pentaphyllous and spreading. The petals are red, pink, or white, the stamens are divided into two segments. The capsule is oval, unilocular, and polyspernum. There are 17 species; three of these are British plants. 1. Nemorum, broad-leaved stichwort, is an evergreen, with green leaves, common in woods and hedges. 3. Graminea, less stichwort. The stem is near a foot high. It is frequent in dry pastures.**

**STELLATE. See Botany.**

**STELLERIA, German groundsel, a genus of plants belonging to the class of octandria, and order of monogynia, and in the natural system arranged under the 313rd order, vergeculce. There is no calyx; the corolla is quadridenata. The stamens are very short; there is only one seed, which is black. The species are two in number, passerina and chamaejasme.**

**STEM. See Botany.**

**STEM, of a ship, that main piece of timber which comes bending from the keel below, where it is scarfed, as they call it, that is, pieced in; and rises compassing right before the forecastle. This stem it which guides the rake of the ship, and all the weight of the planks are fixed into it. This, in the section of a first-rate ship, is called the main stem. See Ship-building.**

**STEMMATA, in the history of insects, are three smooth hemispheric dots, placed generally on the top of the head, as in most of the hystenopterous and other classes.**

**STENODILS, a genus of plants belonging to the class of dicotyledon, and order of angiosperma, and in the natural system ranging under the 27th class, and 26th order, of flora. The calyx is quinquartate; there are five stamens; each of the filaments is bilb, and they have two antherae. The capsule is bicollar. There are four species, herbs of the East and West Indies.**

**STENOGRAPHY. The art of stenography, or short-hand writing, was known and practised by most of the ancient civilized nations. The Egyptians, who were distinguished for learning at an early period, at first expressed their words by a delineation of figures called hieroglyphics. A more concise mode of writing seems to have been afterward introduced, in which only a part of the symbol or picture was drawn. This answered the purpose of short-hand in some degree. After them the Hebrews, the Greeks, and the Romans, adopted different methods of abbreviating their words and sentences, suited to their respective languages. The initials, the letter were reduced for whole words; and various combinations of these sometimes formed a sentence. Arbitrary marks were likewise employed to determine the meaning, and to assist legibility; and it seems probable that the compiler, and every author of antiquity, had some peculiar method of abbreviation, calculated to facilitate expression of his own sentiments, and intelligible only to himself. All the were probably, that some might by these means take down the heads of a discourse or oration; but few, very few, it is, presumed, could have followed a speaker through all the meanders of rhetoric, and noted with precision every syllable, as it dropped from his mouth, in a manner legible even to themselves. To arrive at perfection in the art was reserved for more modern times, and is still an acquisition by no means, general. In every language of Europe, till about the close of the 16th century, the Roman plan of abbreviating (viz. substituting the initials or radicals, with the help of arbitrary characters) was the standard employed. Till then no regular alphabet had been invented expressly for stenography, when an English gentleman of the name of Willis invented and published one; since which we have had a multitude of others by Mason, Gurney, Byron, Palmer, &c. &c. The following is extracted from Dr. Mavor's treatise on the art, which has met with general approbation.**
STENOGRAPHY.

Hewho mdu us mbe ental, grt, nd nmnpnt.
It is ur dry, as rut bags, to sry, te, nd obly h.
A nnt tdl wdd, knd, nd b skunk in.
I wk, wh th wll hst to pss evry bdy.
I w ftm frm any knxs wth n nmn who
nd n rd fr hntt; nd b w w w w w.
N w w w w w w w w.

The characters expressing nine of the consonants are all perfectly distinct from one another; eight only remain which are needful, viz., f, v, d, b, p, g, r, w, and s, to find characters for which we must have recourse to mixed curves and lines. The characters which we have adopted are the simplest in nature after those already applied, admit of the easiest joining, and tend to preserve linearity and beauty in the writing. It must be observed that we have no character for c when it has a hard sound, as in conte; or soft, as in city; for it naturally takes the sound of k or ñ, which in all cases will be sufficient to supply its place.

Rlikewise is represented by the same character as 1; only with this difference, r is written with such an ascending stroke and l with a descending; which is always to be distinguished from the form of the following character; but in a few monosyllables, where r is the only consonant in the word, and consequently stands alone, it is to be made as is shown in the alphabet for distinguishing it from s.

Z, as it is a letter seldom employed in the English language, and only a coarser and harsher expression of s, must be supplied by s whenever it occurs; as for Zedekiah, write Sdekkiah, &c.

The prepositions and terminations in this scheme are so simple, that the greatest benefit may be reaped from them, and very little trouble required to attain them; as the incipient letter or the incipient consonant of all the prepositions, and of several of the terminations, is used to express the whole. But although in the Plate sufficient specimens are given of the manner of their application, that the learner of less ingenuity or more slow perception may have every assistance, we have subjoined the following directions:

1. The preposition is always to be written without joining, yet so near as plainly to show what word it belongs to; and the best way is to observe the same order as if the whole was to be connected.

2. A preposition, though the same letters that constitute it may be met with in the middle or end of a word, is never to be used, because it would expose it to obscurity.

3. Observe that the preposition omni is expressed by the vowel o in its proper position; and for anti, am, ante, by the vowel o, which is the radical part of the word which will easily distinguish from being only simple vowels.

The first rule for the prepositions is (allowing such exceptions as may be seen in the Plate) to be observed for the terminations; and also the second mutatis mutandis, except that whenever s, sus, sus, cions, tions, and ces, occur, they are to be expressed a distinguished in the fourth rule for the consonants, whether in the beginning, middle, or end of words.

4. The terminative character for tio, cion, cion, cion, cion, cion, is to be expressed by a small vertical line placed over the next or penultimate letter when next or penultimate is the right; and the plurals, tions, cions, cions, cions, cions, cions, tions, tions, tions, by a dot on the same side.

**Vol. II.**
The mode of stereotype printing is, first to set up a page, for instance, in the common way, and when it is rendered perfectly correct, a cast is taken from it, and in this cast the metal plate is poured. For the sake of economy, this method of printing has lately been brought into practice by Earl Stanhope, who seems to have overcome all difficulties, and to have rendered the art as perfect as can be expected. His lordship intends to make the invention public.

STERLING, a term frequent in British commerce. A pound, shilling, or penny, signifying as much as a pound, shilling, or penny, of lawful money of Great Britain, as settled by authority.

STERNE, the term, a genus of birds of the order anseres. The marks of this genus are a straight, slender, pointed bill, linear nostril, a slender and sharp tongue, very long wings, a small back toe, and a forked tail. There are 23 species, according to Dr. Latham; the caspia, cayama, surinamensis, fuligiceps, africana, stolba, philippina, simplex, milvina, boissi, striata, vittata, gallica, albonitida, hierodula, pannonica, chrysa, alba, mutica, sinensis, australis, metopoliscus, fisipes, nigra, and obscura. Three of these only are found in Great Britain; the hierodula, minuta, and fisipes. See Plate Nat. Hist. fig. 377.

1. The hirundo, common tern, or great sea-swallow, weighs four ounces one quarter; the length is fourteen inches; the breadth thirty; the bill and feet are of a fine crimson; the breast of the crown, and a small part of the head, black; the throat, and whole underside of the body, white; the upper part, and the coverts of the wings, a fine pale-grey. This is a very common species, frequent on sea-coasts, the mouths of lakes and rivers during the summer, but is most common in the neighbourhood of the sea. It is found also in various parts of Europe and Asia, according to the season; in the summer, as far as Greenland and Spitzbergen, migrating in turn to the South of Austria and Greece. It lays three or four eggs about the month of June, of a dull olive-colour.

These are laid among the grass or moss.

The young are hatched in July, and quit the nest very soon after. They are carefully fed by their parents, and fly in about six weeks. This bird appears to have all the actions on the water which the swallow has on land, skimming on the surface, and seizing on every insect which comes in its way; besides which, the moment it spies a fish in the water, it darts into that element, and seizing its prey, arises as quickly to the place from which it dipp't.

2. The sterna, or smaller sea-swallow, weighs only two ounces five grains; the length is eight inches and a half, the breadth nineteen and a half. The bill is yellow, tip with black; the forehead and cheeks white; from the eyes to the bill is a black line; the top of the head and back part black; the breast and under side of the body cloathed with feathers so closely set together, and of such an exquisite rich gloss and so fine a white, that no satin can be compared to it. These two species are very delicate, and seem unable to bear the inclemency of our shores during winter, for we observe that they quit their breeding-place at the approach of it, and do not return till spring. The manner, haunts, and food, of this species, are the same with those of the former; but they are far less numerous.

3. The fissipes, or black tern, is of a middle size between the first and second species. The usual length is ten inches; the breadth 24; the weight two ounces and a half. The head, neck, breast, and belly, as far as the vent, are black; beyond is white; the male has a white spot under his chin; the back and wings are of a deep ash-colour; the tail is short and forked; the exterior feather on each side is white; the outside, an ashy colour, the legs and feet of a dusky red. These bear frequent fresh waters, breed on their banks, and lay three small eggs of a deep olive-colour, much spotted with black. They are found during spring and summer in vast numbers in the main of Lincolnshire, make an incessant noise, and feed on flies as well as water-insects and small fishes. Birds of this species are seen very remote from land.

STERDIPHY, a genus of fishes of the order apodes. The head oblate, teeth very minute; gill membrane broad; body compressed, without apparent scales; breast, carinate folded; belly pellicled. There is but a single species, that inhabits America, viz. diaplanus.

STERNUM. See Anatomy.

STEWARD, a man appointed in a place or estate, and always signifies a principal officer within his jurisdiction. The greatest of these is the lord-high-steward of England; and that office being very great, of late he has not usually been appointed for any length of time, but only for the dispatch of some special business, as the trial of some nobleman in cases of treason, &c. after which his commission expires.

STICKLEBACK. See Gasterosteus.

STICKS, feet, in printing, slips of wood that lie between the foot of the page and the chase, to which they are wedged fast by the quins, to keep the form firm, in conjunction with the side-sticks, which are placed at the side, the pages being fixed in the same manner by means of quoins.

STIGMA, in entomology, a spot or anastomosis in the middle of the wings of insects near the anterior margin, conspicuous in the hymenopterous tribes.

STIGMATA, in natural history, the apertures in different parts of the bodies of insects or crustaceans, to receive the reproductive organs, or air-vessels, and serving for the office of respiration.

STIGMATIZING, among the antients, was inflicted upon slaves as a punishment, but more frequently as a mark to know them by; in which case it was done by applying a red-hot iron marked with certain letters to
their foreheads, till a fair impression was made, and then pouring ink into their furrows, that the inscription might be the more conspicuous. Stigmata, among some nations, are the marks of a distinguishing mark of honour and notoriety.

STILACO, a genus of plants belonging to the class of gymnospermae, and order of triandria. There is one female. The calyx is monopetalous, and almost three-lobed. There is no corolla, and the berry is globular. There are three species, the pinaster, encoides, and cernus, all foreign plants.

STILBE, in botany, a genus of plants belonging to the class of polygamous, and order of dicotyledons. The exterior calyx of the hermaphroditic flower is triphyllous; the interior is quinquedentate and carpogynous. The corolla is funnel-shaped and quincuncial. There are four stamina and there is one seed in the interior calyx calyptra. The female flower is similar, but has no interior calyx nor fruit. There are three species, the pinaster, encoides, and cernus, all foreign plants.

STILBITES. This stone was first formed into a distinct species by Mr. Hawy. Formerly it was considered as a variety of zoila.

The primitive form of its crystals is a rectangular prism, whose bases are rectangles. It crystallizes sometimes in dodecahedrons, consisting of a four-sided prism with hexagonal faces, terminated by four-sided summits, whose faces are oblique parallelograms; sometimes in six-sided prisms, two of whose solid angles are wanting, and a small triangular face in their place. Its texture is foliated. The laminae are easily separated from each other, and are somewhat flexible. Lustre: Pearl. Hapness inferior to that of zoila, which scratches stilbite. Brittleness: Specific gravity 2.360. Colour: Pearl white, or grey. Powder bright white, sometimes with a shade of red. This powder, when exposed to the air, cakes and adheres as if it had absorbed water. It causes syrup of violets to assume a green colour. It is somewhat decomposed in a porous crucible, it swells up and assumes the colour and semitransparency of baked porcelain. By this process it loses 0.185 of its weight. Before the blowpipe it froths like borax, and is dissipated into an opaque white, coloured enamel. Does not gelatinise in acids. Not electric by heat.

According to the analysis of Vanquelin, it is composed of

<table>
<thead>
<tr>
<th>Component</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>50.0 silica</td>
<td></td>
</tr>
<tr>
<td>17.5 alumina</td>
<td></td>
</tr>
<tr>
<td>9.0 lime</td>
<td></td>
</tr>
<tr>
<td>18.5 water</td>
<td></td>
</tr>
<tr>
<td>97.0</td>
<td></td>
</tr>
</tbody>
</table>

It occurs most commonly in lava, but is found also in primitive rocks.

STILL. See Distillation.

STILLINGIA, a genus of plants belonging to the class of monocotyledonae, and the order of monocotyledones. The male calyx is spherical and multinerved. The corolla is tubular, and erose or grained. The female calyx is unilocular and inferior. The corolla is superior. The style is trifid, and the capsule three-grained. There is only one species, the sylvatica.

STING, an apparatus in the body of certain insects, in form of a little spear, serving them as a weapon of offence. The sting of a bee or wasp is a curious piece of mechanism: it is hollow, as shown in fig. 2; there is of there a bag full of sharp penetrating juice, which in stinging is injected into the flesh, through the tube; within the tube, Mr. Derham has observed, there lie two sharp small hard spines. In the sting of a wasp he told eight beads on the sides of each spine, somewhat like the beads of fish-books. One of these spines in the sting, or shesh, lies with its point a little before the other, to be ready, as should seem, to be dropped into the flesh, which once fixed by means of its foremost bead, the other then strikes too, and so they alternately pierce deeper and deeper, their heads taking more and more hold in the flesh; after which the second or sting follows to convey the poison into the wound, which, that it may pierce the better, is drawn into a point with a small slit below that point for the two spines to come out at. By means of these beads it is, that the animal is thereby forced to lower itself behind it, when disturbed, because it can have no time to withdraw the spines into the scabbard.

STIPAS, feather-grass, a genus of plants belonging to the class of triandria, and order of graminées. There are two species, STILAGO, STILBE, under the 4th order, graminées. The calyx is bivalved. The exterior valve of the corolla is terminated by an awn; the base is jointed. There are 14 species. Of these, the common species is the feather-grass. The beards are feathered. The plant rises to the height of ten inches, grows on mountains, and flowers in July or August.

STIPULA. See Botany.

STIRRUP of a ship, a piece of timber put upon a ship's keel, when some of her keel happens to be broken off, and they cannot come conveniently to put or fit in a new piece; then they patch in a piece of timber, and bind it on with an iron, which goes under the ship's keel, and comes up on each side of the ship, where it is nailed strongly with spikes, and this they call a stirrup.

The company offering a strong reward for finding the murderers, stock-jobbing was carried to an enormous extent, which ended in the ruin of thousands. When the mischief was done, a bill was brought into parliament to prevent this "infamous practice," though the experience of the past might have been considered as the best security that it would never again be carried to the same height. The act passed was soon found ineffectual, in consequence of which another was brought in by Sir John Barnard in 1732, which being rejected, it was brought forward again in 1734, and passed. It is stat. 7. and 8. Geo. c. 8. and declares all contracts and agreements residing in the encouragement to stock or securities, to be null and void, and the money paid thereon shall be restored, or it may be recovered by action commenced thereon within six months, with double costs. All contracts and agreements whatsoever,
made or entered into by buying, selling, assigning, or transferring any public or joint stock, or other public securities whatsoever, or of any part, share, or interest therein, whereof the person or persons contracting or agreeing shall be the same; or upon whose behalf the contract or agreement shall be made, to sell, assign, and transfer the same, shall not, at the time of making such contract or agreement, be actually possessed of, or entitled unto, in his, her, or their own name or names, or in trust for their use, are null and void to all intents and purposes whatsoever; and all and every person whatsoever contracting or agreeing, or on whose behalf, or with whose consent any contract or agreement shall be made to sell, assign, or transfer any public or joint stock or stocks, or other public securities, whereof such person or persons shall not, at the time of making such contract or agreement, be actually possessed of, or entitled unto, in their own name, or in the names of trustees to their use, shall forfeit 500l.

Notwithstanding these prohibitions and penalties, the practice of stock-jobbing has continued, and greatly increased; and though it is attended with many evil consequences, it is doubtful whether, if possible, it would be politic to prevent it, while the public debt continues of such enormous amount; as the current value of the public funds would frequently be greatly depressed if it was not supported by the transactions of those who make a regular trade of dealing therein.

STOCKS, the public funds of the nation instituted for the purpose of paying the interest of the loan. See Loan.

STOCKS, among ship-carpenters, a frame of timber, and great posts made ashore, to build pinneys, ketches, boats, and such small craft, and sometimes small frigates. Hence we say, a ship is on the stocks when she is a building.

STOCKS, a wooden machine to put the legs of offenders in, for the securing of disorderly persons, and by the way of punishment in cases of serious breach. And it is said, that every vill within the precinct of a town is inducible for not having a pair of stocks, and shall forfeit 50l.

STOEBE, a genus of the syngeossy polyantha segregata class of plants; the corolla of the flowers is equal; the proper one is monopetalous and funnel-shaped; the limb is quinquefid and patulous; there is no pericarpium; the seed, which is contained in the cup, is solitary, oblong, and crowned with a long hairy pap. There are nine species.

STOKESIA, a genus of the syngeossy polyantha equatilis class and order of plants. The corollis in the ray are funnul-form, longer, irregular; down four-bristled; recept. naked. There is one species, a herb of South Carolina.

STOLE, gown of the, the eldest gentleman of his majesty's bed-chamber, whose office and honour it is to present and put on his majesty's first garment, or shirt, every morning, and to order the things in the chamber.

STOLEN GOODS. To help people to stolen goods for reward without apprehending the felon. 4 G. I. c. 11.

Persons having or receiving lead, iron, copper, brass, bell-metal, or solder, knowing the same to have been stolen, shall be transported.

29 G. II. c. 30.

STOMACH. See Anatomy.

STOMATEUS, a genus of fishes of the order apodes; the generic character is, head compressed; teeth in the jaws and palate; body oval, broad, slippery, tail forked. There are three species, viz. the farlota, body beautifully barred, each in its proper sheath; feeders, two, short, setaceous, of five articulations; antennæ setaceous. There are 16 species.

STONE, calcinus humanus. See Calculi, and Medicine.

STONES from the atmosphere. See Meteorology.

STONES. See Mineralogy.

STONES and EARTH, analysis of. The only substances which enter into the composition of the simple stones, as far at least as analysis has discovered, are the six earths, silica, alumina, zirconia, gluhia, lime, and magnesia; and the oxides of iron, manganese, nickel, chromium, and copper. Seldom more than four or five of these substances are found combined together in the same stone; we shall suppose, however, in order to prevent unnecessary repitions, that they are all contained in the mineral which we are going to analyse.

Let 100 or 200 grains of the stone to be analysed, previously reduced to a fine powder, be mixed with three times its weight of pure potassa and a little water, and exposed in a silver crucible to a strong heat. The heat should at first be applied slowly, and the mixture should be constantly stirred to prevent the potassa from swelling and throwing any part out of the crucible. When the whole water is evaporated, the mixture should be kept for half an hour or three quarters of a pint.

If the matter in the crucible melts completely, and appears as liquid as water, we may be certain that the stone which we are analysing consists chiefly of silica; if it remains opaque, and of the consistence of paste, the other earths are more abundant; if it remains in the form of a powder, alumina is the prevalent earth. If the matter in the crucible is of a dark or brownish red colour, it contains oxide of iron; if it is greenish, manganese is present; if it is yellowish green, it contains chromium.

When the crucible has been taken from the fire and wiped on the outside, it is to be placed in a mortar, and ground to powder with water. This water is to be renewed, from time to time, till all the matter is detached from the crucible. The water dissolves a part of the combination of the alkali with the silica of the stone; and if a sufficient quantity was used, it would dissolve the whole of that combination.

Muriatic acid is now to be poured in till the whole of the matter is dissolved. At first a facky precipitate appears, because the acid combines with the alkali which kept it in solution; when the effervescence takes place, owing to the decomposition of some carbonat of potassa formed during the fusion. At the same time the facky precipitate is dissolved; as is also that part of the matter which is dissolved in a concretion formed in the water, had remained at the bottom of the dish in the form of a powder. This powder, if it consists only of silica and alumina, dissolves without effervescence; but if it contains one, an effervescence takes place.

If this solution in the acid is colourless, we may conclude that it contains no metallic oxide, or only a very small portion; if its colour is purplish red, it contains manganese; if brownish-red indicates the presence of iron; and golden yellow the presence of chromium.

This solution is to be poured into a capsule of porcelain, covered with paper, and evaporated to dryness in a sand-bath. When the evaporation is finished towards its completion, the liquor assumes the form of jelly. It must then be stirred constantly with a glass or porcelain rod, in order to facilitate the separation of the acid and water, and to prevent one matter from being too much, and another not sufficiently, dried. Without this precaution, the silica and alumina would not be completely separated from each other.

When the matter is reduced almost to a dry powder, a large quantity of pure water is to be poured on it; and, after exposure to a slight heat, the whole is to be poured on a sieve. The powder which remains upon the sieve is to be washed repeatedly, till the water with which it has been washed ceases to precipitate silver from its solutions. This powder is the whole of the silica which the stone that we are analysing contained. It must first be dried between folds of blotting paper, then heated red-hot in a platinum or silver crucible, and weighed while it is yet warm. It ought to be a fine powder, of a uniform colour, not adhering to the fingers, and easily soluble. If it is coloured, it is contaminated with some metallic oxide; and shews that the evaporation to dryness has been performed at too high a temperatute. To separate this oxide, the silica must be precipitated repeatedly, till it is washed and dried as before. The acid solution must be added to the water which passed through the filter, and which we shall denominate A.

The watery solution A is to be evaporated till its quantity does not exceed 30 cubic inches, or nearly an English pint. A solution of carbontat of potassa is then to be poured into it, till no more mater precipitates. It ought to be boiled a few moments to enable all the precipitate to fall to the bottom. When the whole of the precipitate has collected at the bottom, the supernatant liquid is to be decanted off; and water being substituted in its place, the precipitate and water are to be thrown upon a filter. When the water has run off, the filter with the precipitate upon it is to be placed between the plates of blotting paper. When the precipitate has acquired some consistence, it is to be carefully collected by an ivory knife, mixed with a solution of pure potassa, and baked in a porcelain capsule. If any alumina...
or glucina is present, they will be dissolved in the potass; while the other substances remain untouched in the form of a powder, which we shall call B.

Into the solution of potass as much acid must be poured as will not only dissolve the potass, but also completely redissolve any precipitate which may have at first appeared. Carbonate of ammonia is now to be added in such quantity that the liquid shall taste of it. By this addition the whole of the alumina in the precipitate will be rendered precipitate in white flakes, and the glucina will remain dissolved, provided the quantity of carbonate of ammonia used is not too small. The liquid is now to be filtered; and the aluminium which will remain on the filter is to be washed, dried, heated red-hot, and then weighed. To see if it is really alumina, dissolve it in sulphuric acid, and add a sufficient quantity of sulphat of acetat of potass; if it is alumina, the whole of it will be converted into crystals of alum.

Let the liquid which has passed through the filter be boiled for some time; and the glucina, if it contains any, will be precipitated in a light powder, which may be dried and weighed. When pure, it is a fine, soft, very light powder, which does not concret when heated, as alumina does.

The residuum B may contain lime, magnesia, and one or more metallic oxides. Let it be dissolved in weak sulphuric acid, and the solution evaporated to dryness. Pour a small quantity of water on it. The water will dissolve the sulphat of magnesia and the metallic sulphats; but the sulphat of lime will remain undissolved, or if any portion dissolves, it may be thrown down by the addition of a little weak alcohol. Let it be heated red-hot in a crucible, and weighed. The difference of the weights will give the weight of the lime.

Let the solution containing the remaining sulphats be diluted with a large quantity of water, and let a small excess of acid be added; and after being heated, let the liquid be decanted off. Let the precipitate, which consists of the oxides of iron and nickel, be washed with pure water; and let this water be added to the solution of the nitric acid and potass. That solution contains the chromium converted into an acid. Add to this solution an excess of muriatic acid, and evaporate till the liquid assumes a green colour; then add a pure alkali. The chromium precipitates in the state of an oxide, and may be dried and weighed.

Let the precipitate, consisting of the oxides of iron and nickel, be dissolved in muriatic acid; add an excess of ammonia; the oxide of iron precipitates. Let it be washed, dried, and weighed.

Evaporate the solution, and the oxide of nickel will also precipitate, or the whole may be precipitated by adding hydroxyluret of ammonia; and its weight may be ascertained in the same manner as before on the other ingredients.

The weights of all the ingredients obtained are now to be added together, and their sum total compared with the weight of the matter submitted to analysis. If the two are equal, or if they differ only by .03 or .04 parts, we may conclude that the analysis has been properly performed; but if the loss of weight is considerable, something or other has been lost. The analysis must therefore be repeated with all possible care. If there is still the same loss of weight, we may conclude that the stone contains some substance, which has either evaporated by the heat, or is soluble in water.

A fresh portion of the stone must therefore be broken into small pieces, and exposed in a porcelain crucible to a strong heat. If it contains water, or any other volatile substance, it will come over into the receiver, and the pure stone will remain unattainable.

If nothing comes over into the receiver, or if what comes over is not equal to the weight weighing, we may conclude that the stone contains some ingredient which is soluble in water.

To discover whether it contains potass, let the stone, reduced to an impalpable powder, be boiled five or six times in succession with very strong sulphuric acid, applying a pretty strong heat towards the end of the operation, in order to expel the excess of acid; but taking care that it is not hot enough to decompose the salts which have been formed.

Water is now to be poured on; and the residuum, which does not dissolve, is to be washed with water till it becomes tasteless. The watery solution is to be filtered, and evaporated to dryness, in order to drive off any excess of acid which may be present. The salts are to be again dissolved in water; and the solution, after being boiled for a few moments, is to be filtered and evaporated to a consisting proportion of the acid.

If the residuum cannot be dissolved, add a sufficient quantity of alumina; or if it is not sufficient, let it be redissolved, and then evaporated to dryness, and the residuum again dissolved in water, and evaporated.

Sulphat of potass will crystallize first; and by a second evaporation of the stone, contains potass and alumina, crystals of alum will be deposited.

STONES.

Soda, the presence of this alkali may be discovered by decomposing the solution in sulphuric acid, already described, by excess of ammonia. The liquid that is to be evaporated to dryness, and the residuum is to be calcined in a crucible. By this method, the sulphat of potass will be volatilized, and the sodas will remain. It may be redissolved in water, crystallized, and examined.

If sulphuric acid does not attack the stone, as it is often the case, it must be decomposed by fusion with soda, in the same manner as formerly directed with potass. The matter, after fusion, is to be diluted with water, and then saturated with sulphuric acid. The solution is to be evaporated to dryness, the residuum again dissolved in water, and evaporated. Sulphat of soda will crystallize first; and by a second evaporation of the stone, contains potass and alumina, crystals of alum will be deposited.

STONES, earthy. Crooked divided this order into nine genera, corresponding to nine earthly species, one of which had disposed the stones arranged under each genus.

The names of his genera were, calcarce, silicea, graminea, argillacea, mucedus, flores, asbestina, zeolithica, magnesia. All his earths were afterwards found to be compounds, except the first, second, fourth, and fifth. Bergman, therefore, in his Scagrophilia, first published in 1782, reduced the number of genera to five; which was the number arbitrary, which he wrote. Since that period five new earths have been discovered. Accordingly, in the latest systems of mineralogy, the genera belonging to this order are proportionately increased. Each genus is named from an earth, as follows:

2. Siliceous genus.
3. Calcareaous genus.
5. Baryte genus.
6. Argillaceaous genus.
7. Stonian genus.

Mr. Kirwan, in his valuable system of mineralogy, has adopted the same genera. Under each genus, the stones are composed chiefly of the earth which gives a name to the genus, or which at least are supposed to possess the characters which distinguish that earth.

A little consideration will be sufficient to discover that there is no natural foundation for these genera. Most stones are composed of two, three, or even four ingredients; and in many cases the proportion of two or more of these is nearly equal. Now, under what genus soever such minerals are arranged, the earth which gives it a name must form the smallest part of their composition. Accordingly, it has not been so much the chemical composition, as the external character, which has guided the mineralogist in the distribution of his species. The genera cannot be properly to have any character at all, nor the species to be connected by anything else than an arbitrary title. This defect, which must be apparent in the most valuable systems of mineralogy, seems to have arisen chiefly from an attempt to combine together an artificial and natural system.

The order of the substances enter into the minerals belonging to this order, in such quantity as to deserve attention, are the following:
Slate, sand. Under this arrangement are comprehended all the minerals which have an earthy basis combined with an acid. The minerals belonging to it are of course salt and as such have been described under their respective names. But as they occur naturally in states which cannot always be imitated by art, it will be necessary to take a view of them as they are found in the earth. They naturally divide themselves into five general as only five earthy bases have hitherto been discovered native in combination with an acid. These genera, and the species belonging to them, are the following:

I. Calcareous Salts.
1. Carbonate of lime,
2. Sulphate of lime,
3. Phosphate of lime,
4. Fluorescent of lime,
5. Arsenate of lime.

II. Barytic Salts.
1. Carbonate of barytes,
2. Sulphate of barytes.

III. Iron Salt.
1. Carbonate of iron,
2. Sulphate of iron.

IV. Magnesium Salts.
1. Sulphate of magnesia,
2. Carbonate of magnesia,

V. Aluminous Salts.
1. Alum,
2. Mellat of aluminia,

The minerals belonging to this order are distinguished without much difficulty from the last. All of them are soluble in water; but soluble in nitric acid, or in hot sulphuric acid. Most of them melt before the blowpipe. Their specific gravity varies; but it is often above 3.5 when the mineral is too soft to make a glass. None of them have the metallic lustre.

Stonehenge, in antiquity, a famed pile or monument of huge stones on Salisbury Plain, six miles distant from that city. It consists of the remains of four ranks of rough stones, ranged one within another, some of them, especially in the outermost, and third rank, twenty feet high, and seven broad: sustaining others laid across their heads and fastened by mortises, so that the whole must have answeringly lain together. Antiquaries are now pretty well agreed that it was a British temple; and Dr. Langwith thinks it might easily be made probable at least, that it was dedicated to the sun and moons.

Stone Ware. Under the denomination stone ware are comprehended all the different artificial combinations of earthy bodies which are applied to useful purposes. These vary in their names according to their external appearance, the manner in which they are manufactured, and the purposes to which they are applied. Thus we have porcelain, stone ware, pots, crucibles, &c., and these substances, however, are formed on the same principles, nearly of the same materials, and owe their good qualities to the same causes.

These combinations have been known from the remotest ages of antiquity. They were well known to the Jews, as we learn from the Old Testament, long before the Babylonish captivity. Porcelain, or the finest kind of stone ware, was first made in China and Japan; but the discovery of the art of making it in Europe is of much later date. Specimens of it were brought first from China and Japan to modern Europe. These were admired for their beauty, were eagerly sought after, and soon became the ornaments of the tables of the rich. Various attempts were made to imitate them in different countries of Europe, but the greater number were without success. Accident led to the discovery in Germany about the beginning of the 18th century. A chemist in Saxony, during a set of experiments in order to ascertain the best mixtures for making earthenware, stumbled upon a compound which yielded a porcelain similar to the eastern. In the course of this discovery, Saxony soon produced porcelain scarcely inferior to that of Japan in beauty, and superior to it in solidity and strength: but its composition was kept secret; nor were there any accurate ideas respecting the component parts of porcelain among men of science, till Reaumur published his dissertations on the subject in 1727 and 1729. He examined the porcelain of Japan, and the different imitations of it which had been produced in France and other parts of Europe. The texture of the first was compact and solid, but that of the imitations was porous. When both were exposed to strong heat, the first remained unaltered, but the others melted into glass. From these experiments he drew the following ingenious conclusions:

Porcelain owes its semi-transparency to a kind of semi-vitrification which it has undergone. Now it is produced in two ways:
1. Its component parts may be so easily vitrified when sufficiently heated; but the degree of heat given may be just sufficient to occasion the commencement of vitrification. This porcelain when thus heated with great ease melted. Such, therefore, was the composition of the European imitations of porcelain.
2. It may be composed of two ingredients; one of which easily vitrifies, but the other is not altered by heat. When a porcelain composed of such materials is baked in a sufficient heat, the fusible part melts, envelops the inelastic, and forms a semi-transparent substance, which is further altered by the same degree of heat. Such therefore must be the porcelain of Japan. Father Entrecolles, a missionary to China, had sent an account of the Chinese mode of making porcelain, which coincided exactly with this ingenious thought of Reaumur. The ingredients, according to him, are a hard stone called petusum, which they grind to powder, and a white earth called kaozin is intimately mixed with it. Reaumur found the petusum fusible, and the kaozin inexpressibly resistant, but not separately to a violent heat. See Porcelain.

Stone ware is not formed by mixing together the pure earths, which would be a great deal too expensive; but natural combinations or mixtures of earths are employed. These combinations have the following properties: 1. They must be capable, when reduced to powder, of forming with water a paste sufficiently ductile to be made into any form which is required. 2. This paste, after having been exposed to a sufficient heat, or after being baked as it is termed, must acquire such a permanent degree of hardness as to be able to resist the action of the weather and of water. 3. The vessels formed of it must in that state be capable of enduring changes of temperature. 4. They must be strong and tenacious, and not require a strong heat without being melted. 5. They must not be permeable to liquids, nor liable to be acted on by chemical agents.

Common clay possesses a good many of these qualities. When finely ground, it may be formed into a very ductile paste; heat makes it hard enough to strike fire with steel, and capable of resisting the action of most chemical agents; and it is not liable to be melted by heat. Clay accordingly was the first substance employed, and it is still employed for a variety of purposes.

Bricks, for instance, are always made of this substance. The clay is dug out of the earth, and after it has been exposed to the air, reduced to powder, and mixed with water, the mixture is formed into bricks, and allowed to dry; when it is soaked in water, and then burnt in a large furnace constructed of bricks which are employed for covering houses are formed in the same way. The clay, however, is finer, and it is usually ground in a mill.

Bricks and tiles should be impervious to water; they should be capable of withstanding the action of heat, and not be subject to moulder. It is obvious that these qualities must depend upon the nature of the clay of which they are formed, and on the degree in which they have been burnt. Clay is a mixture of alumina and silica in various proportions. When the proportion of alumina is great, the brick contracts much in its dimensions, and is apt to crack during the burn; but clay containing much silica, being less fusible, is capable of holding together the particles of the clay, and tiles are made contains some oxide of iron, hence the red colour which it acquires when burnt.

But though the addition of lime may be proper in some cases in the manufacture of bricks and tiles, it would be exceedingly improper in other cases. Lime ought to be carefully excluded from the clay destined for making pots, and every other utensil which is to be exposed to a violent heat, as it renders the clay fusible. Now lime enters not unfrequently into the composition of clays. It is evident therefore that all clays are not proper for the manufacture of stone ware. They must be free from lime, barytes, and all other ingredients which renders them fusible. They must also be free from metallic oxides, which not only render them fusible, but also injure the colour of the porcelain. The clays must be refractory, as the following is composed of a mixture of alumina and silica. These are known by the names of potters' clay, tobacco-pipe clay, porcelain-clay, &c., according to
the purposes to which they are applied. It is necessary to mix the clay with fine sand and colour to prevent the vessels from contracting too much during the baking.

Thus stone ware is composed of two materials, pure clay and sand; and the mixture depends upon the purity and fineness of these two materials. What is called English stone ware is composed of tobacco-pipe clay and powdered thite; della ware is composed of clay and fine sand; and the coarsest wares of still more common clay and sand.

The materials are ground very fine in a mill, then mixed together, and formed into a paste. The different vessels are carefully modeled on the potter's wheel, and allowed to dry till they can bear handling. After this they receive their destined form completely; and when they are sufficiently dry, they are covered with the requisite enamel, and then put into the furnace and baked.

The ware of coarse vessels is formed by covering their surface while hot with a little litharge, which has the property of running into an opaque glass at a moderate heat when spread thin upon an earthen vessel. The colour is yellow or red. It is seldom perfect; hence these coarse vessels are frequently porous, and incapable of resisting the action of corrosive substances. Common salt is sometimes employed by the potter. It facilitates the fusion of the surface of stone ware, and occasions a kind of vitrification.

The glazing of fine vessels consists of white enamel. This is made as follows: one hundred parts of lead are melted with from 15 to 40 parts of tin, and the mixture oxidized completely, by exposing it to heat in an open vessel. One hundred parts of this oxide are mixed with 100 parts of a fine white sand composed of three parts silica and one part of talc, and with about 25 parts of common salt. This mixture is melted, then reduced to powder, and formed into a paste, which is spread thin over the porcelain vessel before it is baked. The excellence of a good enamel is, that it easily fuses into a kind of paste at the heat which is necessary for baking porcelain, and spreads equally on the vessel, forming a smooth glassy surface, without losing its opacity, or being completely turned to glass. Its whiteness depends upon the proportion of the tin, its fusibility upon the lead.

Porcelain is always covered with a glass composed of earthy ingredients, without any mixture of metallic oxides. Hence the high temperature necessary to fuse it, and the property which porcelain vessels have of resisting the action of the most corrosive substances, appear to be connected. The only common substance commonly employed is felspar, a mineral of a fine white colour and foliated texture, which is found abundantly in the mountains.

It is usual to paint both stone ware and porcelain of various colours. These paintings are excellent, both in elegance of workmanship and in brilliancy of colour. The colours are given by means of metallic oxides, which are mixed up with other ingredients proper to constitute an enamel, and applied in the usual manner with a pencil.

On this subject much light has been thrown by the experiments of Wedgwood; and Briquart has lately published a general account of the processes at Sevres, of which he is the director.

The process differs a little according to the substance on which the colours are to be applied. When the vessels are covered with enamel, less flux is necessary, because the enamel melts at a low heat, and the colours readily incorporate with it; but this renders them more dilute, and makes it often necessary to retouch them. The colours on enamel generally appear brilliant and soft, and are not liable to scale. The flux is either a white or a tint of black, mixed with felspar, nearly the same as those applied on enamel, but more flux is necessary. They are not liable to dilution, as the felspar glass does not melt at the heat requisite for fusing the colours properly. Their cohesion is liable to scale of when repeatedly heated.

Colours are sometimes applied over the whole surface of the porcelain; the flux in that case is porcelain. But such colours are not numerous, because few oxides can stand the heat necessary for fusing felspar without being altered or volatilized.

1. Purple is given by means of the purple oxide of gold precipitated by the smallest possible quantity of muriatic acid. This oxide is mixed with a proper quantity of powdered glass, borax, and oxide of antimony, and applied with a pencil. It cannot bear a strong heat without losing its colour.

2. Red is given by oxide of iron. A mixture of two parts of sulphate of iron and one part of alum is calcined slowly, till it acquires a deep red colour when cold. This powder is mixed with the usual flux, and applied with a pencil.

3. Yellow is given by the oxide of silver; or, by oxides of lead, antimony, and sand; green, by the oxide of copper; blue, by the oxide of cobalt; and violet, by the oxide of manganese.

STO, in music, a word applied by violin and violoncello performers to that pressure of the strings by which they are brought into contact with the finger-board, and by which the pitch of the note is determined. Hence a string, when stopped, is said to be stopt.

Strokes of an organ. A collection of pipes similar in tone and quality, which run through the whole, or a great part, of the compass of the instrument. In a great organ the stops are numerous and multifarious, commonly consisting of several strokes.

Open-dispasion stop. A metallic stop which commands the whole scale of the organ, and which is called open in contradistinction to the stop dispassion, the pipes of which are closed at the top.

Stop-dispasion stop. A stop, the pipes of which are generally made of wood, and its base up to middle C always of wood. They are only half as long as those of the open dispasion, and are stopped at the upper end with wooden stoppers or plugs, which render the tone more mellow and gentler than that of the open dispasion.

Principal stop. A metallic stop originally distinguished by that name, because holding the pitch, the middle of which is generally between the dispassion and fifteenth, it forms the standard for tuning the other stops.

Twelfth stop. A metallic stop so denominated from its being tuned twelve notes above the dispassion. This stop, on account of its pitch, or middle, can never properly be used alone. The open dispasion, stop dispassion, principal, and fifteenth, are the best qualified to accommodate to the ear.

Fifteenth stop. A stop which derives its name from its pitch, or scale, being fifteen notes higher than that of the dispassion. This stop and the twelfth, mellowed and embodied by the two dispassions and principal, form a proper compound for accompanying chord parts in common choirs and parochial churches.

Sesquialtera stop. A mixed stop running through the scale of the instrument, and consisting of three, four, and sometimes five ranks of pipes, tuned in thirds, fifths, and sometimes an small organ pipe, which is stopped at the middle station between the dispassion and fifteenth, it forms the standard for tuning the other stops. The pipe is divided at middle C, when the lower part is called the sesquialtera, and the upper part the cornet. The whole of the stop lies above the fifteenth; the first rank being a seventeen, the second to a twenty-first, and the third rank a twenty-second, above the dispassion.

Mixture or furniture stop. A stop comprising two or more ranks of pipes, similar than those of the sesquialtera, and only calculated to be used together with that and other stops. The mixture is nearly the same as the sesquialtera, and greatly enriches the instrument.

Trumpet stop. A mixed metallic stop, so-called because its tone is imitative of the trumpet. In large organs it generally extends through the whole compass. The mouths of its pipes are not formed like those of the pipes of other stops, but resemble that of the real trumpet. At the bottom of each of the pipes of this stop, in a cavity called the trumpet, is fixed a brass reed, stop at the lower end, and open in front; it is furnished with a tongue, or brass ring, which covers the opening, which, when the wind is impelled into the pipe, is thereby put into a vibratory motion, which produces the imitative tone peculiar to this stop. The trumpet stop is the most powerful in the instrument, and im-

...
proves the tone, as much as it increases the peal of the choruses. Unisonous with the disquisitions, it strengthens the foundation, subdues the disorders of the thirds and fifths of the sequiquia, and imparts to the compound a richness and grandeur of effect adequate to the subordinate subjects.

Climax or octave trumpet stop. A reed stop resembling the tone of the trumpet, as may be inferred from its name; but the scale of which is an octave higher than the trumpet stop. This stop forms a brilliant supplement to the chorus, and is judiciously employed on occasions which require every power of the instrument; but should not be commonly opened; or, indeed, ever without the other stops.

Thrice stop. A stop which is tuned a major third higher than the quintet, and only employed in the full organ.

Larghetto, or slower tremolo. A stop, the scale of which is an octave above the tremolo. Only used in the full organ.

Cercat stop. A stop consisting of five pipes to each note, tuned somewhat in the manner of sesquialtera, having beside the union of the diapason, its third, fifth, eighth, and seventeenth. The cornet being only a treble stop, it is employed in parvis-churches, &c. in conjunction with the diapason in interludes, and of giving out of the psalms.

Dalcroze stop. A stop in the choir organ of a peculiar sweetness of tone, which it chiefly derives from the bodies of its pipes being longer and smaller than those of the other stops. It is in union with the diapasons, and equals them in compass upward, but only descends to G gamut.

Flute stop. A stop imitative of the common flute, or flagello. It is in union with the principal, but of a much softer tone than that stop.

Basso-suite stop. A reed stop imitative of the instrument from which it derives its name. This stop, so far as it extends upward in the scale, is in union with the diapasons, in company with which it only ought to be used.

Fox hunting stop. A reed stop, the tone of which, as its name implies, resembles the human voice in the quality of this stop. It is in union with the diapason, and with which it is in union.

Hunting stop. A reed stop voiced in imitation of the hunting. It is in union with the diapasons, with which it only should be used.

Cremora stop. A reed stop in union with the diapasons. The name of this stop has induced most organ-builders erroneously to suppose that it was originally meant as an imitation of the Cremora violin; but the writers best informed upon the subject inform us, that it was designed to imitate an ancient instrument called a krummhorn, which word has been corrupted into cremona.

STOOGSTAGE, for the subsistence of the sick. In the regulations for the better management of the sick in regimental hospitals, it is said, legally laid down, under the head subsistence, page 16, that sufficient funds should be established for the support of the sick without any additional charge to government; and at the same time, that the sick soldier should be provided with every reasonable comfort and indulgence that can be afforded. The sum of four shillings per week from the pay of each soldier will, under proper regulations, and with strict economy, be sufficient for this purpose; which sum is to be retained by the paymaster of the regiment.

The sick are to be furnished with bread made of the finest wheat-dour, and fresh meat, perfectly good and wholesome.

That the greatest economy may be used in laying out the money for the sick, every article ought to be paid for, by the surgeon, who is required to keep a book, in which he is to enter the amount of the weekly consumption of each man according to the diet table; and this book, with the diet table, is to be laid before the commanding officer and paymaster every week, to be examined and signed by each.

STOPPAGE, in a military sense, deductions from a soldier's pay, the better to provide him with necessaries, &c. A soldier should never be put out of the service, unless purchased by the surgeon, from his pay, than what will afterwards leave him a sufficiency for meaning. Since the abolition of arrears a regulation has taken place, by which soldiers are directed to be stopped one shilling per week, or as much as the expense per week in the infantry, and to be accounted with on the 24th of every month.

STORAX. See STORAX, and RESINS.

STORES. If any person who has the charge or custody of any of the king's armament, ordnance, ammunition, shot, powder, or habiliments of war, or of any victuall for victualling the navy, shall, to hinder his majesty's service, embezze, purloin, or convey away the same to the value of 20s. or shall real or embezze any of his majesty's sails, cordage, or any other materials of war, to the value of 20s. he shall be adjudged guilty of felony without benefit of clergy. 22 Car. II. c. 5.

The treasurer, comptroller, surveyor, clerk of the acts, or any commissioner of the navy, may act as justices in causing the offender to be apprehended, committed, and prosecuted for the same. 9 G. III. c. 30.

If any person shall wilfully and maliciously set on fire, or shall wilfully, presume, or in any manner, hinder his majesty's military, naval, or victualling stores, or other ammunition of war, or any place where any such stores or ammunition shall be kept, he and his attornets shall be guilty of felony without benefit of clergy. 12 Geo. III. c. 24.

STORK. See ABEA.

STOKE, in gardening. See HOT-HOUSE.

STRANGER, among seamen, is a man of a ship that is driven ashore by a tempest, or whom a ship, missing the proper course, runs on shore; it also signifies into what places. Where any vessel is stranded, the justices of the peace are empowered to command the constables near the sea-coast to call assistance, in order to preserve the same if possible.

STRANGURY. See MEDICINE.

STRAP, in a ship, is a rope spliced about any block, or made with an eye, to fasten an object to any other occasion.

STRATA, in the history of the earth, the several beds or layers of different matters, which eave the body of the earth is composed. See Earth, structure of.

SUTURE, of the earth. Scarcely any of the natural phenomena have been slightly treated of by the philosophers of the present and past ages, as the strata of the earth. Few, if any, among the writers on this curious and interesting subject, have distinguished between the undisturbed or regular strata, forming the solid matter of the earth, and the strata violently moved, and worn substances, which are found upon its surface; while these, again, in their observations, have been in too many instances confused with the alluvial deposits. Nevertheless, we have been formed in modern times, or since they have been confined nearly to their present limits. The effects of vegetation, in accumulating peaty matters, and, in conjunction with frost, alternate wetting and drying, the atmosphere, and cultivation, in gradually changing the surface of almost any of the stratified matters, to a soil or mould fit for the growth of some kind of vegetables, have in a great degree been over-cast, and accordingly we find a great number of writers, confidently mentioning different series of substances, which they assert, on observations entirely local, to be the order of the strata on proceeding downward, or upward, in modern times.

Notwithstanding that Mr. Hanksbee many years ago, at the instance of the Royal Society of London, carefully examined a succession of thirty strata, in the shaft of a col-pit, and found that strata specifically heavier, were frequently found lodged above lighter strata; yet, a large portion of the writers since to the present time, have contended that the strata are found deposited in the order, or nearly, of their specific gravities.

John Stracey, esq. a writer in the Philosophical Transactions (No. 391), started an opinion, that the strata were at first formed while in a soft state, as so many wedges, each pointing to and terminating in the centre of the earth; and that by the diurnal revolution of the earth from west to east, these became bent into spirals (as represented in fig. 223, Plate Miscell.), in which case, says he, "there needs no specific gravitation to cause the heavier stratum to be overthrown by the lighter one in its turn, in some place of the globe or other, it will be uppermost," this last remark, made in the year 1725, we do not remember to have been noticed by any subsequent writer or observer, although, from a series of minute observations made within the last fifteen years by a gentleman formerly resident at Mitford near Bath, and now in London, Mr. William Smith, there is great reason to think that this is really the case with all the strata composing the surface of the British islands, and perhaps of the whole earth, in what manner soever the strata in the inner parts of the earth may be disposed.

We do not understand that Mr. Smith was at all acquainted with the above remark of Mr. Stracey; but that in the exercise of his profession of a land-surveyor, superintendent of some coal-mines, and engineer for the cutting of the Somerset coal-canal, he saw ample reason to conclude that the several strata in the section he had described, were laid down successively, and not likewise contemplicably.
STRAWBERRY. See Fragaria.

STRAWBERRY-tree. See Arborus.

STRELITCHIA, a genus of the class and order pentandria monogynia. The spathes are universal and partial; the calyx; corolla are three-petalled; perianth three-leaved; capsule three-celled; fruits many-seeded. There are two species of this magnificent plant, natives of the Cape.

STRENGTH. See Timber, strength of.

STREPTIUM, a genus of the didynamia angiosperma class and order. The calyx is five-toothed; stigma two-lipped; drupe two lobed. There is one species.

STRIE, a measure of capacity, containing four hundred cubic feet. See Measure.

STRIE, among seamen, is a word variously used. When a ship, in a fight, or on meeting with a ship of war, lets down or lowers her topsails, at least half the deck high, they say she strikes. If the vessel, meaning the ship, or submit, pays respect to the ship of war. Also, when a ship touches ground, in shoal-water, they say she strikes. And when a topmast is to be taken down, the word of command is, strike the topmast, &c.

STRIX, the owl, in ornithology, a genus belonging to the order accipitres. The bill is hooked, but has no crest or wax; the nostrils are covered with setaceous feathers; the head and whole body finely variegated with lines, spots, and specks of black, brown, cinnereous, and ferruginous; wings long; tail short, marked with dusky bars; legs thick, covered to the very end of the toes, with a claw; the plumage of a testaceous colour; claws great, much hooked and dusky. It has been shot in Scotland and in Yorkshire. It inhabits inaccessible rocks and desert places, and preys on hares and

3. The estrich, or ostrich, weighs 19 ounces. This is a landier species than the former; and the young will feed on any dead thing, whereas those of the white owl must have a constant supply of fresh meat. It is the strix of the Hindus. The screech-owl, to which the foible of superstition has given the power of preying death by its cries.

4. The ulula, or brown owl, agrees with the former in its marks, differing only in the subjection of the black, but differs in the size of the head and neck. It is found in the United States, and in the black, or brown owl, with the small black head and neck. It is found in the United States, and in the

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7. There the spectacles in Cayenne, which is accurately described by Dr. Latham, is 21 inches in length; the upper part of the beak is of a reddish colour; the lower parts of a russet white; the head and neck are white, and not so full of feathers as those of the beak. They destroy numbers of little leavers, as they say, two species inhabit one, or two eggs, of an elliptical form, and of a whitish colour.

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SUBSTANCES. It is sometimes transparent and colourless, but generally has a tinge of yellow or green. Its specific gravity varies from 3.4 to 3.726. Its texture is generally fibrous; but, in a few cases, it is almost like glass, and crystallized in slender prismatic columns of various lengths.

Strontian is found abundantly in different places of the world, and always combined with carbonic acid or sulphuric acid.

1. The carbonic acid may be expelled from the carbonat, and the strontian obtained pure by mixing the mineral with charred wood, and boiling it to a heat of 140° Wedgewood; or by dissolving the mineral in nitric acid, evaporating the solution till it crystallizes, and exposing the crystals in a crucible to a red heat till the nitric acid is driven off.

2. Strontian thus obtained, is in porous masses, of a greyish white colour; its taste is acid and alkaline; and it converts vegetable blues to green. Its specific gravity, according to Hasselratz, is 1.647. It does not act strongly on animal bodies as barytes, nor is it poisonous.

3. It does not melt when heated like barytes: but before the blowpipe it is penetrated with light, and surrounded with a flame so white and brilliant that the eye can scarcely be held.

4. When water is sprinkled on strontian it is slackened, becomes hot, and falls to powder exactly like barytes; but it is not so soluble in water as that earth. One hundred and sixty-two parts of water, at the temperature of 60°, dissolve nearly one part of strontian.

The solution, known by the name of strontian water, is clear and transparent, and converts vegetable blues to a green. Hot water dissolves it in much larger quantities; and as it cools, the strontian is deposited in colourless transparent crystals. These are in the form of thin quadrangular plates, generally parallelograms, the largest of which seldom exceeds one-fourth of an inch in length. Sometimes their edges are plain, but they often consist of two facets, meeting together, and forming an angle like the roof of a house. These crystals generally adhere to each other in such a manner as to form a thin plate of an inch or more in breadth. Sometimes they assume a cubic form. They contain about 68 parts in 100 of water. They are soluble in 51.4 parts of water, at the temperature of 60°. Boiling water dissolves nearly half its weight of them.

When exposed to the air, they lose their water, attract carbonic acid, and fall into powder. Their specific gravity is 1.46.

5. Strontian is not acted on by light; neither does it combine with oxygen.

6. Sulphur and phosphorus are the only simple combustibles with which it unites.

The sulphuret of strontian may be made by fusing the two ingredients in a crucible. It is soluble in water, and is called strontian sulphur, which is evolved. When the solution is evaporated, hydrosulphuret of strontian is obtained in crystals, and hydrogenated sulphuret remains in solution. These compounds resemble almost exactly the sulphide, sulphuret, and hydrogenated sulphuret of barytes; and, do not therefore require a particular description. The same remark applies to the phosphuret of strontian, which may be prepared by the same process as the phosphuret of barytes.

7. Strontian has no action upon metals; but it combines with several of their oxides, and forms compounds which have not hitherto been examined.

8. It does not combine with alkalies nor with barytes. No precipitation takes place when barytes and strontian water are mixed together.

9. Strontian has the property of tingling flame of a beautiful red, or rather purple colour; a property discovered by Dr. Ash in 1757. The experiment may be made by fusing a little of the salt composed of nitric acid and strontian into the wick of a lighted candle; or by setting fire to alcohol, holding muriat of strontian in solution. In both cases the flame is of a lively purple. In this case the sulphuret of strontian was tried in the same way is found to comminute a blueish yellow tinge to flame.

10. The affinities of strontian, as ascertained by Dr. Hope and Mr. Vauquelin, are as follows:

- Sulphuric acid, Muratic acid, Oxalic acid, Tartaric acid, Acetic acid, Fluoric acid, Boracic acid, Nitric acid, Carbonic acid.

Barytes and strontian resemble each other in their properties as closely as potash and soda: hence, like these two alkalies, they were for some time confounded. It is in their combination with acids that the most striking differences between these two earths are to be observed.

STRUMPFIA a genus of plants belonging to the class of Syngenesia, and to the order of Monogonnia. The calyx is quinquedentate and superior; the corolla is pentapetalous; and the seeds monospermous. There is only one species, the maritima, a shrub of Curacao.

ST RUTTHIO, in natural history, a genus of birds belonging to the order of Grallae, and to the family of Lignores. It includes, The ostrich, has a bill somewhat conical; the wings are so short as to be unfit for flying; the thighs and sides of the body are naked; the feet are formed for running, having two toes, one only of which is furnished with a nail. The head and bill somewhat resemble those of a duck; and the neck may be likened to that of a swan, but that it is much longer; the legs and thighs resemble those of a hen, though the whole of its body bears a strong resemblance to that of a camel. But though usually seven feet high from the top of the head to the ground, from the back it is only four; so that the head and neck are above three feet long. From the top of the head to the rump, when the neck is stretched out in a right line, it is six feet long, and the tail is about a foot more. One of the wings without the feathers, is a foot and a half; and being stretched out, with the feathers, is three feet in length. Its plumage is much alike in all; that is generally black and white; though some of them are said to be grey. There are no feathers on the sides, nor yet on the thighs, nor under the wings. The lower part of the neck, about half-way, is covered with still smaller feathers than those on the belly, and back; and those also are of different colours.

At the end of each wing there is a kind of spur almost like the quill of a porcupine. It is an inch long, being hard and of a horn-like substance. There are two of these on each wing; the largest of which is at the extremity of the bone of the wing, and the other a foot lower. The neck seems to be more slender in proportion to that of other birds, from being further furnished with feathers. The skin in this part is of a livid flesh-colour, which some improperly would have to be blue. The bill is short and pointed, and two inches and a half at the beginning. The external form of the eye is like that of a man. The upper eyelid is adorned with eye-lashes which are longer than those on the lid below. The tongue is small, very short, and composed of cartilages, ligaments, and membranes, intermixed with fleshy fibres. In some it is about one inch long, and very thick at the bottom; in others it is but half an inch, being a little forked at the end.

The ostrich is a native only of the torrid regions of Africa, and has long been celebrated by those who have had occasion to mention the animals of that region. Its flesh is proscribed in scripture as unfit to be eaten; and most of the ancient writers describe it as well known in their times. Like the race of the elephant, it is transmitted down without mixture; and has never been known to breed out of that country which first produced it. It seems formed to live among the sandy deserts, and is altogether unlike the poult. In some measure it owes its birth to its general infirmity, so it seldom migrates into tracts more mild or more fertile. The Arabs assert that the ostrich never drinks; and the place of its habitation seems to confirm this assertion. In these formidable regions owls and vultures are seen in large flocks, which to the distant spectator appear like a regiment of cavalry, and have often alarmed a whole caravan. There is no other feathered bird of such bulk: they are so heavy that they cannot fly, but run at the rate of thirty miles an hour. They devour leather, grass, hair, iron, stones, or any thing that is given. Those substances which the coats of the stomach cannot soften, pass whole; so that glass, stones, or iron, are excluded in the form in which they were devoured.

In their native deserts, however, it is probable they live chiefly upon vegetables, where they lead an inoffensive and social life; the male, as Thernovius assures us, assorting with the female with fidelity. They are said to be very much inclined to venery, and the make of the parts in both sexes seems to confirm the report. It is probable also they copulate like other birds, by compression of the ventricle. Their eggs are inbo in diameter, and weighing above fifteen pounds. These eggs have a hard shell, somewhat resembling those of the crocodile, except that those of the latter are less and rounder.

The season for laying depends on the climate where the animal is bred. In the north-
struthios. all known animals, the ostrich is by far
the swiftest in running; upon observing itself,
therefore, pursues, at a distance, he begins to
run at first but gently; either insensible of
his danger, or sure of escaping. Unfortunately
for the silly creature; instead of going off in a
straight line, he takes his course in circles:
while the hunters still make a small course
within, relieve each other, meet him at unex-
pected turns, and keep him still employed,
still followed, for two or three days together.
At last, with fatigue, and finding all power of escape impossible, he
endeavours to hide himself from those enemies
he cannot avoid, and covers his head in the
sand or the first thicket he meets. Some-
times, however, he attempts to face his pursuers;
and though in general the most gentle
animal in nature, when driven to desperation
he defends himself with his beak, his wings,
and his feet. Such is the force of his motion,
that a man would be utterly unable to with-
stand him if he was not wounded:
the Struthophagi have another method
of taking this bird; they cover themselves
with an ostrich's skin, and passing up an arm
through the neck, thus counterfeit all the mo-
tions of this animal. By this artifice they
make the bird believe the ostrich, and
himself an easy prey. He is sometimes also taken by dogs
and nets; but the most usual way is that men-
tioned above.

When the Arabians have thus taken an or-
strich they cut its throat; and making a liga-
ment below the opening, they shut the bird
as one would rim a barrel; then taking off the
ligature, there runs out from the wound
in the throat a considerable quantity of blood
mixed with the fat of the animal; and this is
considered as one of their dainties.

They next lay the bird; and of the skin,
which is strong and thick, sometimes make a
kind of vest, which answers the purposes of
a corseus and a buckler.

There are others who, more compassionate
or, perhaps, more curious to kill their captives,
but endavour to tame it, for the purposes of
supplying those feathers which are in so great
request. The inhabitants of Daara and Lybia
breed up whole flocks of them, and they are
taken for the sake of their feathers; it is not
for their feathers alone that they are prized in
this domestic state; they are often ridden
upon and used as horses. Moore assures us,
that at Jorf, he saw a man travelling upon an
orstrich; and Addison asserts, that at the fac-
tory of Podere he had two ostriches, which
were then young, the strongest of which ran
swifter than the best English racer, al-
though he carried two negroes on his back.
As soon as the negroes perceived that it was
thus loaded, it set running with all its force,
and made several circuits round the village;
 till at length people were obliged to stop it by
barring up the way. How far this strength
and swiftness may be useful to mankind, even
in a polished state, is a matter that perhaps
deserves inquiry. See Plate Nat. Hist. fig. 359.

2. the casowary (the casaurina of Lin-
neus; and galeated casowary of Dr. Latham)
was discovered by Europeans on Java in the
Dutch about the year 1597. It is nearly
equal in size to the ostrich, but its legs are
much thicker and stronger in proportion.
This conformation gives it an air of strength
and force, which the gaveness and singularity
of its countenance conspire to render
formidable. It is five feet and a half long from
the point of the bill to the extremity of the
claw. The legs are two feet and a half high
from the ground to the tips of the claws.
The head and neck together are a foot
and a half; and the largest toe, includ-
ing the claw, is five inches long. The claw
alone of the least toe is three inches and a
half in length. The wings are so small that it does
not appear, it being hidden under the fea-
theers of the back. In other birds, a part of
the feathers serve for flight, and are different
from those that serve merely for covering;
but in the casowary all the feathers are of
the same kind, and outwardly of the same colour.

They are generally double, having two long
shafts, which grow out of a short one, which
is fixed in the skin. Those that are double
are always of unequal length; for some are
fourteen inches long, particularly on the rump,
while others are not above three.
The boards that adorn the stem or shaft
are about half-way to the end, very long, and
as thick as a horse-hair, without being divided
into fibres; the board, it is flat, shining, black, and knotted below;
and from each knot there proceeds a board;
likewise the beak at the end of the large
feathers are perfectly black, and tapers
from the root of a grey fawny colour; shorter,
more soft, and throwing out fine fibres like
down; so that nothing appears except the ends,
which are hard and black; because the other
part, composed of down, is quite cover-
ted. There are feathers on the rump and
neck; but they are so short and thinly shorn,
that the bird's skin appears naked, except to-
wards the hinder part of the head, where
they are a little longer. The feathers which
adorn the rump are extremely thick; but do
not differ in other respects from the rest,
except in their being longer. The wings,
when they are deprived of their feathers, are
but three inches long; and the feathers are
like those on other parts of the body; the ends
of the wings are adorned with five
prickles, of different lengths and thickness,
which bend like a bow: these are hollow from
the root to the very points, having only that
part of the blade that is in the middle,
which is known to have. The longest of these
prickles is eleven inches; and it is a quarter of an
inch in diameter at the root, being thicker there
than towards the extremity; the point seems
broken off.

The part, however, which most distinguishes
this animal is the head; which, though small,
like that of an ostrich, does not fail to inspire
some degree of terror. It is bare of feathers,
and covered with a kind of horn, which is
formed of a kind of horny substance, that covers it from the root
of the bill to near half the head backwards.
This helmet is black before and yellow be-
hind. Its substance is very hard, being form-
ined by the elevation of the bone of the skull;
and it consists of several plates one over an-
other, like the horn of an ox. The neck is of
a violet colour, inclining to that of slate; and
its red behind in several places, but chiefly
in the middle. About the middle of the back,
the largest feathers, these are the two process
formed by the skin, which resemble somewhat the gills of a cock, but
that they are blue as well as red. The skin
which covers the fore part of the breast,
which this bird bears and rests, is hard, callous, and without feathers.

The same degree of voracity which we perceive in the ostrich obtains as strongly here. The cassowary swallows every thing that it can find, without regard to the capacity of the gullet. The Dutch assert, that it can devour not only glass, iron, and stones, but even live on burning coals, without testifying the smallest fear of feeling the least injury. It is said, that the Cassowary can cut through the beams of a house in this manner. These birds have been known to swallow whole eggs which it has swallowed whole, and even the very eggs which it has swallowed whole, pass through it unbroken in the same form they went down. In fact, the alimentary canal of the Cassowary, as observed above, is extremely short; and it may happen, that many kinds of food are indigestible in its stomach, as wheat or currants are to a man when swallowed whole.

The cassowary's eggs are of a grey ash-colour, inclining to green. They are not so large as that of the domestic fowl, as the size of the female. They are marked with a number of little tubercles of a deep green, and the shell is not very thick. The largest of these is found to have fifteen inches round one way, and about twelve in the other way.

The southern parts of the most eastern Indies seem to be the natural climate of the cassowary. His domain, if we may so call it, begins where that of the ostrich terminates. The latter has never been found beyond the Ganges; while the cassowary is never seen nearer than the islands of Banda, Sumatra, Java, the Molucca islands, and the corresponding parts of the continent. Yet even here this annual seems not to have multiplied in any considerable degree, as we find only one of the kings of Java making a present of one of these birds to the captain of a Dutch ship, considering it as a very great rarity.

The casuarus Nova Hollandiae, or New Holland cassowary, differs considerably from the common cassowary. It is a much larger bird, standing higher on its legs, and having the neck longer than in the common one. Total length seven feet two inches. The bill is not greatly different from that of the common species; but the lower appendage or helmet on the top of the head in this species is totally wanting: the whole of the head and neck is also covered with feathers, except the throat and fore part of the neck about half-way, which are not so well feathered as the rest; whereas in the common cassowary the head and neck are bare and carenunculated as in the turkey.

The plumage in general consists of a mixture of brown and grey, and the feathers are somewhat curved or bent at the ends in the natural state: the wings are so very short as to be totally useless for flight, and indeed are scarcely to be distinguished from the rest of the plumage, was it not for their standing up a little. The long spines which are seen in the wings of the common sort are in this not observable, nor is there any appearance of a tail. The legs are stout, formed much as in the ga- lopin. With the addition of their being jaggied or sawed the whole of their length at the back part.

This bird is not uncommon in New Hol- land, as several of them have been seen about Botany Bay and other parts. Although it cannot, it runs so swiftly, that a greyhound can scarcely overtake it. The flesh is said to be in taste not unlike beef.

STRUTHIOLA, a genus of plants belonging to the class of tetrandria, and order of monogynia. The corolla is wanting: the calyx is tubous, with eight glandules at its smooth mouth. In order to judge, and monospermous. The species are 2, shrubs of the Cape.

STYRCHINOS, a genus of plants belonging to the class of pentandria, and order of monogynia; and in the natural system ranging under the 37th order, lianum. The calyx is simple; the style is simple, with a quinqued stigma; the apple is without juice, oval, smooth, monospermous, bursting open with a spring, &c. There are two species, foreign plants.

STUCCO, in building, a composition of white marble pulverised, and mixed with plaster of lime; and the whole being sifted and wrought up with water, is to be used like common plaster: this is called by Pliny mar- moratum opus, and albarium opus.

STUM, in the wine trade, denotes the unfermented juice of the grape, after it has been several times raked off, and separated from its grains.

STURGEON, See Accipenser.

STURNUS, the starking, a genus of birds belonging to the order of passerine. The back is subalutated, depressed, and somewhat blunt; the superior mandible is entire, and somewhat open at the edges; the nostrils are margnated above; and the tongue is sharp and emarginated. There are 13 species, according to Dr. Latham. The vulgaris, capen- sis, ludoviciana, militaris, celtis, carunculat, gallinaceus, securis, viridis, olivaceus, mortinartus, lynca, dauricus, Junerti, and mexicanas.

The vulgaris, or common starking, is the only species of the sturnus that is indigenous. The weight of the male of this species is about three ounces; that of the female rather less. The length is eight inches three quarters. The whole plumage is black, very resplendent, with changeable blue, purple, and copper; each feather marked with a pale yellow spot. The lesser covers are edged with yellow, and slightly glossed with green.

The starks breed in holes in trees, evergreen houses, towers, ruins, cliffs, and often in high rocks over the sea, such as that of the Isle of Wight. It lays four or five eggs, of a pale greenish-yellow color; and makes its nest of straw, small fibres of roots, &c. In winter, starks assemble in vast flocks; they collect in myriads in the fens of Lincolnshire, and do great damage to the men by roosting on the reeds, and breaking them down by their weight; for roots and the like trees of the country, and are laid up in harvest with great care. These birds feed on worms and insects; and it is said, they will get into pigeon-houses, for the sake of sucking the eggs. Their flesh is so bitter as to be scarcely eat- able. They are fond of following oxen and other large cattle, as they feed in the mea- hows, attracted, as it is said, by the insects which flatter round them, or by those, perhaps, which swarm in their dung, or in mea- dows in general. From this habit is derived the Government of the Cape, which lived seven or eight years, or even longer, in the domestic state. The wild ones cannot be des- oyed by the cull, because they regard not the scream of the owl. A method has been discovered of destroying entire families, by laying to the walls and the trees where they lodge pots of earthenware of a convenient form, which the birds often prefer to place their nests in. Many are also caught by the gin and draw-net.

The starks, it is said, can be taught to speak either French, German, Latin, Greek, &c, and to pronounce phrases of some length. Their plant throat accommodates itself to every in- lation and evolution, &c. It can readily ar- ticulate the letter R, and imitates a sort of warbling which is much superior to its native song. This bird is spread through an extensive and extensive, &c. range in the antient continent.

STURNUS, See Plate Nat. Hist. fig. 380, inhabits Europe, Asia, and the northern parts of Persia; frequents waters, and feeds on aquatic insects and small fishes. It is very solitary, and breeds in the holes of banks; the very nest is composed of hay and roots, lined with dead leaves, and having an en- trance of green moss.

STYLO, a word of various significations, originally derived from stylos, a kind of rod-kin, wherein the ancients wrote on plates of lead, or on wax, &c. and which is still used to write on ivory leaves, and paper prepared for that purpose, &c.

STYLE. See DIALLING.

STYLE. See BOTANY.

STYLE, in matters of language. See RHETORIC, and POETRY.

STYLISALPHONY, a genus of fishes of the order apodes. The generic character is: eyes pedunculated, standing on a short thick cylinder; snout lengthened, directed up- wards, retractor towards the head by means of a cæcum, with a great diameter without teeth; branchio three pair beneath the throat; fins, pectoral small, dorsal of the length of the back, caudal short, with spiny rays; body very long, compressed. This highly singular gen- era was first described in the year 1788, by a specimen then introduced into the Leverian Museum, and figured in the first volume of the Linnaean Transactions, see Plate Nat. Hist. fig. 381.

CHONRATODON stylophorus. The head of this extraordinary animal bears some distinct resemblance to that of the genus stylophorus, and its structure cannot so easily be described in words as conceived by the figure. The rostrum or narrow part, which is terminated by the mouth, is connected to the back part of the head by a flexible leathery duplication, which permits it to be either extended in such a manner that the mouth points directly forwards, or to fall back, so as to be received into the Nurse of this tree, as the upper part of the head. On the top of the head are placed the eyes, which are of a form very nearly approaching to that of the genus cancer, except that the columns or parts on which eye is placed, and which are much broader and
The resinous drug called Styrax oregia in a fluid state from incisions made in the trunk or branches of the tree. Two sorts of this resin have been commonly distinguished in the shops: 1. Styrax in the tear, is scarcely, if at all, fit for medicinal purposes, as, sometimes composed of whitish and pale reddish brown tears, and sometimes of an uniform reddish yellow or brownish appearance; unctuous and soft like wax, and free from visible impurities. It is supposed to be the sort which the patients received from Pamphylia in reds or cakes, and which was thence named calamina.

2. Common Styrax: in large masses, consider a lighter and less compact than the former, and having a large admixture of woody matter like saw-dust. This appears to be the kind intended by the London college, as they direct their styrrax calamina to be purified, for medicinal use, by boiling it with boiling water, and pressing it out from the trees by means of warm irons; a process which the first does not stand in need of; and indeed there is rarely any other than this impure Styrax to be met with in the shops.

Styrax, with some of the antecedents, was a familiar remedy as a resolvent, and particularly used in catarrhal complaints, coughs, asthma, menstrual obstructions, &c. and from its affinity to the balsams, it was also prescribed in ulcerations of the lungs, and other sorts of pulmonary consumption. And our pharmacopoeias formerly directed the pilae styrrae; but this odorous drug has now no place in any of the official compounds; and now as a medicine with a reputation to promise some efficacy in nervous debilities, yet by modern practitioners it is almost totally disregarded.

The Styrax benzoin, see Plate Nat. Hist. fig. 393, has been characterized by oblong acuminated leaves, which are downy underneath, and nearly of the length of the racemose flower. This tree, which is a native of Sumatra, is deemed in six years of sufficient age for affording the benzoin, or when its trunk acquires about seven or eight inches in diameter, for the bark is then longitudinally, or somewhat obliquely, at the origin of the principal lower branches, from which the drug exudes in a liquid state, and by exposure to the sun and air soon concretes, when it is scraped off the bark with a knife or chisel. The quantity of benzoin which one tree affords never exceeds three pounds, nor are the trees found to sustain the effects of these annual incisions longer than ten or twelve years. The benzoin which issues first from the wounded bark is the purest, being soft, extremely fragrant, and very white; that which is less esteemed is of a brownish colour, very hard, and mixed with various impurities, which it acquires during its long continuance upon the tree.

The benzoin which we find here in the shops is in large brittle masses, composed partly of white, partly of yellowish or light-brown, and often also of darker-coloured pieces; that which is clearest, and contains the most white matter, called by authors benzoe amygdaloideus, is accounted the best. This resin has very little taste, impressing on the palate only a slight sweetness; its smell, especially when reduced or heated, is extremely fragrant and agreeable. It totally dissolves in rectified spirit (the impurities excepted, which are generally in a very small quantity) into a deep yellowish-red liquor, and in that state discovers a peculiar, sweet and aromatic odour, as well as sweetness. It imparts, by digestion, to water also a considerable share of its fragrance, and a slight pungency; the filtered liquid, gently exhaled, leaves not a resinous or nihiloglous extract, but a sweetish fluid, or rather, seemingly of a saline nature, amounting to one-tenth or one-eighth of the weight of the benzoin. Exposed to the heat in proper vessels, it yields a quantity of a white saline concrete, called styrax benzoes, of an acridulous taste and grateful odour, soluble in rectified spirit, and in water by the assistance of heat.

The principal use of this fragrant resin is in perfumes, and as a cosmetic; for which last purpose, a solution of it in spirit of wine is mixed with so much water as is sufficient to render it milky, as twenty times its quantity or more. It promises, however, to be applicable to other uses, and to approach in virtue, as in fragrance, to Styrax, and balance of the latter. It is said to be of great service in disorders of the breast, for resolving obstructions of the pulmonary vessels, and promoting expectoration: in which intentions the flowers are sometimes given from three to four grains to be dissolved in water, precipitated by water from solutions of the benzoin in spirit, has been employed by some as similar and superior to the flowers, but appears to be little other than the pure benzoin in substance; it is not the saline, but the resinous matter of the benzoin, that is most disposed to be precipitated from spirit by water. The flowers, sniffed up the nose, are said to be a powerful emetic.

SUBALTERN, a subordinate officer, or one who discharges his post under the command and subject to the direction of another: such as lieutenants, sub-lieutenants, cornets and ensigns, who serve under the captain; but custom has now appropriated the term to those of much lower rank, &c.

We also say subaltern courts, jurisdictions, &c. such are those of inferior lords, with regard to the lord paramount; hundred-courts with regard to county-courts, &c.

SUBLAVIAN. See Anatomy.

SUBCOSTAL MUSCLES. See Anatomy.

SUBDUPLE RATIO, is when any number or quantity is contained in another twice: thus 3 is said to be subduple of 6, as 6 is double of 3.

SUBDUPlicate RATIO of any two quantities, is the ratio of their square roots.

SUBER. This name has been introd. into chemistry by Fourcroy, to denote the outer bark of the queucus suber, or the common cork, a substance which possesses properties different from all other vegetable bodies.

It is exceedingly light, soft, and elastic: very combustible, burning with a bright white flame, and leaving a light black bulky charcoal; and when distilled it yields a little ammonia. Nitric acid gives it a yellow colour, corrodes, dissolves, and decomposes it, converting it partly into blue and partly into a substance resembling wax.
SUBERATS, salt formed with the sebamic acid, which see.

SUBERIC ACID may be formed by pouring six parts of nitric acid of the specific gravity 1.2 into one part of cork grated down or simply broken down into small pieces, and distilling the mixture with a gentle heat as long as red vapours continue to escape. As the distillation advances, a yellow matter like wax makes its appearance on the surface of the liquid. While the matter contained in the retort is hot, it is to be poured into a glass vessel, placed upon a sand-bath over a gentle fire, and constantly stirred with a glass rod. By this means it becomes gradually thick. As soon as white vapours, exciting a tickling in the throat, begin to disengage themselves, the vessel is removed from the bath, and the mass continually stirred till it is almost cold.

By this means an orange-coloured mass is obtained of the consistence of honey, of a strong and sharp odour; while hot, but having a peculiar aromatic smell when cold. On this mass twice its weight of boiling water is to be poured, and heat applied till it becomes a liquid that part of it which is insoluble in water is to be separated by filtration. The filtered liquor becomes muddy; on cooling it deposits a powdery sediment, and a thin pellicle forms on its surface. The sediment is to be separated by filtration, and the liquor reduced to a dry mass by evaporating in a gentle heat. This mass is suberic acid. It is still a little coloured, owing to some accidental mixture, from which it may be purified either by saturating it with potassa and precipitating it by means of an acid, or by boiling it along with charcoal powder.

Suberic acid thus obtained is not crystallizable, but when precipitated from potassa by an acid it assumes the form of a powder; when obtained by evaporation it forms thin irregular pellicles.

Its taste is acid and slightly bitter; and when dissolved in small quantity of boiling water it acts upon the throat, and excites coughing.

It reddens vegetable blues; and when dropped into a solution of indigo in sulphuric acid, as it is called in this country), it changes the colour of the solution, and renders it green.

Water at the temperature of 60° or, even 70°, dissolves only 1/5 part of its weight of suberic acid; and if the acid is very pure, only 1/24th part; boiling water, on the contrary, dissolves half its weight of it.

When exposed to the air, it attracts moisture, especially if it is impure.

When exposed to the light of day, it becomes at last brown; and this effect is produced much sooner by the direct rays of the sun.

When heated in a muffle, the acid sublimes, and the inside of the glass is surrounded with zones of different colours. If the sublimation is stopped at the proper time, the acid is obtained on the side of the vessel in small points formed of concentric circles. When exposed to the heat of the blowpipe on a spoon of platinum, it first melts, then becomes sublunent, and at last sublimes entirely with a smell resembling that of sebamic acid.

It is not altered by oxygen gas; the other acids do not dissolve it completely. Alcohol develops an aromatic odour, and an ether may be obtained by means of this acid.

It converts the blue colour of nitrate of copper to a green; the sulphate of copper also to a green; gas of iron to a deep yellow; and sulphate of zinc to a golden yellow.

It has no action either on platinum, gold, or nickel; but it oxidizes silver, mercury, copper, lead, tin, iron, bismuth, arsenic, cobalt, zinc, antimony, and palladium, but not molybdenum.

With alkalis, etca, and metallic oxides, it forms compounds known by the name of suberates.

Its affinities are as follows: Barytes, Potas, Soda, Lime, Ammonia, Magnesia, Alumina.

SUBLIMATION, a process by which certain volatile substances are raised by heat, and again condensed by cold in a solid form. Flowers of sulphur are made in this way. Soot is also an instance of sublimation. See CHEMISTRY.

SUBNORMAL, in geometry, is a line which determines the point in the axis of a curve, where a normal, or perpendicular, raised from the point or contact of a tangent to the curve, cuts the axis. Or the subnormal is a line which determines the point where the axis is cut by a line falling perpendicularly on the tangent in the point of the contact.

SUBPENA, a writ by which all persons under the degree of a peer are called to chancery, in such case only where the common law fails, and has made no provisions; so as the party who in equity has wrong, can have no other remedy by the rules and course of common law. But the peers of the realm in such cases are called by the lord chancellor, or lord keeper, and is, giving notice of the suit intended against them, and requiring them to appear. There is also a subpoena ad testificandum for the summoning of witnesses as well in chancery as other courts.

There is also a subpoena in the exchequer, as well in the court of equity there, as in the office of pleas.

SUBROGATION, or Subrogation, in the civil law, the act of substituting a person in the place, and entitling him in the rights, of another; but, in its general sense, subrogation implies a succession of any kind, whether of a person to a person, or of a person to a thing. There are two kinds of subrogation, the one conventional, the other legal.

Conventional subrogation is a contract, whereby a creditor transfers his debt, with all appurtenances thereof, to the proot of a third person. Legal subrogation is that which the law makes, in favour of a person who discharges an antecedent creditor, in which case there is a legal translation of all rights of the antient creditor to the person of the new one. This the civilians more usually call succession, as being wholly the work of the law, and to distinguish it from the conventional subrogation, which they also call cession.

SUBSIDY, in law, signifies an aid or tax granted to the king, by parliament, for the necessary occasions of the kingdom; and is to be levied on every subject of ability, according to the rate or value of his lands or goods; but this word, in some of our statutes, is the reference made with that certain persons, to be levied upon account, till their accounts are made up, which is generally once a year, and then they are paid their arrears.

SUBSTITUTION, in the civil law, a disposition of a testament, whereby the testator substitutes one heir for another, who has only the usufruit, and not the property of the thing left him. Substitution is only a kind of fiduciary inheritance, called also idei commissio, in regard the immediate inheritor has only the use or produce of the thing; the body thereof being assigned and appropriated to certain persons, who are likewise to have the usufruit in their turns, but are never to have the property.

Substitution, in algebra, &c. is the putting, in the room of any quantity in an equation, some other, which is equal to it, but expressed in another manner.

SURTANT of a curve is the higher geometry, is the line which determines the intersection of the tangent with the axis; or, that determines the point wherein the tangent cuts the axis prolonged.

In any equation, if the value of the subtangent comes out positive, it is a sign that the points of intersection of the tangent and axis fall on that side of the ordinate where the vertex of the curve line lies, as in the parabola and paraboloids: but if it comes out negative, the point of intersection will fall on the contrary side of the ordinate, in respect of the vertex, or beginning of the abscissa; as is illustrated with the hyperbolic figures. And universally, in all other conic and hyperbolic figures, the subtangent is equal to the exponent of the power of the ordinate, multiplied into the abscissa.

If CB is an ordinate to AB, in any given angle, terminating in any curve AC, and AB = a, BC = y, and the relation between x and y, that is, the nature of the curve, is expressed by this equation, \( x = 2axy + bx^2 - by^2 + cy = 0 \); then this will be the role of drawing a tangent to it: multiply the terms of the equation by an arithmetical progression; suppose, according to the dimensions of y, \( \frac{x^3}{2} - 2axy + bx^2 - by^2 - cy = 0 \)

as also according to the dimensions of x, \( \frac{y^3}{2} - 2axy + bx^2 - by^2 - cy = 0 \)

and the former product shall be the numerator, and the latter, divided by x, the denominator, of a fraction expressing the length of the subtangent; which, in this ease, will be

\( \frac{y^3}{2} - 2axy + bx^2 - by^2 = \frac{y^3}{2} - 2axy + bx^2 - by^2 \)

SUBTENSE, in geometry, the same with the chord of an arc. See CHORD.

Hence, the subtense of an angle is a right line supposed to be drawn between the two extremities of the arc that measures that angle.
Subtraction. See Arithmetic, and Algebra.

Subularia, rough-leaved alison, or arrawort, a genus of plants belonging to the class of tetranymada, and order of silicious; and in the natural order ranking under the 30th order, which the subclass is placed in. The flowers are ovate, concave, and contrary to the partitions. The style is shorter than the stigmas. There is only one species, the aquatica, which is a native of Britain.

Subulated. See Botany.

Succculents. See Succulent plant.

Succinic Acid. Amber is a well-known brown, transparent, inflammable body, pretty hard, and susceptible of polish, bound at some depth in the earth, and on the sea-coast of several countries. It was in high estimation among the ancients both as an ornament and a medicine. When this substance is distilled, a volatile salt is obtained, which is mentioned by Agricola under the name of salt; but its nature was unknown. Boyle was the first who discovered that it was an acid. From succinum, the Latin name of amber, this acid has received the appellation of succinic acid.

It is obtained by the following process: Fill a retort half-way with powdered amber, and cover the powder with a quantity of dry sand; lute on a receiver, and distill in a sand-bath without employing too much heat. There passes over first an inodorous phlegm; then a weak acid, which, according to Scheele, is the acetic; then the succinic acid attaches itself to the neck of the retort; and if the distillation is continued, there comes over at last a thick brown oil, which has an acid taste.

The succinic acid is at first mixed with a quantity of oil. It may be made tolerably pure by dissolving it in hot water, and putting upon the filter a little cotton, previously moistened with oil of amber: this substance retains most of the oil, and allows the solution to pass through. The acid is then crystallized by a gentle evaporation, and this process is to be repeated till the acid is sufficiently pure. Guyton Morveau has discovered that it may be made quite pure by distilling off the insufficient quantity of nitric acid, taking care not to employ a heat strong enough to sublime the succinic acid.

2. The crystals of succinic acid are transparent, white, shining, and of a foliated triangular, prismatic form: they have an acid taste, but are not corrosive: they retain the tint of turmeric, but have little effect on that of violets.

They sublime when exposed to a considerable heat, but not at the heat of a water-bath. In a sand-bath they melt, and then sublime, and condense in the upper part of the vessel; but the coal which remains shows that they are partly decomposed.

3. One part of this acid dissolves in 96 parts of water at the temperature of 30°, according to Sjipeinan; in 24 parts at the temperature of 80°; in two parts of water at the temperature of 212°, according to Storckar de Neuflorn; but the greatest part crystallizes as the water cools. According to Roux, however, it still retains more of the acid than cold water is capable of dissolving.

Two hundred and forty grains of boiling alcohol dissolve 177 of this acid; but crystals again shoot as the solution cools.

4. The compounds which this acid forms with alkalies, acids, and metallic oxides, have received the name of succinates. Scarcely any of them have been examined with attention.

5. When combined with soda, it crystallizes in four and six-sided prisms. When this salt is distilled in a retort, the succinic acid is completely decomposed. There pass over into the receiver an acid liquid, which is the acetic much diluted, and a quantity of brown oil. At the same time carbonic acid gas, and carburetted hydrogen gas, are dispersed, and there remain in the retort soda and charcoal. Hence it follows that this acid, like the others of the same class, is decomposed by heat, and that it is composed of oxygen, hydrogen, and carbon.

6. The affinities of succinic acid, according to Morveau, are as follows:

<table>
<thead>
<tr>
<th>Barytes</th>
<th>Lune</th>
<th>Potass</th>
<th>Soda</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ammonia</td>
<td>Magnesia</td>
<td>Aluminum</td>
<td>Metallic oxides</td>
</tr>
</tbody>
</table>

Succinum. See Amber.

Sudorific. See Materia Medica.

Suffrance. Tenant at suffrance is he who holds over his term at first lawfully granted. A person is tenant at suffrance who continues after his estate is ended, and wrongfully holds against another, see 1 Co. Inst. 57.

Tenants holding over, after determination of their term, and after demand made in writing to deliver possession, are rendered liable to pay double the yearly value. And tenants giving notice of their intention to quit, and not accordingly delivering up the possession at the time in such notice contained, are rendered liable to pay double rent. And it has been held, that under this act, the notice need not be in writing, and that the landlord may levy his double rent by distress. Bur. 1653.

Sugar, which at present forms so important an article in our food, seems to have been known at a very early period to the inhabitants of India and China. But Europe probably owes its acquaintance with it to the conquests of Alexander the Great. For ages after its introduction into the West, it was used only as a medicine; but its consumption increased very greatly: and during the time of the crusades, the Venetians, who brought it from the East, and distributed it to the northern parts of Europe, carried on a lucrative commerce with sugar. It was not till after the discovery of America and the extensive cultivation of sugar in the West Indies, that its use in Europe, as an article of food, became general.

Sugar was formerly manufactured in the southern parts of Europe; but at present almost all our sugar comes from the East and West Indies. The plant from which it is procured is the saccharum officinarum (see Saccharum), or sugar-cane. Other plants indeed contain it, but not in such abundance. In North America, however, it is extracted from the acer saccharinum, or sugar-maple. Attempts have been lately made to extract it from the beet.

The method of making sugar practised in Indostan is exceedingly simple, and requires little or no expensive apparatus. The soil chosen is a rich vegetable mould, in such a situation that it can be easily watered from above. About the end of May, when the soil is reduced to the state of soft mud either by rain or artificial watering, slips of the cane, containing one or two joints, are planted in rows about four feet from row to row, and eighteen inches in the rows. When they have grown to the height of two or three inches, the earth round them is loosened. In August small trenches are cut through the field to drain off the rain, if the season proves too rainy, and to water the plants if the season proves too dry. From three to six canes spring from each slip set. When they are about three feet high, the lower leaves of each cane are carefully wrapt round it; and then the whole belonging to each slip are tied in strong bundles. These are raised high, and stuck into the earth in the middle of them. They are cut in January and February, about 9 months after the time of planting. They have now reached the height of eight or ten feet, and the naked cane is from an inch to an inch and a quarter in diameter. They have not flowered. When this happens, the juice loses much of its sweetness. The canes are now put through the rollers of a mill, and their juice collected into large iron boilers; where it is boiled down slowly to a proper consistence, the scum being carelessly taken off. The fire is then withdrawn, and the liquid by cooling becomes thick. It is then stirred about with sticks till it begins to take the form of sugar; when it is put in mats made of the leaves of the palma-tree (bozasus stelliformis), and the stirring continued till it is cold. This process yields a raw or powdered sugar; but it is clammy, and apt to attract moisture from the atmosphere, because the acids in the juice have not been removed. By the addition of quicklime to the juice, in the proportion of about three spoonfuls to every gallon of boiling, the sugar may be made to acquire that solid property. The impure sugar prepared by this method is called jagary. Every three quarts of juice, or every six pounds, yields about one pound of sugar. From an acre of ground about 3500 pounds of sugar, and consequently about 30,000 pounds of juice, are obtained.

2. In the West India islands the raising of sugar is much more expensive, and the produce much less, owing to the high price of labour; or, which is increased, to the presence of the labourers, and to the inferiority of the soil. The juice is put into large boilers, mixed with quicklime, and boiled to a proper consistence of the scum in the mean time being carefully taken off. When it ceases to beropy, it is drawn off into another vessel, where it is allowed to concret, and the liquid impure part called molasses to separate from it. The more completely this separation is allowed to be, the better is the sugar. The sugar thus obtained is in small hard grains of a brownish-white colour, and is imported to Europe under the name of raw sugar.

3. In North America the farmers procure sugar for their own use by a still simpler pro-
Sugar.

When heat is applied to sugar it melts, swells, becomes brownish black, emitte-sulphur, and exhaunts a peculiar smell, known to the French by the name of caramel. At a red heat it instantly bursts into flames with a kind of explosion. The colour of the flame is white with blue edges.

6. Sugar, as far as known, is not acted upon by oxygen gas. The effect of the simple combustion it has not been described but it does not appear to be great. Azotic gas or the metals have no sensible actions on it.

The lower compartment of Plate Saw-mill, Sc represents a mill for squeezing the juice from the canes. After Wenzel, a strong frame of wood, the lower part D of which is a large block: the upper surface of this is cut out into a basin, to collect and receive the juice of the canes which is expressed by the three rollers FG, whose lower pivots work in sockets in the block D, and the upper sockets are fixed in the beam E. The sockets of the middle rollers are fixed in the beams D and E. The sockets of the other are held between two wedges cut out in contrary directions, the small end of one wedge being on the same side with the large end of the other. By this means the rollers can always be set nearer together, or farther from each other.

When the juice is drawn near the middle roller, drive out that wedge which is nearest the middle roller, and drive the other in; and the contrary when they are wanted farther apart. The rollers are usually of cast iron, and each end has a cog-wheel, as J, on its upper end, which causes them all to turn together, the power of the first mover being applied to the middle one by a shaft K.

When the machine is in work, a man stands on each side of it. The one in the front takes the cans, and puts them in between the rollers FG, which, as they turn, draw the cans through, and express their juice. The man behind them directs the ends of the cases back between the rollers GI, which are somewhat nearer together than the others; and as they come through, a third man carries them away. The juice runs down the rollers into the reservoir, and is conveyed by a pipe to the boiler D. It must be observed, that the reservoir in the top of the block D must be only cut in channels round the outside of the rollers; being left the full height near the centres, to prevent the sugar running down, and getting out between the wedges ab.

When a sugar-mill is worked by wind, the shaft K is connected with the vertical shafit of the mill. If by horses, the levers they work from are fixed to the shaft K, and either the horse-or the man have ground higher than the trough L, or the juice is conveyed by a pipe laid under the walk.

Sugar-mills that are worked by a water-wheel, or steam-engine, have a beaved wheel fixed on the end of the engine shaft which turns it.

The earth proper do not seem to have any action whatever on sugar; but the alkaline earths unite with it. When lime is added to a solution of sugar, and the mixture boiled for some time, a combination takes place. The liquid still indeed retains its sweet taste; but it has acquired also a bitter and astringent one. A little alcohol added to the solution produces a precipitate in white lakes, which appeared to be a compound of sugar and lime. Sulphuric acid precipitated the lime in the state of sulphate, and restored the original taste of the sugar. When the compound of sugar and lime was evaporated to dryness, a smoke transparent tenacious syrup resulted. A very small addition of sugar and alcohol, the sweet taste is completely restored. When alcohol is agitated with the compound of sugar and potash dissolved in water, it reduces to it, but swells on the top in a state of purity.

The acids are capable of dissolving sugar, and those which are concentrated decompose it. Sulphuric acid very soon acts upon it; water is formed, and perhaps also acetic acid, which is evolved in great abundance, and gives the liquid a black colour, and a considerable degree of consistency. The charcoal may be easily separated by dilution and filtration. When heat is applied, sulphuric acid is rapidly converted into sulphurous acid.

Nitric acid dissolves it with an effervescence, occasioned by the evaporation of nitrous gas, and converts it into malic and oxalic acids. 430 grains of sugar, treated with six ounces of nitric acid diluted with its own weight of water, and cautiously heated, separating the crystals as they formed, yielded 250 grains of oxalic acid; so that 160 parts of sugar yield by this treatment 58 parts of oxalic acid. When liquid oxymuriatic acid is poured upon sugar in powder, it is dissolved, and immediately converted into malic acid; and the oxymuriatic acid is converted into common muriatic acid.

Sugar absorbs muriatic acid gas slowly, and assumes a brown colour and very strong smell. The vegetable acids dissolve it; but seemingly without producing any alteration on it.

The action of the oxides of carbon and azote upon sugar has scarcely been examined.

Sugar is soluble in alcohol, but not in so large a proportion as in water. According to Wenzel, four parts of boiling alcohol dissolve one part of sugar. It unites readily with oils, and renders them miscible with water. A moderate quantity of it prevents, or at least retards, the coagulation of milk; but Scheele discovered that a very large quantity of sugar causes milk to coagulate.

The hydrate sulphates, sulphurates, and phosphates of alkalies and alkaline earths, seem to have the property of decomposing sugar, and of bringing it to a state not very different from that of gum. Mr. Cruckshank introduced a quantity of syrup into a jar standing over mercury, and then added about an equal quantity of phosphorus of lime. Phosphorised hydrogen gas was immediately extracted. In eight days the syrup was withdrawn: it had lost its sweet taste, and acquired a bitter and astringent one (the taste of phosphorus of lime). From this solution alcohol threw down white flakes, very much resembling those of mucilage separated from water by the same liquid. A little sugar was
41 ounce-measures of carbo nic acid gas. The carbo nate hydrogen, according to the ex periments of Goe ring, was composed of five parts carbon and one hydrogen.

These experiments are sufficient to show us, that sugar is composed entirely of oxygen, carbon, and hydrogen. It is of course a vegetable oxide. Lavoisier has concluded, from a series of experiments, that sugars, after fermentation, that these substances enter into the composition of sugar in the following proportions:

<table>
<thead>
<tr>
<th>Oxygen</th>
<th>Carbon</th>
<th>Hydrogen</th>
</tr>
</thead>
<tbody>
<tr>
<td>64</td>
<td>28</td>
<td>100</td>
</tr>
</tbody>
</table>

But these proportions can only be considered as very distant approximations to the truth.

8. From the experiments of different chemists, especially of Proust and Getling, it appears that there are different species of sugar found ready-prepared in the vegetable kingdom; distinguished from each other by the figure of their crystal, and other variations in their properties. The species hitherto examined are three in number, namely, common sugar, sugar of grapes, and sugar of beets. As far as is known at present, there is no difference between the sugar of the maple and common sugar.

9. That grapes contain abundance of sugar has been long known. The Duc de Bouillon first extracted it from the juice of grapes, and Proust pointed out the difference between it and common sugar. The juice of grapes, according to him, yielded from 30 to 40 per cent. of this sugar.

10. Margraf discovered sugar in the root of the beta vulgaris; but it is to Achard that we are indebted for the first attempts to extract it from that plant in a large way. The experiments of that philosopher, of Lampadius, of the committee appointed by the national institute, and of Goebling, have thrown more light on this interesting subject. The method which succeeded in the hands of the last, was to boil the beet-roots (deprived of the heart) till they became so soft as to be easily pierced by a straw. They are then cut into slices, and the juice forced out by pressure. What remains is left for twelve hours in water, and the whole subjected to the press a second time. The liquids thus obtained are filtered through flannel, boiled down to two-thirds, filtered a second time, reduced by boiling to one-third of the original liquid, filtered a third time, and then evaporated to the consistency of syrup. The crystalline crust which forms on the surface is to be broken from time to time, and the spontaneous evaporation continued till the surface becomes covered with a tough coat instead of crystals. The whole is then to be thrown into woolen bags, and the mucilaginous liquid separated from the crystals by pressure.

The sugar obtained by these processes, has much the appearance of raw sugar; but it may be refined by the common processes, and brought into the state of common sugar. From the experiments of Goebling, it appears that the sugar is distinguished by a certain degree of a nauseous bitter taste; owing, it is supposed, to the presence of a bitter, extractive matter, which Lampadius has shewn to be one of the constituents of the beet.

11. The plants containing sugar are very numerous. The following are the chief of those from which it has been actually extracted by chemists:

- The sap of the acer saccharinum, betula alba, aslepias syriaca, hericium spondiulon, cocus nucifera, juglas alba, agave americana, fucus saccharinus, fucus carica.
- The juice of arundo canariensis, the roots of pastinaca sativa, siun sisarum, beta vulgaris and cicis, fucus carolis, aegium pepterniuum.

Parranter has also ascertained, that the grains of wheat, barley, &c. and all the other similar seeds which are used as food, contain at first a large quantity of sugar, which gradually disappears as they approach to a state of maturity. This is the case also with peas and beans, the leguminous seeds; and is one reason why the flavour of young peas is so much superior to that of old ones.

SUIT, in law, is used in different senses, as, 1. Suit personal. 2. Suit of court, or suit service, is an attendance that tenants owe to the court of their lord. 3. Suit covenant, is where the ancestor has covenanted with another, to sue to his court. 4. Suit custom, when a man and his ancestors have been seized time out of mind, of his suit. 5. Suit real, or regal, when men come to the sheriff's tomb or feet. 6. Suit signifies the following one in chase, as fresh suit. 7. It signifies a petition made to the king or any great person. Covel.

SUKOTYRO, a genus of quadrupeds of the order brute; the generic character, born on each side near the eyes. There is but a single species, viz. the indicus··man up right, short, narrow, reaching from the top of the head to the rump. It inhabits Java and feeds on leaves.

SULPHIATS, salts formed with the sulphuric acid, which see.

SULPHITES, salts formed with the sulphurous acid, which see.

SULPHUR, distinguished also in English by the name of brimstone, was known in the earliest ages. As it is found native in many parts of the world, it could not fail very soon to attract the attention of mankind. It was used by the antients in medicine, and its fumes were employed in bleaching wool. See Pliny, Lib. xxxv. c. 15.

1. Sulphur is a hard brittle substance, commonly of a yellow colour, without any smell, and of a weak though perceptible taste. It is a non-conductor of electricity, and of course becomes electric by friction. Its specific gravity is 1.990.

Sulphur undergoes no change by being allowed to remain exposed to the open air. When thrown into water, it does not melt as common salt does, but falls to the bottom, and remains there unchanged. It is therefore insoluble in water.
2. If a considerable piece of sulphur is exposed to a soldering-iron, it will become red without any flaring or volatilization. If a piece of sulphur is heated in a dish to a temperature of about 170° C, it will become red without any flaring or volatilization. If a piece of sulphur is heated in a dish to a temperature of about 219° C, it will become red without any flaring or volatilization.

SULPHURIC ACID is a very important and versatile substance. It is the acid of most importance in the manufacture of many other acids, and is used in the preparation of many important chemicals. It is a strong oxidizing agent and is used in the production of many important chemicals, such as nitric acid and perchloric acid.

SULPHURIC ACID is prepared by the action of water on a red-hot piece of sodium peroxide. It is a strong oxidizing agent and is used in the production of many important chemicals, such as nitric acid and perchloric acid.

SULPHURIC ACID is a transparent, colourless liquid. It is a strong oxidizing agent and is used in the production of many important chemicals, such as nitric acid and perchloric acid.

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compound of sulphuric acid and lime, subphat of lime, &c.

It absorbs a very considerable quantity of nitrous gas, and acquires by that a purplish colour. Its affinities are as follows:

Barytes, Ammonia,
Strontian, Glaucia,
Potash, Vitriol,
Soda, Alumina,
Lime, Zirconia,
Magnesia, Metallic oxides.

This is one of the most important of all the acids, not only to the chemist but to the manufacturer also; being employed to a very great extent in a variety of manufactures, especially in dyeing.

Sulphuric acid. Though some of the properties of this acid must have been known in the remotest ages, as it is always formed during the slow combustion of sulphur, Stahl was the first chemist who examined it and pointed out its peculiar nature. His method of procuring it was to burn sulphur at a low temperature, and expose to its flames cloth dipped in a solution of potash. By this method he obtained a combination of potash and sulphuric acid; for at a low temperature sulphur forms by combustion only sulphuric acid. Schede pointed out, in 1771, a method of procuring sulphuric acid in quantities. Dr. Priestley, in 1774, obtained it in the gaseous form, and examined its properties while in a state of purity.

1. Sulphuric acid may be procured by the following process: Put into a jar, two parts of sulphuric acid and one part of mercury, and apply the heat of a lamp; the mixture effervescs, and a gas issues from the beak of the retort, and may be received in glass jars filled with mercury, and standing in a mercurial trough. This gas is sulphuric acid.

2. Sulphuric acid, in the state of gas, is colourless and invisible like common air. It is insensible in quantity; put into a dry glass jar, it can animals breathe without death. It has a strong and suffocating odour, precisely the same with that exhaled by sulphur burning with a blue flame: sulphur, by such a combustion, being converted into a sub- phlogistic acid. Its specific gravity, according to Bergman, is 0.00246; according to Lavosser, 0.00251. It is therefore somewhat more than twice as heavy as air. One hundred cubic inches of it weigh nearly 63 grains.

3. This acid reddens vegetable blues, and gradually destroys the greater number of them. It exercises this power on a great variety of vegetable and animal colours. Hence the use of the fumes of sulphur in bleaching wool and in whitening linen stained by means of fruits.

4. Dr. Priestley discovered, that when a strong heat is applied to this acid in close vessels, a quantity of sulphur is precipitated, and the acid is converted into sulphur. Berthollet obtained the same result; but Four- croy and Vauguien could not succeed.

5. Water and salt with avidity. According to Dr. Priestley, 1000 grains of water, at the temperature 54.5°, absorb 30.6 grains of this acid. Fourcroy, on the other hand, affirms that water at 40° absorbs the third of its weight of sulphuric acid gas.

Ice absorbs this gas very rapidly, and is instantly melted. With this, all that remains is a mixture of liquid sulphuric acid, or sulphuric acid, is of the specific gravity 1.046. It may be frozen without parting with any of the acid. When this mixture has been saturated with this acid at the freezing temperature, its specific gravity is equal to 1.0625, and it is filled with a vast number of bubbles, which continuously increase and rise to the surface. These bubbles are a part of the acid separating from it. It freezes a few degrees below 0°.

6. When liquid sulphuric acid is exposed to atmospheric air or to oxygen gas, it gradually combines with oxygen, and is converted into sulphurous acid. This change takes place more completely if the acid is combined with an alkali or earth. When a mixture of sulphuric acid gas and oxygen gas is made to pass through a red-hot porcelain tube, the two bodies combine, and sulphuric acid is formed.

7. Of the simple combustibles, sulphur and phosphorus have no action on it whatever; but when hydrogen gas and charcoal do not alter it while cold, but on being heated they decompose it completely; water or carbonic acid is formed, and sulphur deposited.

8. Neither azeote nor maritiate acid produces any change on it.

9. Sulphuric acid does not seem capable of oxidizing or dissolving any of the metals except iron, zinc, and manganese.

10. It combines with alkalies, earths, and metallic oxides, and forms salts known by the name of sulphates.

11. Sulphuric acid absorbs this gas in considerable quantity. It acquires a yellowish-brown colour, a penetrating odour, and the property of smoking when exposed to the air. When this mixture is distilled, the first vapour which comes over, and which is a compound of the two acids, crystallizes in long white prisms. This singular compound, formerly known by the name of glacial sulphuric acid, is, when the air is dry, a white powder; but when the atmosphere is moist, melts with effervescence. When thrown into water, it hisses like a red iron.

It has the colour of sulphuric acid. The ethics of the court have lately demonstrated, that this is a compound of sulphuric and sulphurous acids.

12. The affinities of sulphuric acid, as far as they have been investigated, are as follows:

<table>
<thead>
<tr>
<th>Barytes</th>
<th>Magnesia</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lime</td>
<td>Ammonia</td>
</tr>
<tr>
<td>Potash</td>
<td>Glaucia</td>
</tr>
<tr>
<td>Soda</td>
<td>Alumina</td>
</tr>
<tr>
<td>Strontian</td>
<td>Zirconia</td>
</tr>
</tbody>
</table>

13. As this acid is formed by the combustion of sulphur, it cannot be doubted that it is composed of the same ingredients with sulphuric acid; and as it is evolved from sulphuric acid by the action of sulphur, and likewise by some of the metals, it cannot be doubted that it contains a smaller proportion of oxygen. But no precise set of experiments has yet been made to determine the proportion of its component parts. Fourcroy affirms that it contains:

| 85 sulphur |
| 15 oxygen |

1000

But he does not inform us upon what evidence he assigns these proportions. SUM, in sums, signifies the quantity that arises from the addition of two or more magnitudes, numbers, or quantities together.

The sum of an equation is, when the absolute number being brought over to the other side of the equation, with a contrary sign, the whole becomes equal to 0; thus, the sum of the equation $x^2 - 12x + 41 = 0$, is $x^2 - 12x + 41 = 0$. See Algebra, and Arithmetic.

S. MACH. See A. Rh. S. See Astronomy. SUNDAY. See Lord's Day.

SUPERcargo, a person employed by merchants to go on a voyage, and oversee their cargo, or lading, and dispose of it to the best advantage.

S. P. F. S. or Surface. See Geometry.

S. P. S. E. D. A. a writ that lies in a great many cases, and signifies in general, a command to stay proceedings, on good cause shown, which ought otherwise to proceed. By a supersedeas, the doing of a thing, which ought not otherwise have been done, is prevented; or a thing that has been done, is (notwithstanding it was done in a due course of law) thereby made void. 4 Bac. Abr. 667.

A supersedeas is either expressed or implied; an express supersedeas is sometimes by writ, sometimes without a writ; where it is by writ, some person to whom the writ is directed, is thereby commanded to forbear doing the thing thereby directed, or if the thing has been already done, to revoke, as that can be done, the act. 4 Bac. Abr. 667.

Super Statuto de Articulis Cleri, is a law, a writ that lies against the sheriff, or other officer that detain in the king's highway, or in the lands antiently given to the church.

Super Statuto Pacto S. Sch. Et Marshall de Roy, &c., a writ against the subsidy or subsidy, for holding plea of freedom in his court, or for trespass, or contracts not made within the king's house.

Supplies, the sums granted by parliament for defraying the ordinary expenses of the current year. The known or probable amount of the different branches of the year's expences, is stated to the house of commons in a committee of supply, by the chancellor of the exchequer; and after they have been voted by the committee, are formally granted by act of parliament. The granting of the annual supplies as well as permanent taxes, is a peculiar privilege of the house of commons, who never permit any alteration or amendment to be made by the lords, in the bills passed for this purpose.

The grants of parliament were originally considered, merely as temporary aids, to assist the sovereign in defraying such extraordinary expenses as he was subject to for the benefit of the public; and unless the commons happened to entertain at the time, any particular jealousy of the crown and its ministers, the same grants were only left entirely to their disposal. But after the restoration of Charles II., not only more frequent grants were demanded, but, in consequence of the property to which the crown
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grants had benecessary almost every year.
It was impossible, however, for the parliament, distrusting not only Charles’s economy,
but his regard for the interest of his kingdoms,
to vest considerable sums of money in such
unsafe and improvident hands: it Was, therefore, thought requisite to specity the purposes for which each sum was voted. '1 hus
appropriating clauses came to be introduced,
which practice has continued ever since;
and at the commencement of each session, an
account is presented ot the disposition of the

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divisor: thus

grants of the preceding session, shewing how
much has been actually paid on each branch
of the public service, what remains unpaid
of the sums appropriated, with the funds tor
discharging the same*, and the surplus or de-

ways and means.
The supplies annually voted do not include
the interest and charges of the national debt,
the civil list, and some other articles which
are provided for as permanent charges on
the consolidated fund but merely the expences of the army, navy, ordnance, and
such miscellaneous services as are granted
from year to year.
SUPPORTERS. See Heraldry.
ficiency of

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SUPREMACY,

supremacy was

The king’s
established, or, as others say, recovered,
ed head.

at first

by

king Henry VIII. in 1534, after breaking
with the pope. It is since confirmed by several canons, as well as by the articles of the
.church, and is passed into an oath which is
required as a necessary qualification for all
offices and employments both in church and
state, from persons to be ordained, from the
members of both houses of parliament, &c.

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5 */6 &c. express numbers incommensurable
with unity. However, though these numbers
are incommensurable themselves with unity, yet
they are commensurable in power with it because their powers are integers, that is, multiples of unity. They may also be commensurable sometimes with one another, as the y/ 8
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This common measure is found as in
commensurable quantities, only the root of the
common measure is to be made their common
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radical sign, over their product or

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in involving surds, raise the
quantity under the radical sign to the power
required, continuing the same radical sign ; unless the index of that power is equal to tha
name of the surd, or a multiple of it, and in
that case the power of the surd becomes rational.
Evolution is performed by dividing the
fraction, v/hich is the exponent of the surd, by

name

of the root required. Thus the square

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surd *y/ a m x

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square of 5 divides

75, the quantity under the sign in V" 75, without
a remainder ; then place the root of that power
rationally before the sign, and the quotient under the sign, and thus the surd will be reduced
to a

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expression.

/ 3"x’l6

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surds are reduced to their least exhave the same irrational part,
they are added or subtracted, by adding or subtracting their rational co-efficients, and prefixing the sum or difference to the common irrapressions. if they

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into themselves, give at length rational quantities ; yet compound surds multiplied into themselves, commonly give still irrational products.
But, when any compound surd is proposed,
there is another compound surd which, multiplied into it, gives a rational product. Thus, if
were proposed, multiplying it by
a -[«
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y//4, the product will be a

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vered by Mr. Maclaurin, in his Algebra, p. 109,

which

seq. to

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refer the curious.
is of use in reducing surd ex-

pressions to more simple forms. Thus, suppose a binominal surd divided by another, as
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Compound surds are such as consist of two or
more joined together; the simple surds are commensurable in power, and by being multiplied

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of any quantity of the same
name with the surd divides the quantity under
the radical sign without a remainder, as here
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investigation of that surd, which, multiplied into the proposed surd, gives a rational
product, is made easy by three theorems, deli-

surds have not the same radical sign, reduce them to such as shall have the same radi-

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y/a-^or y/a 4 .

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because they are to one another as 2

£nd when they have a common measure^
as ^/2 is the common measure of both, then
their ratio is reduced to an expression in the
least terms, as that of commensurable quantities, by dividing them by their greatest common

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V 2 2 * = 2^ —
= 5 a ^ = 5 = %J 125.

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and have the same sign,
multiply these rational quantities into one another,- or divide them by one another, and set
ties, as

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surds are of different

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V 48 = 5y 3-|-4,y/3:=:9y3;
— 3 V 3 2 V 3 — 5 y/ 3
V 2 X V 2 = Vy/81150 —i/24
\Z54 = 5 ye — 3 ye = 2 y6
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10 y/ 18. The powers of surds are found as the
powers of their quantities, by multiplying their
exponents by the index of the power required ;

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Surds of the same rational quantity are multiplied by adding their exponents, and divided by

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The roots, therefore, of such numbers, being
incommensurable, are expressed by placing the
proper radical sign over them: thus ^/2,^/ 3,

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reduced to the same radi-

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having the same value and a com-

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unity otherwise called an irrational number or
quantity.
The square roots of all numbers, except L, 4,
9 , 16, 25, 36, 49, 64, 81, 100, 121, 144, &c.
(which are the squares of the integer numbers,
1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, &c.) are insommensurables and after the same manner the
cube roots of all numbers but of the cubes of
and
j
2, 3, 4, 5, 6, &c. are incommensurables
quantities that are to one another in the proportion of such numbers, must also have their
square-roots, or cube-roots, incommensurable.

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As surds may be considered as powers with
fractional exponents, they are reduced to others
of the sarre value that shall have the same radical sign, by reducing these fractional exponents

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number or quantity

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Anatomy.

SURD, in arithmeticand

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and 4 = yi6 = ^/64 = ^256 = ^/1024

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church as well as state, whereof he is establishin

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quantity may be reduced to the
form of any given surd, by raising the quantity
to the power that is denominated by the name
of the surd, and then setting the radical sign

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See Medicine.

SUPPRESSION.

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might be expressed in a more simple form, by
multiplying both numerator and denominator
by that surd which, multiplied into the denominator, gives a rational product thus,
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\[
\sqrt[3]{20 + \sqrt{12}} + \frac{20 + \sqrt{12}}{\sqrt{5} + \sqrt{3}} - \frac{20 + \sqrt{12}}{\sqrt{5} - \sqrt{3}} = 5 - 3 = 2
\]

\[
\sqrt[100]{2 + 50 + 6} + 6 = 12 + 6 + 6 = 24 + 6 = 8 + 2\sqrt{15}
\]

To do this generally, see Macaulain, lvi. cit. p. 113.

When the square root of a sum is required, it may be conveniently approximated by the root of a rational quantity that approximates to its value. Thus to find the square root of \(3 + 2/3\), first calculate \(\sqrt{2} = 1.41421\). Hence \(2 + 5/6 = \frac{5}{3} + \frac{5}{6}\), the root of which is found to be nearly \(2.41421\).

In like manner we may proceed with any other proposed root. And if the index of the root, proposed to be extracted, is great, a table of logarithms may be used. Thus \(\sqrt[3]{5 + \sqrt{17}}\) may be most conveniently found by logarithms.

Take the logarithm of 17, divide it by 3; find the number corresponding to the quotient; add this number to 5; find the logarithm of the sum, and divide by \(\sqrt[3]{10}\), and the number corresponding to this quotient will be nearly equal to \(\sqrt[3]{5 + \sqrt{17}}\).

But it is sometimes requisite to express the roots of surds exactly by other surds. Thus, in the first example, the square root of \(3 + 2\sqrt{2}\) is \(1 + \sqrt{2}\), and \(3\sqrt{2} + 2\sqrt{2} = 5\sqrt{2}\). For the method of performing this, the curious may consult Mr. Macaulain's Algebras, where also rules for trinomials, &c. may be found.

**SURETY.** In law, generally signifies the same with bail. See Bail.

**SURETY of the peace.** A justice of the peace may, according to his discretion, bind all those to keep the peace, who in his presence shall make any affray, or shall threaten to kill or beat any person, or shall contend together in hot words; and all those who shall go about with unlawful weapons or attendance to the terror of the people; and all such persons as shall be known to him by his common barator; and all who shall be brought before him by a constable, for a breach of the peace in the presence of such constable; and all such persons who, having been before bound to keep the peace, shall be convicted of having forfeited their recognizances.

When surety of the peace is granted by the court of king's bench, if a supersedeas comes from the court of chancery to the justices of that court, their power is at an end; and the parties to as discharged. If security of the peace is desired against a person, the safest way is to apply to the court of chancery, or king's bench. 1 H. 127. If the person against whom security of the peace is demanded is not present, the justice of the peace may commit him immediately, unless he offers sureties; and a constable he may be commanded to find sureties, and be committed for not doing it. 10.

**SURETY of the good behaviour.** Includes the peace; and he that is bound to the good behaviour, is therein also bound to the peace; and yet a man may be committed to find sureties both for the good behaviour and the peace. Dall. c. 129. See Good Behaviour.

**SUREFET.** See Medicine.

**SURGERY.** is the art of cutting or alleviating diseases by local and external applications, manual or instrumental. As a science it may be defined, that department of medicine which treats of maladies thus susceptible of alleviation or cure.

This, like other parts of medicine, must necessarily have been practised in the medical writers of the antients; and hence the authority of history, both sacred and profane, that the whole of the healing art was for some time restricted to the treatment of external injuries; and that consequently, surgery has not merely been coeval with, but antecedent to, the other branches of medical science.

The history, however, of surgery, among the early Asiatics, and even as cultivated and practised by the Greeks, is involved in fable, and obscured by fiction. Hippocrates was in a manner the founder of surgery as of medicine; and it was not indeed until after the time of this author, that the science was divided into separate branches. This division was effected in the time of Ptolemy Philopator, king of Egypt, and has continued with some modifications, but without precise limits, down to the present day.

Among the Romans, Celsus is the first author, in whose writings we meet with any account of surgery. The first of the antients, whose works were exactly translated into this art. In the works of Celsus, we find a minute statement of all its improvements, from the time of Hippocrates; and by many among the moderns, an examination of the works of Celsus, has been earnestly recommended to the student. The Latinity, however, of this medical classic, is greatly preferable to his surgery.

After Celsus, lived the celebrated Galen, whose authority for so long a period influenced the language and practice of physic, and who, although his works are principally medicinal, wrote likewise on surgery. Galen was the last writer of consequence among the Romans.

About the year 500, Aetius added many observations to those of Celsus and Galen. Aetius was succeeded and much excelled by Paulus Egucera, whose surgical writings have been pronounced superior to those of all the other antients; this last author, together with Celsus, were employed as text-books by Fabricius ab Aquapendente, a writer of celebrity in the sixteenth century.

Among the Romans and Asiatics, Fabricius and Avicenna are the principal writers who treated of surgery. The Canon Medicine of the latter, a compilation principally from Galen and Rhazes, was for a number of years held in such estimation, that it was not, however, until the time of Albucasis, that surgery was much in repute among the Arabs; and from this period to the 14th century, its history is extremely barren. Even at the commences of the 16th century, "surgery was held in contempt in this island, and was practiced indiscriminately by barbers, farriers, and surgery-gilders. Barbers and surgeons combined for 200 years afterwards to be incorporated in one company, both in London and Paris. In Holland and some parts of Germany, even at this day, barbers exercise the razor and lancet alternately."

We find no surgical work worthy of notice in the history of Celsus. A system published by the above-mentioned Fabricius, shortly afterwards attracted much notice, and has been highly commended by Boerhaave; about this time likewise, a French surgeon, made several bold and very important inno-
anatomy, structure, relative connections, and functions, of the parts concerned; for the sword or the bullet may, by the smallest diffe-
rence in its effect, occasion continuo-
us death; give rise to tedious, intractable, and ultimately fatal diseases; or penetrate and even pass through the body, almost with im-
punity.

Wounds of the breast and lungs. Extreme difficulty of breathing, coughing up of blood, a discharge of air from its external orifice, or the sudden formation of emphysema or windy tumour, &c. are described by authors, among the signs indicating a wound in the thoracic substance. If, together with these symptoms, "the patient is oppressed, tossing, insen-
sible; his face ghastly, and his extremities cold; his condition is doubtful; it looks much like a wound of some vessel near the root of the lungs, and if so, he is surely gone. If the oppression comes on more slowly, the pulse only hurried and fluttering, and the extremities not so cold, there is reason to hope that though it is merely in the edges of the lungs; and as it is at a distance from the great veins and arteries, he may escape."

(J. Bell on Wounds.) If, when the breast is wounded, there is no emphysema, no splitting of skin; indeed, of that of the skin, an inspection, which proves that the blood is pouring either into the proper air-cells of the lungs, or the cellular texture of these organs, it may be concluded, that the wound-making instrument has not passed into the thoracic cavity, but is merely in the external part of the chest. To ascertain whether the suffocative oppression just noticed, proceeds from extravasation of blood into the air-cells, or merely into the thoracic cavity, we are directed, that the finger be thrust into the wound, and some blood let out; which opera-
tion, if it is attended with very sensible relief, proves, that the air-cells or proper cavity of the lungs are uninjured; and the danger in this last case, it much less than if these cells had been wounded.

Wounds of the belly. Wounds of the belly are for the most part mortal; and this, when it does not arise from an injury to any of the great vessels or great organs, principally depends upon the extreme suscepti-
bility to peritoneal inflammation. "Wounds of the head are deadly, from the oppression of the brain, and there delirium or coma are the characters. Wounds of the breast are fatal by the oppression of the lungs; and there difficult breathing, tossing, coughing of blood, coldness of the extremities, and a fluttering, pulse are the mortal signs. Wounds of the abdomen are mortal by the inflammation and gangrene; and the signs of danger are, swelling of the abdomen, intense pain, vomitings, costiveness, hiccup, faint-
ings; then an interval of deceptual case, which is merely a sign of intellectual gan-
grene, and of the near approach of death. The wound-making instrument, however, may penetrate or pass through the liver or the spleen, and prove mortal in another way be-
side that of inducing peritoneal inflamma-
tion; viz. by occasioning a sudden and co-
pious extravasation of blood, and in these last cases the fatal symptoms present themselves with more rapidity. In wounds of the liver, the patient immediately sinks; and faints, languishes in a slumbering state, insensible almost and without pain, lies cold and dead-like for perhaps twenty-four hours, and then ex-
pires."

When the spleen or vena cava is wounded, the signs and consequences of the internal bleeding are nearly the same as in wounds of the liver. "A wound," says Mr. J. Bell, "of the spleen, liver, or vena cava, is as deadly as a wound of the heart, so full are they of blood." To this rule, however, there are some very few exceptions.

The inward bleedings from smaller vessels, as of the mesentery, the kidney, the emul-

gent veins, &c. for the most part prove mortal, in the secondary manner above allu-
ded to, viz. by inducing inflammation; in these last instances then, the progress and nature of the symptoms are different. "And here it may be noticed, that if there are immediate fainting on receiving the wound, and coldness, accompanied with a con-
tinued fainting, swelling of the belly, and oppressed breathing, most likely there is blood extravasated, and in dangerous quan-
tity, from the great vessels; but if the patient has lain easy, and there come pain, swelling, fever, and other threatening signs on the sixth or seventh day, with a tumour in one part of the belly, it is most likely a bloody peritonitis has begun to exist by that inflammation. If there are pain and swelling on the first or second day, it is from wounded intestine; if there are pain and swelling, but not till the sixth day, it is from blood; if there be no pain, the patient dies on the fifteenth day, our patient is almost safe."

When the stomach is wounded, a burning sensation is experienced at the pit of this organ, then follow heat, thirst, an acceler-
ate pulse, and violent vomiting, which are succeeded by fainting, extreme prostration of the vital powers, an extremely rapid and fluctuating pulse, swelling of the abdomen, hiccup, and death.

If the wound is in the intestines, the faces often escape from the orifice; fever, pain, irritable pulse, swelling of the belly, faintings, mortification state.

We have hitherto spoken of peritonitis inflammation, as occasioned by an extrav-
asation of blood; frequently, however, the irritating cause by which it is induced, consists of the viscera or viscid matter that may be wounded. Thus, when the gall-
bladder is the seat of the injury, the bile is poured out; when the urinary bladder is wounded, the urine; when the stomach, the food; and when the intestines, the faces are discharged, and excite this fatal inflammation.

It is scarcely necessary to add, that be-
side the symptoms already enumerated, jaun
cicle will almost invariably be attendant upon a wound of the gall-bladder or ducts; and an incontinence or suppression of urine, of the urinary bladder.

Further, a large wound penetrating the cavity of the belly is generally attended with a protrusion of some of the viscera; and even when the wound does not penetrate through the
dominant cavity, the peritonitis sometimes protrudes and occasions hernia. Wounds likewise of the belly, which do not pierce the cavity of the abdomen, often prove dis-
abling to those whose condition is the most fatal, by occasioning serious ulcers among the mus-
cles, and caries of the bones, and hectic fever.

This is frequently the case in gun-shot wounds, where, the bullet being lodged about the loins and in the heart of the muscles, the patient may have escaped the first danger, and yet, by the constant and fatal action of the victim of tedious suppurati on, and lingering wasting hectic.

Respecting the symptoms which succeed to injuries of the head, we shall defer our remarks till we come to notice the surgical operations on the skull; and shall now go on to consider the treatment of wounds.

Treatment of wounds. It will first be ne-
cessary to consider the management of what are called simple wounds, without supposing the injury to have extended to the internal organs; to state the circumstances which may interfere with the orderly course of healing of such wound; and then to notice the more particular treatment of wounds in the breast or belly.

In conducting the cure of simple wounds, the surgeon will find "his duties happily reduced within the narrowest bounds, viz. of saving the patient from immediate bleed-
ing, and of laying the wounded parts so clearly, so neatly, and so evenly in contact with another, that the rest we leave to nature." "I fear," says the author from whom we have taken the above extract, "that from my announcing a rule of conduct so simple as this is, you will sup-
pose, that I mean to speak only of the slightest and more trivial wounds; while I do really mean to include, under this general view, the greatest and the smallest wounds; and to establish but one rule for all, from the ampu-
tation of a limb, or the extirpation of a tu-
mour, to the most trivial cut of the cheek or hand.

"What is amputation but a wound? the greatest wound, clean and fair, made care-
fully by the hand of the surgeon, disposed to heal in the easiest way; and in this great wound, which a fortress includes the doctrine of every lesser wound, what is there to at- tend to but the procuring of adhesion, or the stopping of the flow of blood? What were we told concerning the amputation of a limb that the surgeon knew not how to procure this adhesion? that he had no means by which he could stop the bleeding? The lambrorrhage fatal to most of those who needed to suffer this operation; and the few who sur-
vived lingered through all the miseries of a nine-months cure, tedious and imperfect, with conical, ulcerated, and tender stumps. What indeed is the chief perfection of modern surgery, or the excellence of our operations, but that in bleeding from great vessels we trust nothing to compression, cauteries, or astringents, but tie our arteries firmly; and that we talk no longer about muddying, the edges of a cut, or clearing away the fat of the wound. We never dress the cut surfaces as distinct wounds, but put the sides or lips in close contact, and keep them so. We boast no-	hing of our own powers, but trust all to na-
ture; whose business it is, to make those sur-
faces adhere which will adhere; or reunite by the slower process of suppuration and granulation, those parts among which there has been a loss of substance." (J. Bell on Wounds at other times, however, some months after.)

We have thus taken the liberty of copying the masterly and impressive language of this
ed or hair-lip suture, from its being principally had recourse is in order to unite the cut edges of a hair-lip. The manner of using this suture is the following: The broad edges of the wound are brought as nearly and neatly as possible in contact, and transfixed with the needle employed for the purpose. In the hair-lip operation, two of these pins are inserted, one at the edge of the lip, and one in or above the middle of the cut; we then twist a thread from one to the other pin, in the form of a figure of 8. (See fig. 9 in the Surgical Plates.)

In long and deep wounds among muscular substance, stitching will generally be requisite, and in proportion to their length must the stitches be multiplied. We are commonly directed by authors to make “for each inch of the wound, one stitch of the needle,” passing, according to the extent of the wound, so many separate ligatures, which, after being all passed, are to be tied each over the surface, first by a single, then by a slip-knot. In this manner is the interrupted suture of the antients formed; which they distinguished from the continued suture, from the latter the suture is made, and the edges are sewn all along the wound. In each interstice of the interrupted suture, it will be necessary to lay one strip of adhesive plaster.

When the wound is still deeper, so that the stitches cannot go to the bottom, the compression, and what is called the uniting bandage, must be applied after stitching. This is formed by putting a double-headed roller round the part, passing one head through a slip in the bandage round the roller at once.

"If the wound is pretty deep among the muscular flesh, so that the several stitches of the interrupted suture would make (if tied by the common knots) an awkward and painful suture, likely to excite inflammation, we then convert the interrupted suture into what is called the quilted suture; which is made by splitting each end of the ligature (after the stitches are made) into two threads; then laying a quill or bougie along each side of the wound, we tie all the ligatures each side round one bougie; then draw that bougie tight down, by pulling the ligatures from the other side; then tie the ligatures also on the other side, round the opposite bougie; so that the two bougies, like two large rolls, keep the sides of the wound neat and even." This suture is not often employed.

After describing these different methods of effecting union between the divided edges of a wound, it is necessary to caution the reader further against using them indiscriminately in very deep muscular wounds. "Stitches after all can support only the edges of the wound, while it is the compress and the uniting bandage that must support all below." Thus stitches carried to a great depth have not only failed of their object, but have too often been the immediate occasion of convulsions, inflammations, and their long and dreadful train of consequences.

Stitches must also be employed cautiously if the patient, previous to the accident, has suffered from slight inflammation, or has been exposed during the cure to the contaminted and deadly atmosphere of a crowded, filthy, and unventilated hospital.

With respect to the manner of arresting the bleeding, when one principal, or several ramifications of an artery are divided in a wound, so that profuse hemorrhage takes place, the application of the tourniquet (fig. 10) is called for. The arteries are afterwards to be taken up, and secured in, the following manner: The tourniquet is so long little loosened in order to discover the artery, which makes a noose on the ligature to be employed: this being placed over the tuniculum (see fig. 11), the sharp point of this instrument is passed through the sides of the artery vessels and wound of it taken out from the surrounding flesh, as is sufficient to afford surface for a secure knot, which the assistant makes upon it.

If, from the depth of the wound, the tension has relaxed, the crooked needle is to be employed instead; and it is to be passed under the artery, as little of the muscular substance as possible to be included in the ligature. If the artery to be secured is superficial, and lies against bone, as in the temple, in the hand, or the forearm, it may be secured by a firm compress. If it is convenient to make this compress within the wound, it may be formed of a piece of sponge, cork, folded leather, or linen. Such application will necessarily for a time interrupt the cure by adhesion.

When the wound has been sewed, the ends of the ligatures that are round the arteries are to be left hanging from its corners.

Such then is the immediate business of the surgeon, viz. to arrest hemorrhage; and to bring out as speedily as possible the divided edges of the wound into contact, in order to secure the commencement of that adhesive process already spoken of. But with the closing of the wound, the surgeon's business is not finished. For the part, indeed, if the junction has been duly effected, if the patient is in health and properly managed, a certain degree of union will be shortly formed, the ligatures that have been employed will come away on the fourth or fifth day, and the adhesive action that is going on will not amount either to actual inflammation (although it is called the adhesive inflammation), or be accompanied by any systematic irritation of capital progress, however, of cure, in all wounds that have been closed by ligature, some degree of actual inflammation is always produced; and for this reason, that the ligatures themselves cannot but act as local irritants. Now if the tendency in the system is to inflame; if the stitches have been carried too deep, or the ligatures are too tightly pulled; if there is blood poured out under the skin, by which it is separated from the parts below; if, in a word, any cause has place of either generation or undue irritation; instead of the kindly progress of this adhesive natural and healthy action, pain, inflammation, and swelling of the parts, will ensue and if this arise to any extent, "you must immediately undo your bandage, draw out your pins, or cut your stitches, and take away every thing that is like structure upon the wound; these sudden occurrences may abate the ensuing inflammation, and prevent the total separation of the skin; while you may still endeavour to keep the wound tolerably close by the more gentle means of sticking-plasters."

"But should the inflammation rise still higher, and should you perceive that a total
Surgery.

If gun-shot or bruised wounds cannot be made to heal directly, or by adhesion, it follows that the treatment will have to be found in some measure peculiar; we are, therefore, now to discuss the question of such peculiarity, and in so doing we shall for the present limit the consideration of wounds which have not penetrated the thoracic, or abdominal cavities. The symptoms of wounds in the breast and belly, we have already enumerated; on their management, medical and surgical, we shall shortly enlarge.

Treatment of gun-shot wounds.

In gun-shot wounds which have neither penetrated the two great cavities of the chest and abdomen, nor have been made upon the head, the principal points of consideration are; the direction or place of lodgment of the ball, whether one or more bones have been splintered or broken, whether any considerable artery has been torn up, whether the wound has reached any of the joints, and lastly, by what means any foreign matter, such as the patient's clothes. These points are to be determined by an acquaintance with the anatomy of the parts; by probing, scarifying, or dilating the wound; and the surgeon, from the marks taken of the symptoms which the injury has occasioned.

"All probing should be done at the time of the wound," while the parts are still by the finger, and be gentle. The irritation and inflammation have come on. The finger is the best probing-instrument; "it is not apt to catch upon tendons or nerves; it does not so much as the probe endanger the arteries; and by feeling with the finger, we judge most accurately of the condition of the wound. The finger both directs our operations, and instructs us what is to be done. Perhaps we feel the ball, and then we cut directly upon it; perhaps we feel the wound making a crooked or spiral turn, and we follow it with our incisions; perhaps we are sensible that it touches a great artery, and in working with our bistoury we are careful of that artery; or we know that there is a splinter in a joint, or broken any bone; accidents which not only increase the danger, but which may even incline us in certain circumstances to cut off the limb. In short, all that we receive, is from the information that we have through the finger, and it directs all our operations."

What are these operations? Either to scarify or dilate the wound, as circumstances demand, to make a counter-opening when necessary, and to extract balls, clothes, or splinters of bone. The purposes of scarifying are, "to open the vessels that they may bleed, to enlarge the wound that when it inflames it may have room to swell," and to enable the surgeon when requisite to take up the bleeding vessel, and expel the ball, the splinters of bone, or any other foreign and irritating material.

Every gun-shot wound which is deep and penetrating, with a narrow opening, and with a tense fascia (ven if no foreign body is to be extracted), requires immediate scarification; the incision, it must be carefully remembered, is "to pass through the fascia as well as the skin; the wound must have vent, as the older surgeons were wont to express themselves, in other words "it must have room to swell" during that inflammation which inevitably precedes its cure. The incision, as in strangulated hernia, must be taken off. So far then all is plain and simple. But the practice is too often in the cure of such wounds not so. Counter-openings are sometimes made, or splinters, or other foreign matters are to be searched for and taken out, and great vessels to be secured. When the ball has passed entirely through which it has formed by its exit is called the counter-opening; when it has passed a considerable way, but not entirely through, it becomes the business of the surgeon to make this counter-opening in order to extract the ball. This practice is advised by the generality of surgeons; "when the ball has only passed two-thirds through the limb." Such direction is for the most part to be followed, and the operation should be performed as speedily as possible.

But there is also another kind of counter-opening, which is especially attended to, which the surgeon is at times obliged to practise. The opening which he must afterwards make in the middle of a long wound, when the track of the wound swells, or when the ball leaves the skin, or molten, the sloughs, and the fistulous, seem to be confirmed. For example: a man is wounded by a ball, which breaks one or two of the fingers, pierces the hand, runs up the fore arm, rakes along the bones, and goes out far from its entrance, as at the elbow or shoulder-jooint. Here we can hardly prevent a long suppuration, and too often an exfoliation or spoiling of the bones; and three openings are required; one where the ball entered, another at the counter-opening or that by which the ball passed out, and if the swelling, pain, irritation, or perhaps nervous symptoms, come on, then there will be required also another opening in the middle of the wound. Such an opening will ease the swelling, and prevent a suppuration of the wound. It will prevent gangrene, bring on a good suppuration, and allow a free vent for the matter; it will also prevent the pus from lying in the arm, and it will save us from the severe or rather cruel practice of the older surgeons, who were accustomed, in such cases, to run a large septic through the tube of the longest wound. To make this opening deeper when the wound has become entirely callous, and pours out a thin gleydis discharge; or when, from the adherence of some piece of cloth which prevents its healing, healthy action cannot otherwise be expected.

So far then with respect to the scarifications which are required in gun-shot wounds; we now proceed to treat of the extraction of balls, cloth, or splinters of bones.

Here dilations rather than scarifications are useful: for there is this difference between scarifying and dilating; that scarifying is that same practice which we perform in the mouth of the wound by which we relieve the tension of the fascia or the structure of the skin; but dilating is that deeper incision which we make by pressing our finger deep, and to the bottom of the wound, and pressing it with the bistoury, to make a free way for getting at the bleeding artery, or extracting the fractured bone. When we wish then to extract the ball, we are to employ free incisions.
The fingers are to be used more than the forceps; these when the ball is found are to be introduced, and made to grasp it. Sometimes the ball will have been stopped by a bone and flattened, with a splintering or splintering of such bone; at other times, however, the bone by the force with which the ballhas struck it will be shattered: in this case the splinters of bone are to be all carefully taken out, and the ball removed as of fractured bone. If the ball has entered and sticks in the bone, so that it cannot be extracted in the common way, then a more free incision must be made, and the trepan applied; "or if it is a narrow and firm bone, Mr. L. was ordered to cut the bone burrow above and below, so as to cut away that part in which the ball is fixed."

But it is principally on account of fractured bones, wounded art-ribs, or pieces of cloth, that these dilatations of a wound are called for. It is only the openness of the wound, and the nearness of the ball, that tempts us to search for it; for a bullet sometimes works its way outward through the cellular substance, and comes to the surface with little pain, or often it lies without danger buried in the flesh for years. If there be another occasion for opening the wound, we should never give the patient pain on account of the ball, since it seldom itself gives him pain."

It must, however, be carefully kept in mind, that wounds, even though fair and promising for a short time, will never heal kindly while the foreign matters above-mentioned are suffered to remain. When there is much blood spouting from a gun-shot wound, it will be concluded that a great artery is involved, and if the patient is a case for a surgeon, guided by his knowledge of the anatomy of the limb, will make free dilatations from the mouth of the wound, until he finds the vessel, which he will tie up or secure. He must not, however, if the bleeding artery is of a large size, trust to compress or bandage. A piece of lint dry, or with some simple ointment, is then to be laid over the orifice of the wound, its sides are to be brought as possible, without occasioning much irritation, and adhesive plaster or bandage to be placed over the whole. But there is another kind of hemorrhage from gun-shot wounds still more dangerous, which is the secondary hemorrhage. This often occurs eight or nine days after the injury was first received, and the patient has often fallen a victim to it, even when "at the first the wound was scarcely stained with blood." This hemorrhage is occasioned by the loosening of the eschar of the mortified and bruised parts, leaving a breach in the sides of a great artery. In the course then of healing a wound, the proximity of which to a considerably artery is known, the patient ought to be attentive and incessantly watched: and in some cases it is necessary to keep constantly a tourniquet round the limb.

We conclude this part of our subject by repeating the motives for sacrificing and for diluting gun-shot, as well as the necessity for the purpose "of opening the vessels that they may bleed," and in order thus to reduce the wound as nearly as may be to one made by a cutting instrument. The dilatation of a wound is for the purpose of enabling us to secure any great artery that may have been divided, and to extract splinters of bone, or any other foreign material, the ball itself being that which, on account of its shape and smooth surface, we are the least solicitous.

Of tubular or penetrating wounds.

But there is further another kind of wound which is different in its nature and treatment from that made by a plain and fair division of parts, viz. a penetrating or tubular wound, such as is made by the bayonet or sword; and in this last case it is the surgeon's duty to bring it as much as possible into that condition in which its sides may, by being applied to each other, adhere. "Suppose," says Mr. J. Bell, "a young man is fighting a duel with the sword, is wounded in the sword arm, his antagonist's weapon goes in at the wrist, and out at the elbow. If in such case it injects the arm with blood, forming a proper aneurism, so that we are forced to cut up the fore arm, and tie the wounded artery; but if it is merely a flesh wound, it is no worse than being deep and penetrating; but still it is so different from a common and open wound, that we could bring the sides of this tube-like wound fairly in contact with each other, it is the more uncertain that it does not happen so is plainly this, that the blood which exudes from the very small arteries is sufficient to fill the tube of the wound: it only fills it, but the bleeding practice followed by a compress and close bandage from getting out, the tube of the wound is not only filled but diluted with blood, and therefore cannot adhere, just for the same reason as the healing of an illapatant stump is delayed because where the arteries, not being fairly tied, have bled after the dressing so as to fill the basin of the stump, and separate the flaps from each other. This not only prevents adhesion and brings on suppuration, but produces a gangrenous stump filled with foul and stinking matter, partly purulent, and partly filled with blood."

The obvious inference from all this is, that the best practice in each of which we are now speaking, is principally to be facilitated, nay, is alone to be effected, by cleansing it of this blood (when no important artery is divided), by closing the mouth of the wound with a slight compress, and "laying its sides together with a slight bandage." It was in thus cleansing these wounds of blood previously to closing them, that the remarkable success attended what was denominated some time ago "the secret dressing," this used to be performed by men who were denounced suckers, one of whom was present at every sword-duel. "The encounter ended the instant that one of the combatants received a wound; the sucker immediately applied himself to suck the wound, and continued sucking and discharging the blood till the wound ceased to bleed; and then, the wound being clean, he applied a piece of chewing paper on the wound, tied up the two with a tight bandage, and then the patient walked home."

This mode of treatment has proved successful even in wounds which have pierced, or passed through, some of the cavities, when there have been no veins, nor any great blood-vessels wounded.

In a deep and penetrating wound, therefore, the method of cure consists in purging it of its extraneous load, and conveying its sides to adhere. We do not here need to make incisions or scarifications, as in gun-shot wounds, unless for the purpose of securing some great artery that may have been divided.

Having thus gone over the surgical treatment of wounds, fair, angular, bruised, lacerated, and penetrating, we now proceed to lay down some rules respecting the medical management of patients under these injuries, and which is still more important than the surgery itself of wounds; "for if the connection is not understood between the particular wound and the general health; if the army or hospital surgeon (and the same remark applies with modifications to private practice) does not know with a glance the constitution of a patient, or the true state of his sore; if he is not careful to retain some general principle, which, like a mystic clue, may lead him through this labyrinth, he will see thousands dying around him without knowing the cause, like the fables of the Greek camp falling under the invisible shafts of Apollo."

Among the very many mistakes and unmeaning prejudices which have crept into the practice of both medicine and surgery, that of indiscriminate blood-letting has, perhaps, proved the most pernicious. This practice, so long held up, as it is now shown can possibly be more preposterous, or more dangerous. The writer of this article not many days since heard of an instance (an extreme case it must be confessed, yet, as such, more especially illustrative of the injudicious conduct now referred to) of a superannuated lady, by some accident having been literally scorched to death; the surgeon who was summoned found himself preceded by another "practitioner," who was actually, while the writer's friend entered the room, unheathing his lanceet in order "to take some blood." In like manner, with more colour of propriety, it must be admitted, when a wounded patient is first brought in, and the doctors are called, numbers, even to this day, deemed a necessary preliminary to further proceedings, to bleed the patient. "The sovereign cordial of the landlady" is often more appropriate; and many lives have, perhaps, been saved by the absence of the village surgeon.

Let the following invariable rules be treasured in the mind of the young practitioner, not as dogmas to force, but as principles to regulate, his practice. They are more directly drawn up for the use of army and navy surgeons, but will be found highly important to surgeons in general.

1st. "When your wounded patient is first brought to you, he is in great confusion; there is a tremor, a tonic stiffness, or almost a convulsion of the whole frame; there are coldness, fainting, and nervous affection; but it is merely a nervous affection, and it must be treated as such. You must expect it to subsist in time, and therefore should give him a good warm cordial, and large opiates to quiet the commotion. This is no time for bleeding, whatever the nature of the wound may be. If the stupor continues, you should give commulsions, draughts, and wine."

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2d. "If this nervous commotion being quieted, a sharp fever should come on, still do not bleed, but rather be upon the reserve; for perhaps this, which at first seems to be a pure inflammatory fever, may turn out to be a fit of an ague, to which the patient is subject; it is therefore a low and malignant fever; it may be an attack of some camp disease; and if a diarrhoea, great weakness, and low musing delirium, should come on immediately after you have bled your patient freely, there is no doubt at all of what you had done, and you would indeed have much to answer for.

3d. "Reserve your bleedings for those more dangerous cases, where high inflammation is so often fatal, and do not bleed in wounds of the lips, shoulders, or limbs. Reserve bleeding for wounds of the breast or belly, or great joints; for in all wounds of cavities, inflammation, which can hardly be escaped, is the great danger.

4th. "If a man is wounded after a full meal, there can be no doubt that a gentle vomit will be most useful, where it is allowed by the circumstances of the wound. The old physicians found their advantage in it, and ascribed the good effects of vomiting to the preventing of crude and ill-concocted chyle from entering into the system, so as to kindle up a fever. There is no doubt that a meal which was no load during health, will be a great oppression upon a disordered system, and the carrying it off must be a great relief, although the old physicians, by talking this useless jargon about ill-concocted chyle, might almost provoke us to reject both the doctrine and the practice. The system cannot be weakened by a gentle emetic; and if the system should fall low after vomiting, it were easy to substitute a fitter support, and better excitement, than that of an oppressed stomach and loaded intestines, by first discharging these crude meats, and giving, when the stomach was emptied, food of easy digestion, and cordials suited to the condition of the system.

5th. "But in every wound there comes a period of weakness, in which we repent of every thing we have made, even when it was really needed; a period in which, by confinement and pain, occasional fever, diarrhoea, profuse suppuration, or colliquative sweat, the patient falls so low that it is not easy to support him through the cure: and thus there are two great principles in the treatment of gun-shot wounds: that even at first we should be sparing of blood; and that the period of weakness which is to succeed, is the great danger; on this single point hangs all the practice.

The author afterwards adds, that in mere flesh-wounds we are not entitled to bleed; for if there is no wound of a joint, or fractured bone, the first inflammation never runs to a crisis.

By due attention to the above rules, the surgeon will never find himself at a loss with regard to the immediate requisitions of the wounded, either in army, navy, hospital, or private practice. It will scarcely be necessary to observe, that where immediate bleeding is judged necessary (and this is always the case, as above stated, in wounds of cavities and joints), it may be employed most freely in the young, full-fed, vigorous, and phthisic, in dry and healthy situations, in the spring of the year, when no epidemic disorder prevails, and when the patient is afterwards to enjoy all the advantages of cleanliness, air, and a suitable diet.

In the progress of the cure, the surgeon is still not to lose sight of the intimate connection between the condition of the general system, and the state of the wound. Still fever is to be distinguished from inflammation: and the two opposite kinds of inflammation treated of in the article Medicine, vol. ii. p. 230, are likewise to be sedulously discriminated: the one will require a low diet, evacuating medicines, and, as it is expressed, a cooling antiphlogistic regimen; the other as loudly calls for bark, wine, opium, elixir of vitriol, and above all pure air, and (so as not to overload or oppress the weakened organs of digestion), rich or rather nourishing food. Here, instead of further reducing the system, "you must trust to air and cleanliness, and bark and wine."

We now proceed to speak of the treatment of wounds in the two cavities of the chest and belly.

The first and great danger in a wound which has penetrated the thoracic cavity, is that of suffocation from blood poured into the air-cells, or towards the trachea. The first and principal object then of the surgeon is to obviate this consequence as speedily as possible; and here immediate and sometimes frequently-repeated bleedings are called for, even should the patient be in a condition unfavorable to the discharge of blood. To this end, it is your duty to keep the patient low, and to drain his system so thoroughly of blood, that none shall pass towards the lungs to suffocate him, and that there may not be blood enough in the system to serve as fuel for that inflammation which sooner or later must come on."

When the blood is merely poured into the cellular membrane or cavity of the breast, without entering the air-cells, the finger, as already mentioned, is to be introduced into the wound; or if this wound is too high for the necessary discharge of the extravasated blood, a fresh wound may be made lower down upon the breast, and this so that the surgeon may find it in his power to reach and tie the intercostal artery, if this artery has not been divided.

For the emphysema or windy swelling, which is often so alarming to the bystanders, but which is in reality the most trivial symptom, scarifications are to be made in order to discharge the collected air.

If, during the cure of a breast-wound, there comes on a pricking in the side; if the cough is aggravated, or the putrid matter comes more copious, and the systematic irritation increased, there will be reason to suspect the remains of some irritating material, as a splinter of bone; in this case, the wound is to be probed, injected, and every endeavour made to extract the irritating cause.

"Sensible, at every turn, how slight a matter will irritate the pleura and lungs, the surgeon will never allow himself to do so unnatural a thing, as to cut into the pleural cavity across the chest, when this is thus easily irritated by the most trifling piece of bone or rag of cloth; but he merely lays a bit of oiled cadis gently within the wound, with a large emollient poultice over all."

To conclude. In the wounds we are now describing, the surgeon must in the first day bleed copiously, and repeatedly; he must again bleed should bloody expectation recur, weakening the system in order to prevent the lungs from being shut up with the air; of which the oppression is forgotten, and the danger of suffocation, and the bleedings from the lungs, are over, he begins to support his patient's strength with opium and bark, and promotes his health and strength.

Wounds in the abdomen. While the danger from wounded lungs is chiefly of suffocation, in wounds of the abdomen, as before stated, we have principally to fear either sudden death from internal hemorrhage, or peritonitical inflammation, when the bleeding has been too profuse. Against this internal bleeding, bleeding from the ari is the great preservative; and this, as in wounded lungs, must be done with a very liberal hand. When the peritonitical inflammation has come on, the patient must be assiduously preserved from all motion and irritation; oysters of a mild gentle kind must be injected, the belly forment, and opiates administered.

No food is to be given for the first ten or twelve days; nourishment is to be conveyed by elysor, or if any thing is taken by the stomach, it must be extremely mild and gelatious. If the wound has not penetrated the intestine, but part of the sound gut is protruded, it must be gently returned with the finger, and the outward wound stitched over it.

When, from the passing out of the faces, it is evident that an intestine is wounded, this is not to be searched for with the finger, but suffered to remain; and from the universal pressure among the parts, the outward and inward wound will be brought opposite to each other. If, however, the wounded intestine is protruded, it is to be connected by a single stitch to the external wound, in order that the faces may be thrown out from this line, and the adhesive process encouraged.

When, through a narrow wound, a sound bowel is obstrued, and becomes inflamed, this pressure is to be relieved by opening the wound a little wider, the intestine is to be carefully returned, and then the outer wound stitched.

Before we quit this subject of wounds, an apology may be thought necessary for enlarging disproportionately on this division of the article. We have done so for the purpose of illustrating the advantage that practical surgery has received from the natural, as opposed to the artificial cure of wounds, of which the learned author will find it necessary to impress on his mind as a directory in every step of his practice, whether operative or medicinal. We shall conclude this section by an extract from an author to whose incomparable treatise on wounds we have been principally indebted for what information the preceding observations may have conveyed.

To it is an old, but it is becoming more and more difficult, that in our profession we are but as the ministers of nature; and, indeed, the surgeon, still more than the physician, achieves nothing by his own immediate power, but does all his services by observing and managing the properties of the living.
the body; where the living principle is so strong and active in every part, that, by that energy alone it regenerates any lost substance, or re-unites, in a more immediate way, the more simple wounds." J. Bell's Discourses on the Nature and Cure of Wounds.

Of aneurism.

Wounded arteries cannot always be secured. Very often, as we have above stated, a large vessel is divided or punctured at a considerable distance from the surface of the wound, or in situations where the artery cannot be commanded: the blood is by consequence immediately and profusely poured out, spreads among the contiguous parts, and produces an aneurismal tumour. This is the false or diffused aneurism of authors, and the manner in which it is formed is sufficiently obvious.

The progress of this aneurism varies according to the situation and size of the artery that has been wounded. In the course of a few hours, the blood has been known to diffuse itself through the whole extent of a limb; at other times a very small tumour has been noticed, growing to great length of the same size for some weeks. As the increase of the tumour in false aneurism is generally occasioned by a diffusion of blood among the surrounding parts; it does not, like the true aneurism immediately to be noticed, become more prominent as it enlarges. In the first stages of the disease, a pulsation is almost always perceived in the tumour. This gradually lessens, and often at length becomes imperceptible. After some time, more or less according to the depth and magnitude of the wounded vessel, the skin becomes of a livid appearance, the member becomes stiff, painful, and the contiguous joint immovable, the integuments at length give way, and if the artery is large a fatal hemorrhage ensues.

When an artery has been accidentally punctured by the transfusing of a vein, an accident which sometimes happens sometimes between blood-lotting at the arm, the extravasated blood either diffuses itself into the surrounding cellular substance, or, when the vein and artery are more immediately in contact, the portion between the vessels is preserved; the vein, by the consequent impetus of blood comes to be dilated, and what has been denominated varicose aneurism occurred.

This kind of tumour may be recognized by the tremulous kind of motion which attends it, accompanied by a peculiar hissing noise, and by the tumour entirely disappearing for a time upon pressure.

When from accident or disease the coats of an artery lose in any particular point their ordinary power of resistance to the blood's impetus, and the diameter of the artery becomes in consequence dilated, the true or encysted aneurism is formed. It was, indeed, to this dilatation of arteries, without the rupture of their coats, and extravasation of blood, that the term aneurism was originally and is more properly applied.

In this manner it may be situated near the surface, the outer skin at first is of a natural appearance, the tumour is compressible, and a pulsation may almost always be observed in it. As the swelling increases, the skin becomes paler than ordinary, parts of the tumour are often firmer than others, and the pulsation cannot be discovered at all points upon pressure. Pain now comes on, the skin becomes discoloured as in false aneurism, an oozing of bloody matter is perceptible around the wounds, and if the seat of the disease has been a large artery, in one of the cavities of the body where compression cannot be applied, death is the inevitable consequence. Sometimes the fatal termination is occasioned by the gradual destruction of surrounding parts. Even bones have become carious in consequence of their proximity to a large aneurism.

Besides these three species of aneurismal tumours, the false, the varicose, and the encysted, Mr. J. Bell describes another disease, which he calls aneurism from anastomosis. This, our author observes, is constituted not by the dilatation of any branch of an artery, but by a mutual enlargement of the smaller arteries and veins; it proceeds from a trivial size to a large and formidable tumour; it is characterised by perpetual throbbing, which at length becomes a constant and distinct pulsation. It beats strongly when the circulation is unusually accelerated; in spring and summer, its pulsatory motions become fuller and more acute; it goes on to form sacs among the cellular parts, like the true aneurismal tumours. These enlarge, become at length livid, and burst from time to time; and then, as in other aneurisms, the tumour pours out its blood, and, according to its extent, reduces the patient.

Diagnostic marks. The existence of an aneurismal tumour is not always to be pronounced with decision, for although pulsation might be regarded as a true diagnostic character of the disease, it is not absolutely so; for other tumours may be situated so near a large artery, as to be regularly affected by its pulsations. When there is any doubt of the nature of the swelling, pressure should be made on it; and if it disappears or lesseis, and immediately recovers its size upon the pressure being taken off, it may be considered as an aneurism. In these cases, however, even of an aneurism, the reduction cannot always be effected.

Causes. The simple statement of the mode in which the two first species of aneurism above noticed are occasioned, is a sufficient account of the causes producing them. The true or encysted aneurism appears for the most part to depend upon a diseased disposition; often, indeed, it is brought on by violence or accident, but even then the predisposition is generally to be supposed. Women are less obnoxious to aneurism than men, especially the large aneurism of the thigh; and this Mr. J. Bell ascribes to their exemption from the hard labour of the other sex. To this conclusion, however, it has been objected, that even where the labour of females is greater than that of the men, and where even their occupations are such as to occasion those exertions which principally endanger the artery, the immunity is still the same.

When aneurism is produced gradually and without violence, this disposed pre-disposition is more evident. In this case, likewise, the prospect of cure from operation will be more faintly marked than when the tumour has succeeded to external injury; for this reason a diffused and varicose aneurism promises to be remedied by operation, with more safety than the true or encysted aneurism.

Aneurism, likewise, are more or less dangerous according to the origin of the disease. When they are formed in large blood-vessels near the heart, they are not the subject of operation; and it had generally been conceived that even in the extremities, when they were seated high up, in the axilla, or near to the neck, this would be inadmissible on account of the complete stoppage to the circulation, which was imagined a necessary consequence of obliterating the great artery of the thigh or arm. By an anatomical and practical investigation of this subject, it has, however, been demonstrated that the insculating vessels are in either instance sufficient to supply the limb; and that when failure attends the operation for aneurism, it is to be ascribed to other sources. In this substitution of the collateral branches for the arterial trunk, consists, indeed, the cure of aneurism, when it is effected without operation.

Treatment. The cure of every species of aneurism has been attempted by continual pressure on the tumour. In the false, or diffused aneurism, however, no advantage can be derived from this treatment. In the true varicose aneurism, moderate pressure may be attended with benefit; and even the true aneurism, when the artery is so situated that pressure can be made, has been cured according to the accounts of authors by this mode. Indeed, from the nature of this kind do not seem to promise any benefit, the operation ought to be speedily performed.

When first the operation for aneurism was practised, it was invariably the rule to secure if possible the large artery leading to the tumour by the tourniquet; then to cut into the sac, lay the cavity of the tumour freely and fairly open, clear it of the clotted blood, secure the artery by ligature, and treat the wound according to circumstances. In some cases it is necessary still to pursue this plan, as in a large and spreading aneurism of the groin; but where the artery leading to the tumour can be divided without sacrificing it, even before it reaches the cavity of the sac, it has been proved that this mode of operating is the most expedient. Mr. John Hunter first proposed it, by directing, in popliteal aneurism, that the great vessel from which it was resected should be laid bare on the front part of the thigh, that the artery should be obliterated by ligature at this part, and that the tumour, now deprived of its nourishment, should be left to be disintegrated by the sores. This plan is now generally adopted. The surgeon dissects down upon the artery, in the part which is judged most convenient for the operation, ties the vessel at two places at half an inch or more distant from each other, cuts it across in the middle between the ligatures, and thus destroys its communication with the tumour; the blood is gradually solicited by the insculating vessels, which become at length fully to supply the place of the trunk.

In performing this operation, the surgeon is to dissect the artery very clean; it should be carefully tied by itself, without including the adjacent giving nerve; a firm waxed ligature, without any intervening substance, is to

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be passed round it by means of a blunt needle, or crooked probe, and the wound treated in the common manner.

In the aneurism by anastomosis, Mr. Bell observes that the only radical cure is complete extirpation; we are not to cut into it, or in any way attempt the interruption of any particular vessels leading into it, but the whole group of vessels by which the tumour is supplied must be entirely extirpated.

Of fractures.

Fractures are not in all instances easy of detection. Pain, swelling, distortion, loss of power in the injured member, shortening of the limb, and a peculiar crepitation sound upon the part being handled, are described as the signs denoting a broken bone; these, however, are all, excepting the last, which cannot in every case be perceived, in a greater or inferior degree, common to bruises, sprains, dislocations, and injuries independent of fracture.

When a bone is simply divided, without any protrusion of its broken ends, lacerations of considerable blood-vessels, or any other circumstance to render the accident complicated, the practice of the surgeon is obvious and simple: by a gentle and firm pressure, we have seen, adhesion is insured by merely bringing their divided edges together; in like manner, though much more tardily, junction will be effected between the divided extremities of a fractured bone, by replacing and preserving them in even and steady contact. The healing of wounds is not accelerated, but on the contrary retarded, by the several contrivances and interferences of the older surgeons: so by the cruel practice of tight compressing, bandaging, and the use of machinery, in fracture, not only unnecessary pain is occasioned to the patient, but the process of cure, instead of being facilitated and hastened, is considerably impeded. Nature, in either case, will not be interfered with.

The time which bones take in uniting is proportioned to the age and health of the individual. In persons of middle age and fifteen years and upwards, simple fractures of the arm will for the most part be fully and firmly united in a little more than a month from the accident. Fractures of the shoulder and thigh-bone are, under the same circumstances, about six weeks or two months in healing; while the smaller bones, as the clavicle, the ribs, the ischia, and the bones of the hand, seldom occupy in their cure more than three weeks.

In simple fractures, provided the parts have not been unduly irritated, either by much motion after the accident, or by tight straining bandages, the symptoms of inflammation will subside in a few days. Sometimes, especially when the surgeon has been called late, it is necessary to subdue the local irritation by solution of lead, the application of linement, and other means used in common inflammation, and these it is often necessary to continue for several days. Now and then it will be found expedient to bleed from the arm. These requisitions must be determined by the good sense and judgment of the surgeon. It is impossible to lay down abstract rules for conduct. To bled, however, merely because a bone is broken, is a practice equally unmeaning and erroneous with that before alluded to, with regard to wounds in soft parts.

Before speaking of individual fractures, we shall present the reader with the following instructions to distinguish between those that are due to fracture, especially applied to a broken leg, will be found applicable with proper exceptions to fractures in general.

"In setting a broken limb," says our author, "there is no extension required but much of care and attention; suppose you were not a surgeon. Lay the patient in bed, and lay the limb upon a pillow; if you design to use splints, have two long troughs, or pieces of pasteboard, (in figure 60 is represented the usual splint employed) in a fractured leg bent into a hollow form, lined, or rather cushioned, with two or three piles of flannel, with tapes or rubands, four or five in number, attached to the outside of the splints, by which bones are to be held. After all is gently tied together with bow-knots, to be slackened or tightened according to the swelling of the limb. The pasteboard ought to be soaked and softened a little, that it may take a shape suitable to that of the limb."

A long splint of this kind being laid flat upon the bed by the side of the fractured leg, desire one of your assistants to apply his hands broad round the upper part of the limb, and grasp it gently and steadily; take the foot and ankle in the same manner in your own hand, slip your left hand under the broken part of the limb, and then sliding it gently along, lay it upon the pillow or its splints. The pillow should be like a mat-trass, flat and firm.

Begin then to lay the limb smooth; let your assistant again grasp it, by spreading his hands upon the thigh or below the knee, with the design of extending along with you, not by lifting the leg from the pillow; but rather by keeping it down, andstyled by your pressure, while you with both hands lift the foot and leg: press them gently, but very firmly; raise them a little from the pillow, and draw them gently and steadily towards yourself. You have thus extended and smoothed the broken leg, in a manner which you almost suppose agreeable rather than painful to the patient, press it down steadily and gently; keep it flat and pressed until it gets a seat and bed in the pillow. If splints are applied, the limb is to be pressed against the lower splint; the upper splint is then to be laid above it, and by grasping the soft and moistened splints, you must model them as little. When the whole has taken a form, take several tapes one after another; and after having tied them in a general way, go over them again one by one, and tie them a little closer, so as to keep the limb agreeably firm."

This author, in another place, remarks (when speaking of fracture in general), "when the limb by accident has been disordered or shortened, you are to venture, without fear of hurting the callus, to extend it anew, and lay it straight again."

"It may be proper to observe, that while much inflammation is present, we are to defer the application of splints, even in the gentle manner above advised, till such inflammation has in a considerable degree subsided."
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see the directions given above. When the bones of the tarsus, side, and toes, are fractured, it will be necessary to apply a splint to the fractured part, and in general a large one beside over the sole of the foot.

Fractures of the upper extremities. Fractures of the scapula are by no means common: they are ascertained by the touch, by the great palpitating clear part, and by an incapacity of moving the arm. It is with difficulty that the parts are retained after replacement: a long roller is to be used, with which the shoulder is to be supported, and the arms to be kept suspended, in order to relax the muscles.

A fracture of the humerus is generally easy of detection. When it has been reduced, two splints are to be employed, and a flannel or linen roller is to be applied gently over them. The arm is to be supported in a sling. In a few days, or a week, from the accident, it may be examined, to ascertain whether the broken ends have been properly adjusted. In fracture of the clavicle, one or both bones are broken, the joint of the elbow is to be gently bent. Two splints of pasteboard are to be used, one large and long, upon which the arm is to be laid, the other small and slender, which is to be secured by slight tapes, ribbons, rollers, or the twelve-tailed bandage. (See fig. 63.) The arm, during the cure, is to be supported in a sling, with the palm of the hand towards the head.

When the olecranon is fractured, the arm must be preserved in an extended state, by a long splint reaching from one way above the elbow-joint, down to the point of the fingers. The arm should be hung by, and connected to, the side. In little more than a week from the accident, the dressings are to be removed, and a slight motion given to the joints, in order to prevent ankylosis.

When the carpal bones are fractured, there is usually considerable inflammation, which must, as much as possible, be abated by local applications: splints are to be employed as in fractures of the fore-arm, and the arm is to be supported in a sling.

In fractures of the metacarpus, a firm splint should be placed over the palm of the hand, which should be made to reach from the points of the fingers to the elbow. When a finger is broken, a splint of pasteboard, moistened and moulded into the form, is to be used; and a large roller may be applied all over the hand, in order to prevent the motion of the fractured finger.

Of fractures of the clavicle, ribs, sternum, and spine. A fractured clavicle may sometimes be perceived by feeling along the course of the bone. The motions of the shoulder-girdle are likewise necessarily impeded. In reducing this fracture, the arm is to be raised, so as to bring the ends of the bones towards each other; and it is to be preserved in this position till union is accomplished.

When a rib is fractured, which may generally be ascertained by feeling with the fingers, if one portion rises over another it should be reduced by moderate pressure, and the bandage may be applied all round the chest, which should be continued for some weeks. If a portion of the rib is forced inwards, some surgeons direct that an opening be made over the depressed part, which is to be elevated by the finger or forceps. When the sternum is fractured, a similar treatment is said to be required. In this last case it is necessary sometimes to trepan.

When the vertebrae are broken, the accident is for the most part fatal, and by the fractured pieces pressing upon the spinal marrow, a palsy is occasioned in the parts below the injury. The surgeon, however, is to attempt the displacement of the vertebra, as when part is depressed, an incision has been advised, in order to raise the depressed portion.

Of compound fractures.

These fractures are called compound in which the external teguments are wounded, from the same accident by which the bone has been broken. These are necessarily of much more difficult management than cases of simple fracture. Some surgeons indeed have indiscriminately recommended amputation of the limb in every case of compound fracture; while others have cautioned the propriety of preserving the limb, even for the worst accidents of this kind. This question, like many others, has been agitated too much in the abstract. The propriety of immediate amputation, or a prior attempt to preserve a limb, will depend entirely on the extent of the injury, but on the age, habits, and constitution of the patient, as well as the circumstances which he shall be under during the cure. In the army of every practice, amputation is often necessary, where in private it would be premature and cruel.

When we are to attempt the cure of a compound fracture, the first object is to remove such pieces of bone as are intermingled in the form of splinters, as well as other extraneous bodies. If there is merely a protrusion of the bone through the wound, without any separated pieces, we are to attempt an immediate reduction, as in simple fracture. If this cannot be effected even by pretty strong extension, an endeavour must be made to force the bone by pressure. If, on account of the narrowness of the wound, it is impossible to reduce the fracture, the wound must be dressed in the form of a stuffed bandage. It is sometimes necessary to saw off part of the projecting bone, in order to effect the reduction. When this has been accomplished, the wound is to be closed as much as possible, and compressing lint placed over it, and the limb secured by an eighteen-tailed bandage. In order to encourage adhesion, and prevent suppuration of the wound as much as may be, the limb without inordinate pressure should be supported as firmly as possible. When suppuration has come on, the limb is to be carefully dressed every morning. Indeed the chief business of the surgeon will be to preserve the wound clean and clear by regular washing and sponging, by laying clean lint upon it, and by the occasional use of spiritual applications. It is scarcely necessary to add, that the patient's health must be supported with much care. While causes of irritation are avoided, a due excitement must be kept up. (See the section on wounds.)

Of Luxations.

Dislocations, like fractures, are sometimes difficult immediately to discover. An inca- pability of moving the limb, pain, tension, a lengthening, shortening, or other deformity, and often considerable inflammation, are the general symptoms attending a dislocated or luxated bone.

Endeavours to reduce luxations ought to be made, as speedily as possible; as they grow older, they grow more difficult of treatment. Indeed, after a bone has been a considerable time dislocated from its place, it often forms a new and artificial joint for itself among the contiguous muscles, and the subject of the accident is by consequence rendered irrecoverably lame. When, however, dislocation accompanies fracture, it is sometimes necessary to cure the latter before the reduction of the former is attempted. This is the case when the fracture is contiguos to the joint.

When much local inflammation accompanies luxation, it is to be carefully subdued by the common anti-inflammatory applications: and, according to circumstances, it will be sometimes requisite to bleed at the arm. When the luxation has been reduced, the parts must be retained in their situation, by placing the limb in a relaxed position, and by applying appropriate bandages.

Luxation of the superior extremities. Of the arm as humeri. The shoulder-joint may be luxated by the head being forced downwards and backwards. The more usual kind of dislocation, however, is by the head being forced downwards and forwards. An upward luxation cannot happen without a fracture of the upper arm bones.

The signs of a dislocated shoulder are inability to raise the arm, the head of the humerus being felt out of its proper place, while a vacancy is observed under the acromion.

This luxation is often extremely easy of reduction. The surgeon should be provided with assistants to extend the arm, by means, if necessary, of a belt, or any substitute for this placed round the arm, with long straps attached to it, by which to extend the limb; another assistant is to draw back the shoulder-blade, while the operator, standing on the outside of the arm, directs the extension according to the situation of the bone, and thus reduces it. When several assistants are not at hand, an arm-dislocation may be reduced by placing it on the knee, and thus acting as with a lever. The arm, especially if the patient has been subject to the accident, may be supported in a sling some time after the reduction.

Luxation at the elbow is not common; it is attended with a shortening of the fore-arm, a projection behind above the elbow; while in the bend of the elbow the extremity of the humerus may be felt.

It is to be reduced by gradually extending the fore-arm rather in an oblique direction, and gently increasing the curvature of the elbow, and by endeavours to disengage the ends of the bones. After the reduction, the muscles should be relaxed by preserving the elbow for some time rather in a bent position.

When the fore-arm is dislocated at the wrist, the rotatory motion of the hand is prevented. After the bones are replaced, a tight flannel roller should be bound round the wrist, and the arm supported in a sling.

When the bones of the wrist are luxated, which by no means is a rare accident, much pain and inflammation follows, and the
motion of the joint is destroyed. The arm is to be supported, and but very gently extended, and the bones pushed into their proper position, which is to be preserved by bandages or splints. The metacarpal bones when dislocated are to be managed in a similar manner. When the thumb or fingers are dislocated, the phalanx is to be held by an assistant, while the surgeon elevates the dislocated end, and replaces it.

Dislocations of the inferior extremities.

Dislocations of the thigh-bone are not very common. This bone is however susceptible of displacement in four different directions: upwards and obliquely backwards, downwards and a little forward, directly forward upon the pubes, and backwards over the ischiatic notch.

In the first the limb is shortened, and the knee turned inwards. When the neck of the thigh-bone is fractured (an accident which has been confounded with dislocation), the knee and foot are on the contrary directed outwards; this may also in case of dislocation be more difficult than when the neck of the bone is fractured.

This dislocation is to be reduced by extension downwards and forwards. The patient is to be laid on his back, and a double sheet may be placed under his thigh, which being attached to some fixed points, will serve to raise and support the limb during the proper extension.

In a dislocation downwards and forwards, the thighs are reversed; the head of the thigh-bone may here be distinctly felt in the perineum. The extension in this case must have an upward and outward direction; its reduction is easier than in the preceding case. In returning the ball of the bone into the socket, the surgeon must be careful to act cautiously; too precipitate a reduction is apt to push it again out of its place, and produce an upward dislocation.

When the dislocation is forward upon the pubes, we are directed by some surgeons to lay the patient on his side, and support the thigh by means of a pulley fixed to some point above the joint, and operated thus assisted draw the bone inwards. In the fourth kind of hip-dislocation (over the ischiatic notch) the length of the limb is not interfered with; but the accident may be ascertained by the disappearance of the trochanters. Here the reduction must be attempted, by giving the bone an upward direction, while the knee is pressed inwards. The limb should not be used for some days after the reduction.

The patella can only be dislocated upwards and downwards by a rupture of its ligament or tendons; in this case the bone will be drawn up, and assume the appearance of fracture. It may however be luxated to one or the other side. For reduction, the limb must be extended; and in lateral luxation the edge of the bone at the greatest distance from the joint may be depressed, by which the opposite edge is elevated, and may be returned into its place. The patella is seldom luxated at the knee-joint; when the accident happens, it is easily detected. In reducing such a dislocation, the limb should be gently extended, and the bones replaced by the hand. Inflammation of the joint, with much solicitude, to be guarded against.

Dislocations of the ankle-joint are very rare. Indeed they are scarcely possible without a fracture of the end of the tibia. In reduction an extension of the foot, even with the leg, should be the object; then the bones are reduced. Luxations of the tarsal bones are to be treated in a similar manner. When the metatarsal bones and toes are dislocated, the reduction is to be effected as in the metacarpus and fingers.

Luxation of the spine, coccyx, ribs, and clavicle.

In consequence of the firm ligamentous connection of the vertebral bones, dislocation seldom happens without fracture. When it does, it is almost invariably fatal. When the coccyx is displaced, it may be generally felt protruding. It is to be reduced by pressure with the fingers. This bone is sometimes forced inwards and causes much pain, tenesmus, and sometimes a suppression of urine. In this case the finger is to be introduced into the anus, and the pressure made upwards. Dislocations of the ribs are exceedingly rare. It may be expected that the reduction is to be bent the body backwards, in order to press out the ribs.

When the clavicle is dislocated the end projects forwards under the skin, near its common place of junction with the breast-bone. The reduction is to be made by pushing the protruded bone in with the fingers, while an assistant pulls back the arms and shoulders. The arm is afterwards properly supported in a sling.

Luxation of the bones of the head and face.

When the cranial bones are separated, the head must be supported by a bandage. If one of the nasal bones is luxated inwards, it is to be elevated and reduced by inserting a tube into the nostril covered with lint. If the lower jaw is outward, the bone is to be pressed in by the fingers, and a double headed roller applied round the face. To reduce luxations of the lower jaw, which are not very uncommon, the thumbs pressed against the operator, the patient is to be kept in, and by the appearance of the tongue, the distance should be as far as possible between the jaws, and then the fingers acting upon the outside of the angle of the jaw, attempts should be made to bring forward till it moves a little. It is then to be pressed forcibly down.

Of amputation.

Thus, as it is now performed, scarcely any operation in surgery is more simple and secure. In preserving the extremities, so that they can be fairly brought over the stump, and properly to tie, or otherwise secure the bleeding vessels, constitute the points of practice in amputation; and, as we have previously shown, rank among the most important improvements in modern surgical practice.

The following are the general directions for performing amputation: The tourniquet is first to be placed on the most convenient part of the limb for securing the vessels. The tourniquet: a circular incision is then to be made with the amputating knife (fig. 71) or common scalpel, which is to pass all round the limb, and go through the skin and cellular substance; there are next divided away from the muscles to such a distance as will allow the divided edges of the integuments to come into contact over the stump. The skin thus separated is to be drawn up from the muscles, or turned back upon them, and kept by an assistant till the operator has made an incision at the edge of the reflected skin, beginning from beneath, and cutting in a circular direction down to the bone. The muscles are then to be separated from the bone, as the skin before was from the muscles, to such a distance, as to enable them afterwards completely to cover the end of the bone. The whole mass of flesh is then to be kept up from the bone by retractors (fig. 72 and 73); the peritoneum is to be divided all round in the place where the saw is to be applied, but not at all taken up from the bone: the saw (fig. 74) is now to be used, and the bone divided with long firm strokes, taking especial care that during this part of the operation the assistant holds the limb with steadiness. If there have been any splinters of bone left, they should be immediately taken away with pincers (fig. 75). The tendon is then cut, the principal arteries drawn up, and the nerve divided free from the nerver. Some warm wine, or other cordial, is to be given to the patient. The wound is to be cleared of blood, the muscles pressed, the joint to be fairly laid together over the stump; adhesions are to be broken, the requisite bandaging applied, the patient taken to bed, and the wound treated in the common manner (see section on wounds). Unless any untoward circumstance arises, a complete cure will be thus made in the course of a few weeks.

After this general statement of the mode in which amputation is to be performed, we might now be expected, as in our accounts of fracture and luxation, to go over the separate parts which at different times come to be operated upon. Such minuteness, however, would be inconsistent with our plan and limits, and we shall merely observe, that in all cases of amputation the above rules apply; that the surgeon must be determined by his own judgment respecting the particular point at which a limb should be amputated; that it must be accurately performed, and that what is indeed is almost too obvious to require notice, that in general as much as possible of the limb should be preserved.

Of joints, are to be operated upon in the way of amputation, further directions are necessary. Amputation at the larger joints ought indeed, in every instance, if possible, to be avoided; for a wound in a joint is, as we have already seen, invariably hazardous. When, however, in consequence of abscesses in these parts, compound fractures at the union of bones, caries, or other diseases, it becomes necessary to amputate at the joints, it will be necessary, after first securing the artery, to make a circular incision, as in common cases of amputation; then on each side of the limb another cut is to be made in a longitudinal direction, from the joint to the incision, and passing through the skin and muscles, which are to be now divided, and the limb removed. If during the operation any branches of arteries have been divided, these are to be taken up or secured, the wound to be closed, the muscles and skin brought neatly and fairly together. The
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Union is to be effected by adhesive plaster and by proper bandages.

Wounds or injuries of the head.

Among many erroneous and unfounded opinions, this is by no means the most uncommon; that wounds of the head are among the most dangerous in proportion to the degree and extent in which the skull is fractured. "It is the injury of the brain alone which is dangerous; and very often are so close, the connection and sympathy of all the external and internal parts, that the brain is hurt by the very slightest injury of the scalp or bone, while the skull may be extensively injured, and the accident be comparatively trivial. Actions of the brain from blows or wounds of the head are immediate or secondary; the last are those which do not directly follow the injury from which they proceed, but make their slow insidious progress in the form of a disease. They are insidious, because they frequently arise to an alarming extent in consequence of a hurt which was at first deemed slight, and scarcely deserving of notice. They are slow; for after receiving such an injury, shall perhaps continue in seemingly perfect health, or with only a few signs of moment, shall at length fall a victim to the disorder, which has all this time lain as it were in embryo. One soldier, for example, shall have his temple grazed with a ball, shall hardly know that he is hurt, or be sensible for some time that he is indisposed; shall walk about for six weeks apparently in perfect health, and then all at once shall drop and fall low, become sick and weak; shall fall into a sort of a most dreadful struggling delirium, and then expire: and it shall be found, that the pia mater is separated from the skull, the skull itself black, and the brain matter mingled and oppressed with pus. While, on the other hand, another soldier in the same battle shall be so wounded with a sabre, that the scalp, skull and all, shall be cut clean away with a wound even of the brain itself, and yet the patient accounts, or which a soldier, wounded with a musket-ball, which is left sticking in the skull, with much depression, and many fractures of the bone, shall come to the hospital walking about on crutches, and in the instant restoration of the bone, and all the incisions and pickings of the bone which such a case requires; and shall eat and drink heartily, sleep soundly, and suffer not one bad symptom during the cure.

Most commonly, however, even in these secondary affections of the brain, a certain degree of sickness, faintness, and stupor, immediately follows the stroke, the blow, or the fall, upon the head. This from the state the man revives very slowly; at length seems to have regained his health, but after the lapse of some weeks perhaps, the faintness, sickness, and giddiness, recur; then come on fever, delirium, weight or pain in the head, and even a sign denoting a low inflammation of the brain; this state at length comes to be succeeded by paralysis, insensibility, and death.

This disorder is a plain case of a diseased dura mater, and an abscess of the brain, almost sufficiently evidenced by the progress of the symptoms, but rendered doubtful when on the surface of the skull arises a small, soft, puffy, regularly circumscribed tumour, not of the ephipetal kind, for that denotes a mere affection of the scalp, nor a soft and fluctuating tumour, for this may proceed from blood poured out from one of the cranial arteries.

"The trepan is in this case almost a hopeless operation, and yet it is to be tried." The intention of operating under these circumstances is, to discharge that matter which collected either between the dura mater and skull, or between the meninges and the actual substance of the brain, gives rise to all the distressing and alarming symptoms. When this is the case, it will be found necessary, not merely to trepan the skull, but to pierce the membrane. Such an operation will usually for a time lessen the patient's sufferings; but often he is again oppressed, and sinks and dies; or if he lives, great lungs sooner or later shoot up through the openings, and as by blood or matter, or at last oppressed, and dies commonly in convulsions.

The danger in this last case seems to depend upon the exposure of the brain by the operation; the surgeon then will be careful not to multiply openings for the discharge of a matter, for oppression and inflammation of the brain is just proportioned to the delay in opening the head: and on the other hand the danger after the operation is just proportioned to the number of holes.

The immediate injuries of the brain, as opposed to the secondary affections above described, are divided by surgical writers into those of compression and concussion.

A man, for example, receives a violent blow upon his skull, which by its force shall press in part of the bony defence of the brain directly upon the substance of this organ: he immediately falls down in a state of stupefaction; his pulse and breathing are oppressed; but no signs follow result from compression.

Concussion is a kind of injury more obscure in its theory, but not less fatal in its consequences. It is an internal derangement of the brain, or of the nervous system, which disconnection cannot trace, and which appears to be a shock to the whole, rather than an injury to any particular part of the organization.

In the former case, that of compression, relief may be expected from operation, but there is neither motive nor use in operating for concussion. In some instances of the former, blood-letting is imperiously called for; in the latter, to bleed is inevitably to increase the disease.

It is therefore absolutely necessary to decide early and clearly upon the precise nature of the injury. This decision, however, is not in every case easy even to the surgeon who may have had frequent opportunities of comparative observation. Most of the symptoms which attend compression likewise accompany concussions; and the existence of depressed bone, which must form, at least in part, a case of compression, is not always to be detected by external examination.

In cases of an equivocal or undecided nature, where it is imagined that compression may exist, although it is not perceptible, it has been advised by a modern surgeon to trepan in many different parts of the skull, in order to ascertain and remove the cause producing the symptoms. "It often happens," says Mr. Benjamin Bell, "that no external mark is to be made with to lead to the seat of the injury; even after the whole head is shaved, and examined with the most minute attention, the skull will in various instances be found perfectly sound, without any appearance either of tumour or discoloration. A patient in such circumstances we suppose to be in great hazard, from the brain being compressed in one part or another; unless this compression is removed by an operation, he must, in all probability, die. In what manner then is a practitioner to conduct himself? The situation is distressing; but still, in my opinion, there should be no hesitation as to the line of conduct a surgeon ought to pursue, which should be quite the reverse of what is almost universally adopted." This author, in another place, adds, "it will be proper to perform the first perforation in the most interior part of the cranium, in which it can with any propriety be made; and to proceed to perforate every accessible part of the skull, till the cause of the compression is discovered." Ben. Bell's System of Surgery.

In cautioning against such practice as is here condemned, we were particular, to give the judgment of the reader, under the sanction of high authority. It is observed by the celebrated Potz, "that symptoms of oppression are no good reason for cutting the integuments." And Mr. J. Bell, in his comment upon the above observations, thus addresses his readers: "I must in a few words entreat you to consider whether this practice would lead you. A boy is struck by another boy with a stone, lies for months against the nose, contumacy, and with every bad symptom; his surgeons are all the while advising the operation, his friends are pleading for a respite, when the boy begins gradually to recover, and the head is perfectly restored." Consider, our author goes on to say, "if in any given case, the patient lying oppressed, and having no mark of injury outwardly upon the head, you should advise the trepan; while a man who had studied more the common sense of surgery than the authorities of school-books, should prevent this unmeaning operation; and if in the mean time the patient should be entirely relieved, what would become of the young surgeon, if you should be allowed to perform the operation, and were to find nothing wrong, what consolation would that be?"

Indeed while there is but one motive for applying the trepan, viz. to relieve the brain from compression, whether that is from inflammation, or depression, or disease, a principal care of the surgeon ought to be, not to perforate the cranium upon mere suspicion of something lying somewhere, but on the contrary, to be ever wary of doing too much, rather than of effecting too little, in the way of operation.
We cannot better conclude this subject, than by again extracting the rules of practice from an author, whom, from a sense of the rectitude and value of his doctrines and precepts, we have often taken so much pleasure in following. Mr. J. Bell says, 'if there be an injury in the scalp, a burst of the skull, an internal separation of the dura mater, or any injury which endangers inflammation of the brain; and if along with that kind of danger there are actually symptoms which mark inflammation of the brain; we try to prevent or moderate the inflammation by bleedings. If there is a concussion, and the patient lies oppressed, vomiting, with difficult breathing and a slow pulse, (and this, it may be observed, is the most frequent, direct, or immediate injury from a blow or fall on the head,) we give opium, wine, and all forms of stimulants. If there are along with this oppression external marks of injury after an accident, such as might cause extravasation of blood, or depression of the skull, in such case our duty is first to open the scalp, so as to examine the skull, and next to trepan, if it is to be done; and then, in hopes of relieving the brain. If there is blood, it is to be known only by guess, by having opened the scalp at the place of the blow, in the expectation of finding a fracture of the skull, and distempering the skull, in hopes of finding blood lying upon the surface of the brain. But still, if after opening the skull the patient lie comatose and oppressed, in being plain he must die if not relieved. Also from the tension of the dura mater we suspect there is blood within that membrane; we must venture to open it also, in hopes of relieving the brain. If matter lying upon the surface is the cause of compression, it will be known by the previous symptoms, by quickness of the pulse, headache, flushed face, turgescent eyes, corded feeling in the head, and all the other signs marking an inflammation of the brain. And if after all these symptoms, shivering, languor, faintings, signs of vomiting, and delirium come on, we are sure of the case. If there is found a fissure of the skull, that fissure is not itself the cause of danger, but it is the mark of that degree of injury which may have produced it. It also marks the place of the violence, and points out where we should apply the trepan. A fissure is not of itself a motive for trepanning the skull; but if with the fissure the patient lies oppressed, then the operation is the mark of danger, perhaps from extravasated blood, and the fracture or fissure of the skull marks the point on which we should apply our trepan.

When the bones are directly pressed down by the blow, our way of proceeding is very plain; if the bones are moveable, we raise them gently up; if they seem totally disengaged, we pick them away; if the bones are locked in with one another, and pressed under the sound skull, we cut one angle with the trepan, and that enables us to raise the depressed bone. In all this operation we should be gentle, and rather reserved; for when blood has covered the whole skull, from the sagittal division to the parietal bone, it has all been evacuated by one single opening, and the patient saved. When there has been pus generated in great quantity, and much of the dura mater detached, one single perforation has been sufficient. When pieces of skull have been apparently so detached from their membranes, that they have seemed irretrievably lost, they have notwithstanding lived and healed, especially in young patients; and often when the depression has seemed far from being proceeded from, it is inexpedient to raise it, or has been so difficult to raise that he has forsaken it, the patient has lived notwithstanding the great oppression, and been restored to perfect health.

Operation. The operation of trepanning will necessarily vary, according to the circumstances of the case; the following are given as the general rules of practice: After the head is shaved, an incision is first to be made through the integuments, in such a form as to enable the surgeon, when the operation is over, to bring the edges of the wound as nearly as possible together; when the part has been fixed upon for the application of the instrument, so much of the skull is to be denuded of its pericranium by a raspatory, (fig. 13) as will allow the trephine (fig. 14) to be inserted. If a trephine be used, the operator, of sufficient depth to fix the central pin of the trephine, that the saw may be prevented from slipping; when the saw works steadily and securely, the central pin of the trephine is removed; the saw is then, from time to time, to be taken out of the groove, and cleaned by the brush (fig. 15). During the progress of the operation, the depth of the groove ought to be examined; if one part be deeper than another, the pressure of the saw is to be made principally on the opposite side. The operator must often examine whether the piece is loose; when it is perceived so, it must be snapped away by the forceps (fig. 16) or lever (fig. 17), for the sawing should by no means be continued until it is quite detached. Let the membranes of the brain are injured. When, after the piece of bone is extracted, the inner edges of the perforation appear ragged, they are to be carefully smoothed by the lenticular (fig. 18). The depressed portion of the bone is now to be raised with the lever; if there are any parts of bone which are likely to remain, they are to be pieced away, extravasated blood let out; and, as above-mentioned, if blood or matter is contained under the dura mater, this membrane itself is to be punctured. From the extent of the perforation, it is absolutely necessary to make more than one perforation; in these cases they ought to be made to run into each other, in order to prevent the necessity of dividing intermediate spaces. After the objects of the operation are accomplished, a pledge of lint, either dry or with some simple ointment, is to be laid on the wound in the dura mater (provided that membrane may have been punctured): the edges of the scalp are then to be brought nearly as may be together, and another piece of lint laid along the outer wound; some fine linen is to be placed over the whole, and the parts secured by proper bandaging, or by a common night-cap.

At every dressing the purulent matter is to be carefully absorbed by a sponge: the wound to be treated upon the same principles as wounds in general; and should fungous arise out of its edges, we are, according to their nature and extent, to attempt their removal by cautery, by excision, or ligature.

Of inflammation, its characters and varieties. Inflammation may be divided into ordinary, constitutional, and specific; the first dependent for its production upon those susceptibilities which in a greater or inferior degree are common to every individual, the second arising from peculiar tendency to disorder in some constitutions, the last always arising from the application of a particular exciting cause. For example, To that kind of vascular irritation which constitutes the inflamed state, and which is the subject of inquiry in another place (see Membrane, etc. Sect. Plegmatic), all are obvious, provided the exciting cause acts with sufficient power: but those inflammations that are called scrophulous, which are immediately excited by the same powers which are produced of communis, will not in all individuals follow upon the application of such powers; such then furnish examples of constitutional inflammations. As an instance of the third or specific inflammation, we may adduce the venereal disease, either in its first introduction into the system, or in several of its secondary stages.

As all these disorders have something in common, while at the same time each is distinguished by its separate character, so the rules of treatment in relation to them are both general and particular. Thus the observations which apply to the management of a common abscess (the result of inflammation), apply likewise, to a certain extent, to one resulting from the venereal virus, although the requisitions of this last are further regulated by the peculiarity of its exciting agent. We shall first treat of common, secondly of constitutional, thirdly of specific, inflammations. For the symptoms, progress, termination, and medical treatment of inflammation, consult Medicine. It is the simple surgery of this disorder alone that remains to be noticed. The local applications suited to the region, or, as it is technically expressed, resolution of an inflamed surface, when the inflammation is of the active or ethereal kind, are the different preparations of lead dissolved in vinegar, mild expressed oils, or simple oil. The first of these is often most conveniently employed in the shape of castor, made by mixing the dissolved lead, Goulard's extract for example, with crumbs of bread. This application ought to be cautiously renewed, and kept on the part cool. Lead is sometimes applied in combination with simple ointment; this, however, is not in general eligible, as the action of the lead is in some degree blunted by uniting it with oily or unctuous substances.

Local blood-letting by leeches, or by cupping and scarifying, is sometimes necessary, in order to reduce the inflamed state; and all heating, or otherwise irritating applications to the part, are to be assiduously guarded against. In passive, asthenic, or indolent affections of the inflammatory kind, it is sometimes necessary, even while the inflammation continues in its first stage, to treat the complaint with local well-assorted stimuli. In these cases we avoid cold applications, leeches, saturnine preparations, &c. and order warm and large poultices, made with mustard and oil, frequently renewed, fomenta.
ions, the inflation of white poppy, or of chamois-leather flowers, and sometimes even volatile emulsions.

When the suppurrative stage of active inflammation has commenced, the repellant applications are likewise immediately to be employed. Action is now not to be checked, but encouraged; warm fomentations are to be applied; poultices made with bread and milk, with a small quantity of lard or simple ointment, are to be resorted to; those are to be laid upon the part soft and warm, and renewed very frequently, and to be renewed. Sometimes when the suppurrative process seems too tardy and indolent, it may be necessary to add to the poultices some of the heating or stimulating gums, such as galbanum, which may be made to unite with the poultice, by dissolving it in the white of an egg.

The completion of the suppurrative process, or the full formation of abscess, is known by the cessation of throbbing, and other symptoms of suppuration, and by the pointing of the tumour. The tumour now becomes more distinct, from a whitish or yellowish appearance. Sometimes when the tumour is not deep seated, the fluctuation of matter is evident.

The methods of opening abscesses are by caustic, by incision, or by seton: the first, although in some cases, as in the case of the tumour, is present by no means in common use; it is more painful and insidious than the mode by incision. When caustic is employed, a piece of sticking-plaster is to be laid upon the tumour, to be laid upon the tumour, and then to the action of the caustic is to be introduced, and retained by plaster and bandage, until it has made an opening through the integuments of the tumour, which, generally, will not be some hours after its application. When an eschar is formed, some emollient ointment is to be employed to soften and separate it.

When the knife is employed, all that is necessary to attend to is, to avoid any considerable blood vessels, to make the opening large enough to give free outlet to the matter, and as the most depending part of the swelling.

When a seton is used, such an instrument as represented in fig. 1, may be threaded with a thread of sufficient length to reach the tumour, and passed out at the under; and the matter of the abscess thus allowed gradually to discharge itself. Dry lint, changed once or twice a day, is the only dressing necessary in a common abscess.

When an inflamed part, instead of thus passing on into suppuration, becomes gangrenous, the external applications are required to be of a stimulating nature; such as solutions of sal-ammoniac, &c., in general, however, the dressing of gangrene is to be trusted to internal invigorating powers, and keeping the part clear and clean. When mortified parts lie deep, and are not thrown off by the living energy of the surrounding surface, it is often necessary to make incisions into the skin for the purpose of removing them.

Of ulcer. When the ischar or mortified part has been separated, the sore remains in the form of a simple sore ulcer, which is one of the most common objects of surgical practice, the treatment of which is entirely resolvable into the means of assisting nature in her endeavours to procure proper and healthy granulations of fresh flesh, in preventing morbid luxuriance, and disposing to an even and clear cicatrization. Various methods have been had recourse to, in order to accomplish these objects, such as turpentine, warm stimulating ointments, in conjunction with the use of the excitement of which, and as the best application of the kind, we may notice the common basilicon ointment of the shops, with the red-precipitate powder. But the management of obstinate ulcers has recently been abundantly facilitated by the employment of simple adhesive plaster, which is cut into strips, and laid carefully, firmly, and neatly, over the whole ulcerated surface; these, where it can be used, to be assisted by bandage. This practice was first generally introduced by Mr. Brynton, and has, with justice, been ranked among the highest improvements in modern surgery. At every dressing of an ulcer thus treated, the sore is first to be cleaned by sponge and warm water; if, notwithstanding the uniform pressure of the plasters, fungous excrescences arise, they may be touched, when dressed, with some kind of escharotic; the eschar which has been then to be brought up as near together as the loss of substance will admit of; and the strips of adhesive plaster separately passed over the sore, till it is entirely covered. Over this dressing common castor-oil may then be laid, and the bandages then applied. When the ulcer is attended with much inflammation and swelling, the management of it for a time is to be solely entrusted to the applications of these. One of the most efficacious materials of which these may be constituted, and one of the best applications to obstinate ulcers of the leg, which are often attended with crysipilateral inflammation, is the grounds of stale beer.

This far of ordinary inflammation and its consequences: we now proceed to treat of this state as connected with, or modified by, a peculiarity of constitutional disposition. Inflammation is peculiar in their nature, and confined to certain parts of the system. Thus, inflammatory disorders of a scrophulous kind invariably affect secretory surfaces and cancerous inflammations, which are always in glandular parts. Suppose, for example, the breast of a female to be subjected to the causes of inflammation, the operation of such causes, if applied at a certain time of life, or under circumstances of cancerous predisposition, will end in the production of true cancer; the nature of the inflammation from the first being peculiar: while under circumstances of freedom from the cancerous tendency, an equal degree of irritation in the breast, without having any peculiarity in its nature and progress, or without demanding a specific mode of treatment. Further, even in an individual predisposed to cancer, inflammation of a part which is not glandular, will, by consequence, not be cancerous. What, therefore, we have denominated constitutional inflammations; are inflammations of certain parts, and thus branch out into distinct diseases. We have distinguished the principal inflammations from a scrophulous diathesis, although every secretory surface is obvious to the affection; these are white-swelling of the knee joint, and lumbar, poas abscess.

**White-swelling.** This disorder is most frequent in the knee joint, and indeed the name is usually made to denote a disease of this part.

**Symptoms.** Pain in the joint, especially on motion, or, when it is in a bent position, swelling, which generally augments, with an enlargement and varicose appearance of the cuticular veins; while the joint swells, the parts below become either diminished or affected with a scleromatous enlargement, parts of the abscesses at different points; gradual decline of the patient's health, hectic fever. Sometimes the pain is more confined, and it is often then more acute; at other times the pain and swelling are: from the first diffused through the whole extent of the joint.

**Causes.** White-swelling is a scrophulous inflammation. In those cases in which the enlargement of the joint commences with the pain, the pain itself being more distended, the primary affection seems to be an inflamed state of the capsular ligament; in other cases the disease is perhaps originally seated in the bones. Mr. B. Bell has described these different species by the names of rheumatic and scrophulous; but the fact is, that they both depend upon the scrophulous diathesis; and it has been well observed by an able writer, "that between acute rheumatism and white-swelling there is no sort of analogy, neither as to their causes, their symptoms, their terminations, their proper method of cure, nor any thing else." Dr. Herdman on White-Swelling.

**Treatment.** Both in the medical and surgical treatment of all scrophulous inflammations, it must be recollected that they partake more of the atherine than the opposite character. Thus in white-swelling, however violent the inflammation, or urgent the pain, blood-letting, general or local, is seldom or never advisable. Blisters, warm fomentations, and bathing, volatile liniment, the counter irritation of icerous issues, mercurial purgation, are the only remedies which yield any good air. When suppuration has taken place, "soft and easy dressings," warm poultices, small doses of calomel with opium. Cinta? Amputation of the limb, which is often performed to save the patient from the protracted necessity of riding, is not indiscriminately advisable, on account of the patient being, in some instances, too feeble and diseased to admit of the operation.

**Of lumbar or poas abscess.**

**Symptoms.** Pain in the loins, which does not, as in lumbar, affect the muscles of the loins generally, but passes rather upwards in the direction of the spine, and downwards in an oblique direction, towards the inner part of the thigh. After the existence of this pain, for a longer or shorter period, marks of suppuration come on, and a tumour gradually appears in the groin. This is to be distinguished from hernia by a recollection of the preceding symptoms, and by the fluctuating and fluctuating feel of the swelling.

**Causes and seat.** This disease appears to be an inflammatory affection of the vertebral ligaments, occasioned by an acute diathesis, of temperature, blows, or any violence done to the part, and other causes of inflammation: it terminates in suppuration, which runs along the sheath of the poas muscle, and thus appears in the groin.
Treatment. This, to be effectual, ought to commence with the commencement of the disease. When the ulcer has formed to any extent, the malady is highly dangerous. Plisters to the loins, volatile embrocations; very small doses of calomel, with opium or barytous. When a tumour has formed in the thigh, which continues to increase, it is to be opened. During the subsequent discharge, the patient's strength is to be carefully supported, by nourishing diet, wine, opium, brand, and pure air.

Cancer. Cancers, previously to their appearing in the form of ulcers, are termed occult. An occult cancer is a scirrhouss swelling of a gland, attended with lancinating pains, which state of parts often exists for some time before ulceration or open cancer is produced; this last, however, sometimes appears without any previous scarcity. The symptoms of cancer will be best described by tracing the usual progress of a cancerous breast. A small knotty tumour is generally seen on some parts which attends a mamma; this continues nearly in the same state, perhaps, for some months; it at length increases, and a pain is felt to proceed from it towards the axilla; the integuments gradually become discoloured, and at length ulceration is formed.

Causes and peculiarities. There has been much dispute whether cancer be a disease of parts merely, or of the system: all, however, that ought to be understood respecting the general nature of cancer, is, that it is a sequelability, as we have above endeavoured to explain, exists in some habits, and especially at certain periods of life, to this malady, which in such habits may be induced by the same causes which occasion common inflammation. The usual time for the formation of cancerous mamma is when the menses disappear. Previous to this period, swellings of the breast assume more of the scirrhouss character.

Treatment. Cica is has been much extolled as a remedy for schirrous; faith in its virtues are, however, gradually declining. It may be combined with small doses of calomel. Mercurial ointment to the part, volatile embrocations; not too stimulating. Laxatives has been employed as a lotion in occult cancer with seeming benefit. If the disease advance, no cure can be expected but from operation, which should be had recourse to early, previously to the extension of the disease into the contiguous glands.

Operation. If the skin be sound, a longitudinal or transverse incision, according to the shape of the tumour, is to be made with the scalpel along its whole length, at a small distance from the nipple; this incision is to pass through the skin and cellular substance, and while the patient's arm is extended, the mamma is to be carefully dissected from the integuments and pectoral muscle; the glandular substance should be detached, although only a part be the seat of the disease. In closing the integuments after the completion of the operation, the twisted suture may be employed, assisted by strips of oxidized linen. A plan of simple admission is to be laid over the part, covered by soft linen or tow, and the dressings are to be retained by appropriate bandage.

When the operation is performed, after the existence of the disease for some time in an open state, it will often be necessary to cut away with a knife at the root of the operation, in order to remove the incision may, in this case, be made of an oval form; and if the axillary glands be found scirrhouss, the scapel should be carried on full into the arm-pit, and the imbricated body carefully dissected out. When the operation is over, the divided edges are to be brought up as nearly together as possible, and dressings and bandages applied, as in other similar wounds.

VENEREAL AFFECTION.

The venereal disease is an example of that species of inflammation which we have called specific. It appears in two forms. To the one is more generally applied the denomination of syphilis; the other is called gonorrhoea virulenta. These affections are imagined by some to originate from the same specific poison; by others, the cause productive of true syphilis, and that occasioning gonorrhoea, are supposed to be of a different kind. This last is perhaps the best founded opinion, viz. that the matter which, when inoculated in the urethra, produces a discharge from the urethra, called gonorrhoea, is not capable, under any circumstances, of producing true venereal chancre.

Symptoms of gonorrhoea. A peculiar itchiness and smarting sensation about the extremity of the urethra, attended with some reddening or tightness; this is succeeded by the appearance of mucus about the extremity of the penis, which soon increases in quantity; it is generally of a brown appearance, and is attended with some irritation and pain in the organ, and by discharging the urine, and with nocturnal erections. Sometimes the lymphatic glands of one or both groins become inflamed, enlarged, and this form bubo. The time at which the symptoms of gonorrhoea make their appearance is variable; sometimes the disorder will follow impure coition in the space of a few hours; at others it will be several days.

Treatment. In the first and inflammatory stages, demulcents largely drunk, such as decoction of linden, solution of gum arabic, tragacanth, & c. Mild purgatives, such as cascara, are useful. Opiate at night. Bathe the penis in warm milk and water. Situations and pungent lotions. If from the too precipitate or early use of astringent injections, or from other causes, the inflammation extends itself to the testicle, causing pain and swelling of this part (hermias seminie), the scrotum is to be supported by bandage. Leeches are to be applied should the inflammation be violent, and the testicles be to preserved constant moistened with a solution of sugar of lead, or some other astringent preparation. For the swollen glands, friction with mercurial or common ointment and camphor. Volatile embrocation. If the inflammation cannot be expelled, the stone or stone-like portion to be dissolved by bread and milk poultices. If every symptom of the disorder go off, with the exception of a white mucous discharge from the urethra, which continues notwithstanding the use of antiscirrhouss injections, give tincture of cantharides in grain doses, or the same in electua, which will be for the most part found more efficacious than the balsams generally employed for this purpose. Should still the discharge continue, and, from the unusual appearance in the stream of urine, a stricture in some part or parts be suspected, introduce some instrument into the urethra, and try to evacuate the stone.

Symptoms of syphilis. True syphilis is perhaps invariably introduced into the system through the medium of chance, unless in cases where it is transmitted from parents to children. Chancre is a small ulcerated sore, with a slightly raised or eroded. This, when it appears on the penis, is frequently followed by an inflammation and enlargement of one or both groins; these, if neglected, pass on to suppuration; ulcers on the tonsils, succeed, with eruptions of the skin, especially about the roots of the hair; at length come on pains in the bones, which are often highly excruciating, and although sometimes taken for, to be distinguished from, rheumatic swellings, by their being rather in the centre of the bones, and deep set, than in the joints, and superficial; by their not being accompanied with fever equivalent to the violence of the pain; by the absence of that general prostration of the system which attends rheumatism, and sometimes by a circumcised swelling extremely painful growing up from the bone. When any doubt exists respecting the nature of those ulcers in the parts named, limbs are suspected to be venereal, they may generally be decided such by their peculiar coppy appearance: they are likewise, in general, more circumscribed than other ulcers, and their edges have a peculiar callousy.

Treatment. Mercurials given in such a form, and in such quantity, that what is called an alternative kind of action shall be for some length of time maintained in the system, without occasioning salvation, is an effect from mercury, which appears always to defeat its own object. Chances on the penis may, if the application be made to them a very short time after their production, be totally destroy-ed by caustic, and the absorption of the vi-rus and consequent disease thus prevented. When the scrotum is first perceived, they are to be kept from enlarging by the vigorous application of mercurial ointment, which, if not inconvenient, is perhaps the best and surest mode of introducing this medicine into the tissue. For other preparations of mercury, see MATERIA MEDICA AND PHARMACY. With respect to the time of continuing mercury, it may perhaps be laid down as a general rule, not to continue the medicine until two or three weeks after the apparent discontinuance of the disorder. Secondary affections, from the venereal action not having in the first instance been entirely subdued, are extremely frequent, and are always formidable. Opium, saraparilla, and, recently, nitrous acid, have each been judged specific for venereal affection; but it is now pretty generally supposed that they merely act as auxiliaries to the disease.

There are some other affections that were not noticed in the article MEDICINE, which depend upon a specific poison, and which, though constituted by a species of cutaneous inflammation, are not, like the exanthemata,公认的 abscesses, accompanied by febrile irritation. The cutaneous eruptions, which require to be noticed here, are the annulus repens, the man, and psora.

Annuus repens, ring-norma. This is a...
Surgery.

Treatment. Metallc or vegetable astringents in solution, such as nut-galls or white vitriol. The white precipitate ointment is spoken of as a wonderfully efficacious, in the hands of the men, in this and the two following complaints; the head to be covered during the cure with an oil-skin cap.

Tinea, scald head. This eruption commonly breaks out over the roots of the hair; it appears in small ulcers, which at times spread over the whole head, and produce friable crusts.

The secretion of the contagious matter, upon which this disorder depends, is generally excited by poverty of diet, irritation, and other malnourishment of infants.

Treatment. Shave the head; wash the surface first with warm water and soap; white precipitate ointment; tar ointment; a solution of corrosive sublimate; generous diet, with cleanliness.

N. B. A milder disease than tinea often breaks out on the face and head of very young children: this (crusta lactis) is not infectious. It is to be treated by keeping the child clean, cool, and much in the air; and by sprinkling the eruption with calamine powder, if necessary, which is likewise the best application to those excoriations of the skin which are apt to break out about the gums of infants.

Pomata. "Small pustules with watery heads, appearing first on the wrists and between the fingers." "There are two kinds of itch, which appears between the fingers and the joints of the knees and elbows, and which is seldom seen in these places, but all over the other parts of the body. The latter is seldom thought to be the itch, as it does not easily infect even a bull-flow, and resists the usual means of cure by brimstone."

Darwin.

Treatment. Sulphur ointment; mercurial corrosive sublimate in a very weak solution; white precipitate ointment; sulphur taken internally.

Of indolent tumour.

Tumours which are not necessarily or in their origin attended by inflammation, are called indolent; these nodular enlargements of parts are principally seated in the cellular membrane: they are differently named, according to the nature of their contents. When the swelling is made up of a substance of the consistency of fat, it is denominated sebaceous or fatty; if of a firmer consistence, a sarcomatous tumour. When it is filled with a substance the consistence of honey, the enlargement has been called a medullary or medullary tumour. The mass arthromatous is applied to those swellings which consist of a substance of a harder kind. Sometimes the contents of tumours are formed of a coagulable fluid, when they are termed hydatid. Sometimes there are swellings in the bursae or sinuses of joints.

These tumours may be removed by making an opening with a lancet, if their contents be of a fluid nature, evacuating such fluid, and afterwards removing their se. If the contents of the tumour are solid, they are to be extirpated by making a longitudinal incision on the side of the tumour, and removing the tumour by the point of the finger, or any convenient instrument that is blunt.

Of nuxi mentalis, corns, warts, and polypi.

When those marks on infants which are fancifully attributed to impressions made on the mind of the mother during pregnancy, do not rise above the level of the skin, they are not of course the subjects of surgical operations. Sometimes, however, these appear in the form of sarcomatous tumours, firm, prominent, and fleshly: in these cases the swelling may be cut out. If any considerable arteries run into it, these are to be taken up, and the skin that remains, brought over and united by adhesive plaster. If the tumour be connected with the sound parts by a narrow neck, it will generally be advisable to destroy it by making a ligature round its neck.

Corns are formed by a thickening and hardening of the external skin from pressure. They are to be treated by first bathing the feet in warm water, and then paring off as much as possible, without giving pain. This operation is to be frequently repeated; some simple ointment may be laid over the corn, and all pressure avoided as much as possible.

Polypi are indolent tumours found in various parts of the body, as the nose, mouth, throat, vagina, uterus, and rectum. When, notwithstanding the use of astrangent solutions, such as of alum, vinegar, &c., they continue to grow, become painful and troublesome, they are to be extirpated by the knife or scissors, when the roots of the tumour can be commanded, otherwise by tearing them out, and cauterising the wound. This is much more painful, not so cleanly, or in such cases much less painful, while it is more secure, by ligature, of wire, of catgut, of silk, &c. The ligature is to be passed double over the tumour, and carried to the root by the fingers, split probes, fig. 4. or rings, fig. 5. The ends of the ligature are to be now introduced into a canula, fig. 6. which is to be pushed along the opposite side of the tumour, till its end reach the root of it, when the ligature is to be drawn with some tightness, and fastened to the canula, which is to remain in the passage; the ligature is to be daily tightened till the polypus drop off. When the polypus is in the throat, the ligature should be applied through one of the nostrils.

Diseases of the bones.

Bones, like the soft parts, are subject to inflammation, which often terminates in caries, or a kind of gangrene, forming the disease called spina ventosa, or ganaeus ossis. This seems to be a septicacious affection.

Symptoms of spina ventosa. Dull heavy pains in the part, or originating without any perceptible exciting cause; lameness and sensation of weight in the affected limb; after the continuance of these symptoms for some time, without any appearance externally to indicate disease; the intermitten eruptions, suddenly perhaps, will become pitiable and unsightly. This arises from the matter having issued in a way that has become curious. Unfortunately attend to the restoration and preservation of the constitutional excitement and health. Bark, steel, very small doses of calomel, good air, nourishing diet, chiefly of ant mal food.

The fibrillities and maladies ossium. The one disorder constituted by a disposition in the bones to be broken or injured from the most trifling exertion; the other, by a want of firmness and hardness in the bone, are occasioned by disordered action in the secretory or absorbent vessels of these organs. They are alone to be remedied by internal strengthening remedies, suited to the nature of the prevailing malady.

The vascular node, as to its immediate cause, is obscure; the external swelling, with which after a time it is characterized, appears to be occasioned by an extension of the periosteum. Sometimes the pain of these tumours is mitigated by dividing the periosteum.

Among the diseases of the bones is often classed an affection which is very common, especially in young children, viz. a loss of power in the lower extremities, consequent upon a displacement of some part of the bone of the bony column of the spine. This, in fact, appears to be a disease of the ligaments. The frequency of this complaint in children is so great as to prevent, the treatment, to be effectual, ought to commence early, and in its origin. Unless attended to with care, it is apt to be mistaken for a nervous or common infantile indisposition.

Symptoms. An unusual backwardness in walking, languor, listlessness, a tendency to hysterus, and lastly, a feeling of protrubence or curvature in some of the spine.

Treatment. A seton in the back near to the disordered promontory, small doses of calomel, as in other septicacious affections. Nourishing diet, cleanliness, air.

Of erosion and arteriotomy.

Blood-letting from the arm is an operation so simple and familiar as hardly to require notice. The ligature that is used for the purpose of stopping the venal circulation should consist of broad tape; this is to be firmly bound round the arm about an inch or two above the joint of the elbow; the intermediate space between this and the hand of the joint is in general the most convenient for introducing the lancet. The surgeon is to make choice of that vein which rolls least under the median basilic, although not always the most prominent, is usually chosen, both on account of its being less apt to slip from under the lancet, and because there is less danger of injuring any cutaneous nerves when the cephalies are opened. The artery being felt to pulsate below is not to be regarded as an objection; for transfixing the vein under any circumstance should be carefully guarded against; and unless the instrument be thus carried through the
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The usual most parts of opening an issue are on the fore part of the humerus, the hollow above the inside of the knee, the neck of the tusk, the spine or between the ribs; in the two former places the pea or blister issue is commonly used, in the others the cord or seton.

A blister issue is made and kept up by the common blistering plaster being first applied, which is followed by the daily use of chantharies ointment. The pea issue is sometimes made by cautie, but more commonly, and much better, by puncturing the skin in up, and cutting it through, making a wound of sufficient size to receive the common issue pea; this is to be daily removed, a fresh pea put into the wound, and thus a purulent discharge will be excited and maintained.

The seton is to be made with the seton needle, (fig. 8.) threaded with cotton or silk, this is to be pushed into the skin, and carried out at some distance, passing the instrument fairly through; and, when the eyes, which is cord that may be employed is to be left hanging out from the orifices; the cord is to be daily drawn out and renewed.

Diseases of the eyes.

Inflammation of the eyes is of two species; the one called by systematics, ophtalmia membranarum, inflammation of the membranes of the eye; the other, ophtalmia tarsi, inflammation of the teardrop glandular and scrofulous affection. Membranous inflammation is to be subdued by satirical lotions, by bleeding with leeches on the temples; and if the disorder be violent, and the inflamed vessels very turgid, by cutting the vessels across upon the eye. Light, and all other sources of irritation, it is hardly necessary to observe, should be kept from the eye as much as possible.

Ophthalmia is very apt to be treated by rubbing over the lid, when the eye is closed, some of the active mercurial ointments, of which perhaps the most efficacious is the ung. hydragyri nitriti of the London Pharmacopoeia.

Munibromous inflammation, if violent or long continued, is apt to be followed by specks on the cornea; these may sometimes be removed by absorbent remedies, local or general, such as colostom thrown into the eye through a quill, or small quantities taken internally so as to produce a very gentle mercurial action in the system. Sometimes, when the speck on the cornea is very prominent, it may be removed by a small knife. When the membranous excrecence termed pterygium, spreads from the white of the eye over the cornea, a scarification should be made through it entirely round, and at a little distance from the circumference. After the hemorrhage has subsided, a satellite lotion is to be applied to the eye.

Inflammation now and then terminates in an abscess of the eye, which confines the humour to a small space, and thereby makes it impossible to abstract all the matter by incision. When this occurs, the matter must be evacuated by an incision into the cornea. Ucers of the eye may arise, from the same causes, constitutional or local, that occasion ulcers in other parts: the general principles of treatment must likewise be the same.

The serous humour of the eye sometimes accumulates inordinately, and constitutes a kind of dropical swelling of the organ; this disease is to be distinguished from abscesses by the manner in which it has been produced, by the patient remaining sensible to light, and by the pupil contracting. Dropsy of the eye may be remedied in its early stages by purgating the under edge of the cornea, or by piercing the sclerotic coat just behind the iris. After the operation, some tincture and astrigent lotions are to be used.

It is sometimes necessary to puncture the eye, in order to discharge blood that may have been extravasated from its vessels and remain unabsorbed.

When the eye has become cancerous, the whole of it is to be dissected out, free from the lids, if the operation is performed before these parts have become diseased.

Cataract. This is a disorder either of the crystalline lens or of its capsule, preventing the rays of light from falling upon the retina. Cataract usually commences by a diminution of vision, followed by the sensation of пар-1 and permanent opacity, and is at length succeeded by almost total blindness. This disorder is usually without, but is sometimes accompanied with pain. It is distinguishable from the gutta serena by the want of pain, which in the last disorder is not present. In phthisic serena the pupils do not contract in a strong light; in the cataract, the contraction of the pupil usually remains. Whether the capsule mere or the lens, the opacities of the lens, is affected, it is not easy to ascertain.

In the commencement of cataract, advantage has sometimes been experienced from small doses of colonel, hyoscyamus; cicutas and electricity have each been used with supposed benefit. When the disorder is confirmed, it is only to be removed by an operation, by shaving or extraction, by forcing the opaque lens down into the vitreous humour, or by excision or cautery operations.

Qf couching. 'The operator is either to be seated with his elbow resting upon the table, or, which is preferred by some, he ought to stand resting his arm upon the side of the bed, or table, or even fixed by the speculum, (fig. 19.) or in such a manner as to allow the whole of the cornea and a small portion of the sclerotic coat to protrude, a couching needle, (fig. 21.) is to be held in the right hand in the manner of a writing pen, if the left eye be the subject of the operation; the ring and little fingers are to be supported upon the cheek or the temple of the patient; the needle is to be entered in an horizontal direction through the sclerotic coat, a little below the axis of the eye, and about one-fourth of a line behind the edge of the cornea, so as to get entirely behind the iris, to prevent that substance from being wounded. The point of the needle is to be carried forward till it be discovered behind the pupil. The operator is now commonly directed to push the point into the lens, and depress it at once to the bottom of the eye, and the better to bring the lens either bursts through the capsule at an impasse it carries with it tearing, the parts with which it is connected. Instead of this, the needle ought first to be pushed into the
lens near its under edge, as Dr. Taylor advises, and then carried some way down into the vitreous humour, so as to clear the way for the lens. It is then to be drawn a little back, and carried to the outer portion of the capsule; and, by pressing upon it, the lens, if solid, is to be pushed down by one, or if fluid, by several movements, to the bottom of the vitreous humour. It should then be pushed downwards and outwards, as Mr. Bell directs, so as to leave it in the under and outer side of the eye; where, in case it should rise, the passage of the light would be little obstructed. The needle is then to be withdrawn, the specimen removed, and the eyelids closed; and a compress soaked in a saturation solution to be applied over them. It is not advisable, in general, to remove the dressings till about eight or ten days after the operation.

**Operation of extracting the lens.** “The operator takes the knife, (fig. 23.) and holds it in the same way as he does the needle for conjunctivitis; he then enters the point of it with the edge under the lower part of the cornea about the middle of one half a line from its connection with the sclerotic coat, and as high as at the centre of the pupil; he is then to pass it across the pupil to the inner angle in an horizontal direction, keeping the edge of the knife little forwards or from being cut; the point is then to be pushed through opposite to where it entered; the upper half of the cornea is next to be cut, and at the same distance from the sclerotic with the parts at which the point of the knife went in and came out from the eye. In cutting the upper half of the cornea, the pressure of the speculum upon the eye should be gradually lessened; for if the eye be too much compressed, the aqueous humour, with the cataract and part of the vitreous humour, are apt to be forced suddenly out immediately after the incision is made. The operator then takes a flat probe, and raises the flap made in the cornea, while he passes the same instrument, or another probe, (fig. 24.) rough at the extremity, cautiously through the pupil, to scratch an opening in the capsule of the lens. This being done, the cataract is to be pressed till the pupil is closed, or the eyelids are to be shut, to allow the pupil to be dilated as much as possible; and while in this situation, if a gentle pressure be made upon the eyeball, at either the upper or under edge, or orbit, the cataract will pass through the pupil more readily than it would do when the eyelids are open. If the lens cannot be easily pushed through the opening of the cornea, no violent force should be used, for this would tend much to increase the inflammation. The opening should be enlarged so as to allow the lens to pass out more freely. When the cataract does not come out entirely, or when it is found to adhere to the contiguous parts, the end of a small flat probe or a scoop, (fig. 25.) is to be introduced, to remove any detached pieces or adhesions that may be present. The iris sometimes either projects too much into the anterior chamber, or is pushed against the opening of the cornea. When this happens, it is to be returned to its natural situation by means of the probe already mentioned. Sometimes the opacity is not in the body of the lens, but entirely in the capsule with it. The extraction of the lens alone would here answer no useful purpose. Some practitioners attempt to extract first the lens and then the capsule by forceps; others the lens and capsule entire.” The after treatment is to be the same as in connexion with the operation.

A difference of sentiment prevails respecting the superior eligibility of the one or the other of these operations. Among the surgeons of London, the extraction is principally advised.

**Of fistula lachrymalis.**

An obstruction of the lacrimal sac or duct constitutes this disease. It is divided into four stages: the first is constituted by a mere dilatation of the sac, and is characterised by a tumour between the inner corner of the eye and the nose, attended with a discharge of tears and mucus over the cheek, the integuments being entire, and as yet free from inflammation. In the second stage the swelling is larger, the skin inflamed, and out of the puncta lachrymalia may be now pressed a yellowish purulent fluid. The lacrimal duct, and being round the diseased duct; in the fourth, the passage from the sac into the nose is obliterated, its inside being ulcerated or fungous, and the bones being cavernous; it is only then to this last stage that the term fistula can with propriety be applied.

It has been attempted, by the introduction of a probe (fig. 27.) from one of the puncta lachrymalia into the nasal duct, to overcome the obstruction, and by some surgeons the intestiments: the injection of astringent fluids has likewise been proposed by means of a syringe, (fig. 28.) the pipe of which is also to enter one of the puncta; but these operations are scarcely practicable and all perhaps that, in the first period of the disorder, ought to be attempted, is frequent pressure with the finger on the tumour; when the disorder advances, and the tumour threatens to burst, an opening should be made into it with a small scalpel, beginning the incision a little above the line from the angle of the eye to the nose, and laying the sac fairly open; the contents of the tumour are then to be pressed out; and we are advised to direct for the nasal duct with a probe, and if it can be found, to introduce a piece of catgut bougie, or lead, bending it downwards so as to preserve it in the passage to the sides of the involved duct. The wound is to be dressed with wax and oil, and the dressings retained by sticking plaster. When the passage of the duct is secured, the substance that had been introduced is to be withdrawn, and the wound healed.

In the last, or properly fistulous, stage of the disorder, the attempts at cure are attempts to procure a new duct for the passage of the tears, the original one being obliterated. For this purpose the canula of the trocar (fig. 30.) is to be introduced to the under and back part of the lacrimal sac, and retained while the stilette is to be passed in it in an oblique direction downwards and inwards, till it reach the nasal cavity; the perforation of the bones will be perceived by the operation; and the passing of the instrument into the nostril, is usually followed immediately by the passage of some bloody mucus out of the nose; when this has thus penetrated the spongy bones, it is to be withdrawn from the canula, and a leaden probe or piece of catgut introduced. The canula is now to be removed; one end of the probe is to remain in the new-formed duct, and the other, as small as is practicable, to hang over the edge of the wound, which is now to be covered with lint and adhesive plaster. The probe is to be removed almost daily until the new duct is completely calous, when it is entirely to be removed, and the wound healed.

In cases of much constitutional affection, where the disorder treated in the above manner is likely to recur, it has been proposed to introduce a cane of gold, silver, or lead, into the artificial opening, and to heal the skin over it. The instruments used for this purpose are represented in figs. 31, 32, 33.

**Of diseases of the teeth.**

The causes of tooth-ach are obscure. Caries of the teeth seems to be sometimes a constitutional, at others an entirely local disease. For the preservation of the teeth, they ought to be kept constantly brushed, with a brush simply, or with some powder that is not of an ionic nature. For acids, although for a time they cleanse and whiten the teeth, eventually injure their texture; the salts constitute the objection of gold, silver, or lead, as commonly termed dentifrices powders. Tooth-ach when it proceeds from a disease of the tooth itself, only admits of temporary cure by the common applications of opium, camphor, and the warm essential oils. The empirical remedies for diseased teeth are perhaps generally composed of some strong concentrated mineral acid, by which the carious is for a time separated from the sound portion of the tooth.

**Extraction of the teeth.** Many are far too liberal in disposing of their teeth: if the first fit of the tooth-ach be endured, the disorder will frequently, for years, or for life, be suspended, and the tooth remain sound, which by a precipitate extraction would have been unnecessarily lost. In some, there is a tendency, from the fear of the operation, to the other extreme. When a tooth is extensively out, and the means to be extracted, for the sake of preserving those that are contiguous and the momentary pain of extraction is trifling in comparison of the multiplied and protracted fits of tooth-ach.

The instruments for extracting teeth operate in a lateral direction: it is indifferent on which side they are forced out, whether outwardly or inwardly, excepting in the instance of the denues supinator of the lower jaw, which ought invariably to be forced outwardly. Before the claw of the instrument is fixed on the tooth, the gum should be separated from it as deep down as possible; the fulcrum of the instrument is to be on the side opposite to that at which the tooth is to be extracted, and with a single turn, which should not be by jerk or violence, but made with a slow, regular movement, the tooth will come out of its socket.

From very violent affections of the teeth, and from other causes of inflammation, the membrane of the alveolar sac sometimes inflames, and becomes the seat of abscess. When the symptoms of this disease are violent pain in the cheek, and swelling extending upwards towards the nose, the ears, and the eyes; the swelling generally points in the
cheek, and sometimes a discharge of matter takes place from the nostrils or the roof of the mouth. This discharge is to be cured by making a free opening for the discharge of the matter, either by extracting one of the molars and perforating the antrum with a trocar (fig. 37), through the bottom of the socket, or by extracting a tooth, the perforation may be made with a tubular instrument through that part of the antrum which projects over the molars. Astrigent solutions may be thrown occasionally into the cavity, generally depend on the

Of rana. An obstruction in the duct of one of the salivary glands sometimes produces a tumour under the tongue, of such a size as to impede the motion of this organ, and at length to threaten suffocation. This tumour is to be laid fully open, and the mouth may afterwards be washed with some astrigent solution.

Enlarged tonsils and cheeks are not unfrequent occurrences. When these by their size interfere with respiration or swallowing, they are to be removed by ligature in the same manner as polypi. When the enlarged tonsil is of a conical shape, Cheseled's needle (fig. 43.), may be employed, which, when passed through the tonsil, is to be pushed through the base of the tumour; the tonsil now being taken hold of by a hook is to be pulled forward, divided, and tied, so as that each division shall surround each half of the swelling. This kind of ligature may be employed for an enlarged uvula or polypi.

Deafness, when consequent upon an incorrect position, hardening of the wax, is best removed by squirting the ear with warm water in which some soap has been dissolved. When deafness arises from mere dryness in the meatus, some drops of sweet oil should be put into the passage. The supplicative discharge from the ears in young children may generally be relieved by some slightly astrigent lotion, such as a weak solution of vitriolated zinc or sugar of lead. When contained upon loss of nervous power, either local or general, no relief can be expected from these topical applications. Electricity has been tried with apparent benefit in these cases.

Branchotomy. When the trachea is to be opened, we are directed to make a longitudinal incision, of about an inch and a half, through the skin and cellular substance, commencing at the under end of the thyroid cartilage; the muscles are then to be separated, the operator taking care to avoid the thyroid gland: when the trachea is laid bare and the bleeding vessels secured, a puncture is to be made with a common lancet between two of the rings of the trachea, of such size as to admit a canula. Dr. Monro directs that a double incision is to be made in the inner and outer sides withdrawn from time to time, and cleared of the obstructing mucous. He directs the instrument to be fixed by a strap round the neck. As soon as the purposes are accom-

plished for which an opening was made into the trachea, the canula is to be taken out, and the wound closed by adhesive plaster. The

Paracentesis of the throat. When the chest is opened in order to evacuate purulent matter, this cavity, an incision should be made with the scissors through the skin and cellular membrane, between the sixth and seventh ribs, from one to two inches long; and, in the direction of the ribs, the muscles are next to be divided, and the incision made as near as possible to the upper edge of the inferior ribs. The pleura now exposed is to be gently opened; if the lungs adhere to the ribs where the incision is made, the fluid will not immediately discharge itself from the opening: in this case, the adhesion may be separated by a blunt probe, or the incision may be carried a little on towards the sternum. When the fluid begins to flow out, a silver canula (fig. 43.) may be introduced into the wound, attached to the patient's body, and being provided with a cork to it, the operator is either to let out the whole of the matter at once, or to draw it off frequently according to the strength of the patient. The wound, after the evacuation of the fluid, is to be kept open for some time.

Paracentesis of the abdomen. Tapping is usually performed by puncturing the abdomen at the middle line between the spine of the ilium and the navel. Others direct the opening to be made in the linea alba. An equal pressure is required during this operation upon the belly; such pressure may either be done by the operator, or by the hands of assistants; the part at which the puncture is to be made being drawn a little over the edge of the bed, if the patient be found lying in a horizontal situation, the surgeon fixes the head of the instrument (a trocar) while the forefinger directs its point; he is then to push it forward till it ceases to meet with resistance. The perforator is now to be taken out, and the water allowed to discharge, while the pressure on the surrounding parts is continued and increased. After the whole of the water is drawn off, the wound may be covered with a pledge of simple lint. This may be laid some flannel dipped in spirits, and bandages are now to be applied round the body with firmness. The bandages should not be removed for one or two days succeeding the operation; after this time they may be taken off daily for a little while, and the abdomen rubbed with some stimulant embrocation.

Hernia. From malformation, pre-disposition, or accident, the contents of the abdomen may protrude beyond their boundaries, and thus constitute hernia, or rupture. The most usual place for descent is through the ring of the external oblique muscle, constituting the inguinal canal or scrotal hernia, and hernia congenita, from under the ligament of falcipus or poupourt, forming fununal hernia, and from the navel constituting umbilical hernia.

The causes of rupture we have said are either pre-disposition, accident, or malconformation. Where the constitutional tendency is observed, the tracking causes should with solicitude be avoided. These are violent muscular exertion, particularly of those muscles whose action is principally upon the contents of the abdomen, such are especially called into action in violent straining to procure stool, in fits of coughing, hurried respiration, laughter, &c.

It is hernial congeits alone that immediately follows upon malconformation, strictly speaking. It is occasioned by the protrusion of some portion of the bowels through the passage by which, just previous to birth, the testicles descend from the abdomen into the scrotum. This passage is commonly shortly closed after the descent, and thus the intestine prevented from entering the bag of the testicle. In the case of congenital hernia the opening is preserved.

Hernie, with the exception of the one just mentioned, are invested with peritoneum, and thus enclosed in a sac; and to whatever extent the protrusion may have taken place, the tumour still forms in a manner a part of the abdominal cavity. Rupture is an improper application for the disorder.

It may be conceived that parts thus protruded, even before the occurrence of the immediate inconvenience with which they are attended, are in no measure free from danger of serious and alarming consequences. We have been mentioning, for instance; a part, in many cases, of the bowels, which the intestines are constantly passing forward to the anus; and this swelling, so disproportionate to the passage through which it has been protruded, that it is only in some situations of the body, when the parts are not full and tense, that in any case, and with duly managed pressure, they can even for a time be made to resume their former and natural situation.

The reduction of hernia ought then, by all means, to be attempted as soon as it is perceived; and future descents prevented by constant and uniform pressure over the part where the displacement had taken place. For the different kinds of these used for this purpose, see figs. 42, 43, 44.

When, from neglect on the part of the patient, a hernia is incapable of reduction, and is at the same time free from pain or stricture, the operator should be observed in avoiding a repetition of the causes which produced the disease. The alvine discharges are to be regularly maintained, and all violent exertions guarded against; and, without care, an irreducible and increasing hernia often continues through life without any impediment in the functions, or any interruption in the communication between the protruded and contained portions of the abdominal contents.

The dangerous symptoms in hernia originate either from spasmatic stricture of the aperture through which the sac and its contents have passed, or from distention and inflammation of the parts protruded: in this last case, indeed, the symptoms may be attributed to stricture; for the opening, although of sufficient size to allow of the communication between the tumour and the abdominal cavity previous to their falling into disease; now that parts of this disease are preternaturally enlarged and inflamed, becomes too narrow for such communication; its unyielding edges form a stricture on the inflamed vessels, and thus increase the inflammation and its consequences. The disorder is now called strangulated hernia. The
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signs of approaching strangulation are the following: pain in the tumour, an unusual tenderness over the whole belly, increased by any exertion of the abdominal muscles, consti- tiveness, quickened pulse, nausea, vomiting, and increase and extension of the pain, greater tumescence in the abdomen, extreme anxiety, and other symptoms of peritonal inflammation.

These symptoms demand speedy remedies; vera to avoid the consequences and pain are already too violent to admit of attempts to reduce the rupture, they should be, if possible, subdued by fomentations over the tumour, and the whole of the abdomen, by the injection of plasters, by warm baths, and by topical and general blood-letting. The return of the bowels should as soon as possible be attempted, for inflammation may have been present for some time without so much as a trace of rupture having been reduced as to prevent reduction, if properly regulated. The patient should be placed on the side opposite the hernia, with his pelvis and lower limbs raised, in order to relax the muscles; the abdomen should be grasped, a fistula made with the fingers in a direction upwards, and a little inward towards the crural arch, if the hernia be of the thigh; upwards, and outwards towards the ring, if it be an inguinal hernia. When the symptomatic symptoms continue, the tumour is incapable of reduction, and every appearance proves a complete strangulation of the hernial sac; there is no safety for the patient, unless in the operation which we are now briefly to describe for the inguinal and femoral hernia, which are the principal and almost only cases of strangulated hernia for which the surgeon is called upon to operate.

Operations for inguinal or scrotal hernia. The patient should be laid with his body in an almost horizontal position; while the buttocks are somewhat elevated, the thigh are to be brought down, and secured by assistants; the parts are first to be shaved, an incision is then to be made with a scalpel through the skin and cellular texture, commencing about an inch above the tumour, and carrying it down some way, but not allowing the fingers, being thus exposed, a directory to be introduced between it and the sac, in a direction upwards and outwards. A blunt pointed bistoury is to be inserted in the groove of the directory, and the ring dilated by this instrument till the point of the finger can be introduced; while the surgeon makes the dilata- tion of the ring sufficient to reduce the hernia, he must be careful of not dilating too freely, lest the bowels be again forced down. The stricture being thus relieved, the protruding intestines are to be re- turned, the outer wound closed with stitches, and proper bandages applied. When the wound has cicatrized, a truss should be worn.

The operation for femoral hernia is performed much in the same manner. Here the structure is from the ligament of the thigh, which, after the sac has been opened, is to be divided to the requisite extent.

Hydrocele. Hydrocele, or dropsy of the scrotum, is either encysted or anascorous; either diffused through the cellular mem- brane, or contained within the tunica. The anascorous hydrocele is distinguished from the encysted by the general spreading of the tumour, by its comparatively rapid progress; and although it sometimes depends upon a local cause, by its being more usu- ally connected with general dropsy. Anas- corpuscular hydrocele is treated by incision, or punctures; but usually this is not the case, and the dropsical tendency be counteracted by general remedies, much advantage is not to be expected from either.

Hydrocele of the vaginal canal generally first comes on with a sense of fulness about the inferior part of the testicle, which gradually becomes more tense, and rises higher in the body of the testicle: the increase of the swelling sometimes occasions the penis almost to disappear. The tumour throughout is scarcely attended with any pain; it is usually, but not invariably, transparent; its transparencynce and fluctuating feel, indeed, have been a criterion to distinguish this from scrotal hernia; but such distinction is formed with more accuracy by the manner in which the disorder has commenced and proceeded, viz. from below, upwards; the converse is the case with hernia) and by no de- gree of pressure during the swelling to dis- appear.

The tunica vaginalis may be punctured, and the water drawn off as in other species of hydrocele. In the former only a temporary, not a radical cure. The radical treatment consists in not merely evacuating the water from, but causing an irritation be- tween the vaginal and abdominal coats of the testicle, to make them adhere, and thus obliterate the cavity. This is effected by in- cision, by caustic, or by injection; the last of which, recommended by Mr. Earle, is now, on account of its mildness and safety, very generally practised. The water is first drawn off by a trocar passed into the under and fore part of the tumour; the canula of which is still left in the orifice, the operator securing it with one hand, passes the tube of an elastic bag (filled with red wine somewhat diluted) directly through the canula; he then injects the contents of the bag into the cavity, leaves the tube of the instrument, which is provided with a stop-cock, in the canula, by which the injected fluid is regulated. This, after remaining about five or six minutes, is to be taken out, and the fluid suffered to dis- charge itself through the canula.

The wound in the testicle is now to be co- ored with a pledge of lint, and the testicle itself is to be supported in a suspensory band- age, and the patient confined to his bed for some days. After this method of treat- ment, hydrocele is apt to return, but the opera- tion can then be repeated.

The spermatic cord is subject to hydro- cele, both of the anascorous and encysted kind. The latter is sometimes confounded with hernia, but may be distinguished from it by the tumour commencing at some distance down the cord, though it is still above the testicle, which is not the case in the hydrocele of the tunica vaginalis. This swelling may likewise be distinguished from hernia by its not being altered in size from any posture or pressure. When the tumour becomes large, the palliative, or radical cure, as in the va- ginal hydrocele, must be resorted to.

Varicocele is an unusual dilatation of the veins of the testicles. When this affection is slight, the physician, by controlling the use of the spermat- ic cord, may desist from further practice; should it become great, the patient will be relieved by the operation as follows: a small incision is made in front of the testicle, and a small ligature of silk is thereby passed over the spermatic cord, and tied in the manner of a suture.
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left hand, while with his right he introduces it with its concave side turned towards the body; the left hand is now to draw the penis gently forward, and upon the instrument, which is thus gradually inserted into the bladder. If the sound drop immediately upon the stone, the surgeon will feel a tremulous motion. In this, however, he must be careful that he is not deceived. If the instrument is right, as at first introduction, hit upon the stone, it is to be moved in various directions, or the finger may be passed into the anus, or the body of the patient placed in different postures. Even if after these trials, the existence of stone does not appear obvious from sounding, the operation may in a day or two be repeated.

To dissolve stone in the bladder various expedients have been practiced, but with success. All that art has hit upon been able to accomplish, is in some measure to obviate the constitutional tendency towards its production, and nothing appears more effectually to operate in this manner than a long continued use of vegetable or mineral alkali, accompanied by a saline salt. (See Medica et Phar- macy). The pain of stone may sometimes be temporarily relieved by opiates and other antispasmodics, as well as by analgastic tonics.

Of the operation for extracting stone. (Lithotomy). Two methods only of performing this operation are in the present day spoken of: the one, the high; the other, the lateral operation; and, indeed, the former, which consists of making an incision into the bladder above the pubes, is almost entirely laid aside. It cannot be done without wounding the peritoneum, and, consequently, endangering inflammation of this membrane, the mischief from which have been already experienced on. See the section on wounds.

The lateral operation was first performed by Frere Jacques, a French priest. It was practiced and improved by Cheselden, and has recently undergone some alterations.

The patient, properly prepared by laxatives, enemas; &c. without being too much rounded, is directed to lie on his back, with the urine some hours previous to the operation. The periym and neighbouring parts are to be shaved.

A table, a little more than three feet in height, is to be covered with blankets, pillow, &c. upon which the patient is to be laid, and secured in the following manner: Two pieces of broad tape, about five feet long, are to be doubled, and a noose formed upon them, to be passed over the patient's wrists; the patient is then to lay hold of the middle of his foot upon the outside; one end of the tape is to be passed round the hand and foot, and the other round the ankle and hand, and the turns repeated in the reverse way; each hand and foot is then to be tied; the buttocks are to be brought an inch or two over the edge of the table, and by pillows to be raised higher than the shoulders. One pillow should be placed under the patient's head.

The surgeon is now to introduce a grooved staff (fig. 51) through the urethra into the bladder, with this he feels the stone; he then, with the staff, brings it into the right groin, so that its convex part may be felt in the perineum, on the left of the raphe. He then fixes it, and gives it to an assistant, who holding it with his right hand, is to press it gently, until, with his left hand, he raises and supports the scrotum. The operator, now, with great nicety (fig. 52), brings the thighs, makes an incision with a convex-edged scalpel through the skin and cellular texture, immediately below the symphysis pubis, which is just under the scrotum, and where the crus penis and bulb of the urethra meet; and on the left side of the raphe, and in a slanting direction, continues it downwards and outwards to the space between the anus and tuber of the ischium, terminating somewhat lower than the base of that process. As soon as the incisions are thus divided, two fingers of the left hand are to be introduced, with one keeping back the lips of the wound next the raphe, and with the other pressing down the rectum. The surgeon should be particularly careful not to cut the crus of the penis, which can be easily felt and separated with one of the fingers at their under part. The surgeon now makes a second incision about two inches deep, and as low down as possible, first, but rather nearer the raphe and anus. The transversalis penis will by this second incision be divided, and as much of thelevator ani and cellular texture as will make the prostate gland accessible to the finger.

The operator now has a view of the membranous portion of the urethra; he is to seek the groove of the staff with the fore finger of the left hand, the point of which is to be pressed up against the head of the urethra into the prostate gland. It is to be kept there, and turning the edge of the scalpel upwards, he cuts upon the groove of the staff, and divides freely the membranous part of the urethra, from the prostate gland to the bulb, till the staff can be perceived perfectly bare, and the point of the finger admitted.

The prostate and neck of the bladder are now to be divided, which may be done by a scalpel, but the gorget (51) is more usually employed. The membranous part of the urethra being divided, and the fore finger retained in its position, the point of the gorget, previously adapted to the groove, is to be placed, there, on the edge of the finger, which will serve to conduct it into the groove of the staff; to this particular attention is to be given. The operator now rises, takes the staff from the assistant, raises it to nearly a right angle, and presses the convex edge against the symphysis pubis; again satisfies himself that the back of the gorget is in the groove of the staff, and then pushes on the instrument till its point slips from the groove into the bladder; farther than this the gorget is not to be carried, lest the opposite side of the bladder be wounded. The entrance of the gorget into the bladder will be shown by the intermediate discharge of the urine from the wound; the staff is now to be withdrawn, and the finger pushed up along the gorget to search for the stone, that the manner of introducing the forceps may be known; at least that the finger serves to dilate the wound in the bladder. A pair of forceps (fig. 52) are now to be introduced with their blades shut close, and the gorget is then to be drawn slowly away in the same direction in which it entered. The handles of the forceps are now to be depressed till they are completely opened; one blade is to be directed towards the symphysis pubis, when the stone is touched, the blades of the forceps are to be opened and moved in various directions, so as to lay hold of the stone; if the operator find a difficulty in doing this, the forceps may be introduced into the rectum, and the back of the bladder which may lodge the stone, elevated. If the forceps happen to grasp the stone, in a direction inconvenient for its extraction, it should be permitted to fall back, and the operation repeated. The stone should be extracted slowly. When it has broken in the bladder, or is in detached pieces, the scoop (fig. 53) or finger may be introduced to remove the smaller fragments. Sometimes it is necessary to inject the wound with warm water, and raise the patient's body, in order to wash out some of the remaining concretions.

When any considerable artery bleeds, it is, if possible, to be taken up with a ligature; if this cannot be done, pressure is to be made on the wound with a firm roller.

When the operation is over, the pelvis of the patient should be placed lower than the body, in order to preserve the wound in a dependent position, to facilitate the discharge of urine. When the urine has subsided, the bandages are to be united, a piece of dry lint put between the lips of the wound, which is to be often renewed, and the thighs are to be brought together. The patient is then to be laid in a bed, with the pelvis low, a large dose of laudanum given; and when much pain is afterwards complained of in the abdomen, anodynes are to be given by the mouth and by enema, and fomentations, with bland warm water, to be applied to the parts. Sometimes after the operation of lithotomy, the wound will be healed in a month; at other times, even if the operation be successful, the patient will be confined for three or four months.

Incontinence of urine. This may arise from various causes; loss of power in the sphincter of the bladder, irritation about the neck of this organ, laceration of its coats, or pressure from the uterus in advanced stages of pregnancy, are those which may be conceived fully adequate to produce an incontinence or suppression of urine. When a suppression of urine arises from deficient power in the bladder to expel its contents, the catheter (figs. 73 and 79) is to be introduced as the same manner as the sound, in order to draw off the water; in cases likewise of suppression from the pressure of the gravid uterus, the catheter is often employed with much advantage.

When the urine is retained in consequence of irritation and inflammation in the neck of the bladder, the disorder is violent and alarming; it is characterized by the ordinary symptoms of inflammation, attended with an extreme pain and much swelling of the affected parts, so that the catheter cannot be introduced. Treatment: Topical and general; blood-letting, anodyne fomentation, opiates in large dose; injections into the rectum of warm water, warm bath.

When the urine is retained in consequence of irritation and inflammation in the neck of the bladder, the disorder is violent and alarming; it is characterized by the ordinary symptoms of inflammation, attended with an extreme pain and much swelling of the affected parts, so that the catheter cannot be introduced. Treatment: Topical and general; blood-letting, anodyne fomentation, opiates in large dose; injections into the rectum of warm water, warm bath.

The patient is now to be introduced into a warm bath, and by lotions and warm applications to the perineum, the parts about the wound will be brought to a healthy state. When the urine is retained in consequence of irritation and inflammation in the neck of the bladder, the disorder is violent and alarming; it is characterized by the ordinary symptoms of inflammation, attended with an extreme pain and much swelling of the affected parts, so that the catheter cannot be introduced. Treatment: Topical and general; blood-letting, anodyne fomentation, opiates in large dose; injections into the rectum of warm water, warm bath.
Surgery.

about an inch and a half above the pubes directly into the bladder, and withdrawing the stilete to permit the urine to flow through the canula; to this point a cork is to be fitted, so that the urinary discharge may afterwards not be continued, and by drops, but at intervals.

When the puncture is made from the perineum, the trocar must be introduced at a little distance from the raphe perinei, and passed into the bladder, a little to the upper and outer side of the prostate.

Fistula in perineo. A sinusous ulcer in the perineum may be produced by injury in the bladder or in neighboring parts, or may arise from inflammation of these parts, common, venereal, or carcinous. When the complaint is local, it is to be treated by incision in the manner of other fistulous ulcers, and dressed with emollient applications, or with poultices, according to the nature and degree of the inflammation and discharge.

Fistula in ano. This is a sinusous ulcer in or near the rectum. It is called disease of the integumentary or, independent of the gut, while it is at the same time communicates with the gut. When there is no actual communication of the ulcer with the rectum, it is called an incontinence of the tube, or any external opening, the ulcer communicates with the gut, it is termed occult ulcer.

Fistulous ulcers near the rectum, may be produced by any local causes of irritation, they frequently follow upon the inflammation produced by obstinate hemmoroidal affections. Piles, indeed, are perhaps the most common source of fistula in ano. These are to be remedied by laxatives of a bland and oily nature, by sitting over warm water as the best means of softening the parts; and if the pain and swelling are considerable, by the application of leeches upon the tumour: such applications are principally suited to what are termed blind piles. When the disorder is accompanied by a discharge of blood from the anus in an excessive degree, cold and astrigent are to take place of warm and emollient applications, such as solutions of sugar of lead, which application of cold water, while costiveness, even in the case of bleeding piles, is to be carefully guarded against, by laxatives: chaly beets internally will often be attended with much advantage. The fistula ferrea maritini of the London pharmacopoeia, has been given as a preventative of piles, with much apparent benefit. In the treatment of the complaint, it ought always to be examined, whether it acknowledges a local or a general cause, and whether the hemmoroidal disposition depends upon debility, which is often the case, and is then only to be combated by tonic agents.

When an abscess has formed in or about the rectum, and the tumour points externally, a free incision ought to be made into its most depending part, in order to discharge the matter as speedily as possible; the wound is then to be covered with soft linen, upon which is spread some simple ointment; and is to be bandaged. When the parts are much inflamed, a large emollient poultice laid over the dressing.

When the abscess has been permitted to open itself either externally or internally, and has formed a sinus ulcer, which is known by the nature of the discharge, the direction of the sinus or sinuses must be ascertained, by feeling with the finger in the anus; when the course of ascertainment, free incision is to be made along their whole length; the patient is to be placed so that his body shall lean upon a table or a chair; the surgeon is to introduce his finger, previously oiled, into the rectum. A crooked probe-bored history is then to be inserted into the fistula, and pushed against the finger in the rectum; the instrument is now brought downwards, the sphincter of the anus divided, and the sinus thus opened. When the fistula is occult, it is necessary to make an artificial opening, previous to the passing of the bistoury. After the sinus or sinuses have thus been laid open, plettages of lint or soft linen spread with a simple ointment, are to be gently introduted into the wound, and a compress of soft linen applied over the surface, and kept there by bandage. The dressings during the cure are to be often renewed, at least once in twenty-four hours. Abscess will sometimes form slowly in the rectum, and discharge its contents without any fistulous ulcers following. In these cases, after the discharge of the matter, much advantage is often found by the use, for some time, of astrigent and deducting injections, such as of lime-water: which the patient himself, by means of a syringe contrived for the purpose, may use with ease and safety inject.

Explanation of the Plates.

Fig. 1. A lancet and canula for discharging the contents of an abscess by means of a seton.

Fig. 2. A director for guiding the knife in discharging the contents of an abscess, &c.

Fig. 3. A pair of forceps for extracting polypi.

Fig. 4. A flat probe for conducting a ligature to the root of a polypus.

Fig. 5. A ring probe for assisting in securing a ligature upon the root of a polypus.

Fig. 6. A double canula for fixing a ligature upon the root of a polypus.

Fig. 7. A bandage for making compression after performing the operation of arteriomy on the temples.

Fig. 8. A seton needle.

Fig. 9. a, b, Two pins of different forms used in the twisted or harelip suture. The first commonly made of silver, with a movable steel point; the other of gold.

Fig. 10. The tourniquet most generally used.

Fig. 11. The tenaculum used in drawing out the mouth of bleeding vessels for the purpose of securing them by ligature.

Fig. 12. A blunted-pointed bistoury.

Fig. 13. A raspatory for removing the pericranium in the operation of the trepan.

Fig. 14. The trephine, with all its parts connected and ready for use. a, The centre-pin, which can be raised or depressed by the slider b. c, The part where the saw is united to the handle by means of the spring d.

Fig. 15. A brush for cleaning teeth of the saw.

Fig. 16. Forceps for removing the piece of bone when nearly cut through by the trephine or the trepan.

Fig. 17. A levator also employed in removing the piece of bone.

Fig. 18. A lenticular for smoothing the ragged edge of the perforated bone.

Fig. 19. A speculum used for keeping the eye-lids separated, and the eye fixed, in performing various operations upon that organ.

Fig. 20. A flat curved hook for elevating the upper eye-lid, and fixing the eye, in performing various minute operations upon its surface.

Fig. 21. A coughing-needle.

Fig. 22. A coughing-needle for the right eye, fitted for the operator's right hand.

Fig. 23. A knife for extracting the cata-

Fig. 24. A flat probe for scratching the capsule in extracting the crystalline lens.

Fig. 25. A flat probe or scoop for assisting in removing a cataract.

Fig. 26. A knife for extracting the cata-

Fig. 27. One of Anel's probes for removing obstructions of the lachrymal ducts.

Fig. 28. A syringe and pipe (by the same) for injecting a liquid into the lachrymal ducts.

Fig. 29. A crooked pipe which fits the syringe.

Fig. 30. A trocar and canula for perforating the os unguis in the operation for the lachrymal duct.

Figs. 31, 32, 33. Instruments employed by Mr. Pelletier in the operation for fistula lachrymalis. Fig. 31. A conductor for clearing the nasal duct. Fig. 32. A conical tube to be left in the duct. Fig. 33. A compressor for fixing the tube in its place.

Fig. 34. A trocar for making an artificial parotid duct.

Fig. 35. Pins used in the operation for hare-lip, represented as they are usually inserted into the part.

Fig. 36. A gun-correct.

Fig. 37. A trocar for perforating the antrum maxillare.

Fig. 38. Mr. Cheselden's needle, with an eye near the point, for tying a knot on scrinous tinnitus.

Fig. 39. An instrument for perforating the lobes of the ear.

Fig. 40. An instrument recommended by Mr. B. Bell for supporting the head after the operation for very sick.

Fig. 41. An instrument invented by Dr. Moaro for fixing the canula after the operation of bronchootomy.

Fig. 42. A spring-truss for an inguinal or femoral hernia of one side only.

Fig. 43. A silver canula for carrying off pus collected in the thorax.

Fig. 44. A spring-truss for an umbilical hernia.

Fig. 45. A spring-truss for an inguinal or femoral hernia existing on both sides.

Fig. 46. Mr. Andre's trocar for evacuating the contents of an encysted hydrocele.

Fig. 47. Mr. B. Bell's trocar for operating in the hydrocele.

Fig. 48. A bag of resin elastica, with a stop-cock and short pipe, which fits the canula of the trocars figs. 77, 78, for the purpose of injecting the cavity of the tunica vajinalis, in the case of hydrocele.

Fig. 49. A straight-edged bistoury, sharpened.

Fig. 50. A sound used in searching for the stone.

Fig. 51. A grooved staff for the operation of lithotomy.
SURVEYING OF LAND. Surveying, or the measurement of the surface of the earth, is by some supposed to have had its origin in Egypt, and that, more especially, on the banks of the Nile; the inundations of which are said to have obscured the landmarks which the stock-owners yearly made between their neighbours' properties and their own; and to avoid this annual inconvenience, it was found necessary to devise some plans of form and dimensions which they could employ after every inundation. Such was the opinion of Herodotus, Proclus, and others, who have continued to the present age, but it is not our intention to justify such opinion, and we are rather disposed to countenance a position laid down by a modern traveller (Mr. Brown) who has spent much time on the borders of the Nile. He tells us, in Upper Egypt the river is confined by high banks, which prevent any inundation of the adjacent country: and so it is, whose angles, except at the extremities of the Delta, where the water of the Nile is never more than a few feet below the surface of the land, and where, of course, the inundations take place; here, however, the country is, as may be expected, without inhabitants. But wherever the origin of this science may have been, the usefulness thereof is, now-days, well known and appreciated.

Geometry is the foundation of land-measuring; and we shall proceed to the most practical rules for finding the areas of such geometrical figures as occur in surveying.

Square. The area of this figure is found by squaring the length of either of its sides, or, by multiplying the base by its perpendicular; as in Pl. XVII. Fig. 1, AB is therefore the area. So also, AB x BC = the area.

Parallelogram, rectangle. The area hereof is found by multiplying the length by the breadth; as AB x AD = the area. See fig. 2.

Rhombus, or Rhomboids. Multiply the base by the perpendicular height; thus, in fig. 3, AB x ED = the area.

Also, when two sides and their included angle are given, the product of those sides multiplied by the natural sine of the angle = area; that is, AB x AC x sin B = area.

* * * The angles of a regular rhombus are each 60°; those of a rhomboids may be more or less.

Triangle. Multiply the base by a perpendicular derived from the opposite angle; half the product is the area; \[ \frac{ab \times s}{2} = \text{area.} \] (Fig. 4.)

Also, when all the sides are given, from half the sum of the three sides subtract each side severally; multiply the half sum and the three remainders continually together, and square-root of the last product will be the area; that is, \[ \sqrt{\frac{ab + c + d + e}{2} \times \frac{ab + c + d - e}{2} \times \frac{ab + d + e - c}{2} \times \frac{c + d + e - a}{2}} = \text{area.} \] (Fig. 5.)

Trapezium. Divide it into two parts by a diagonal line; demit perpendiculars from the other angles. Multiply the diagonal by the sum of the two perpendiculars; half the product = area; (fig. 6.)

Or, when it can be inscribed in a circle, and the sides are given; from half the sum of the sides subtract each side severally; multiply the four remainders continually together, and the square-root of the last product will be = area; (fig. 7.)

\[ \sqrt{\frac{a + b + c + d}{2} \times \frac{a + b + c - d}{2} \times \frac{a + c + d - b}{2} \times \frac{b + c + d - a}{2}} = \text{area.} \] (fig. 8.)

Regular Polygons. When a side and a perpendicular deduced from the centre are given, half the perimeter multiplied by the perpendicular = area; (fig. 9.)

\[ \frac{ab + ac + bc}{2} \times G = \text{area.} \] (fig. 10.)

When only a side is given, the square of the side multiplied by the tabular number or multiplier below = area.

That is, \( AB \times \text{tab. num.} = \text{area.} \)

POLYGON TABLE.

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<td>12</td>
<td>Duodecagon</td>
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</tr>
</tbody>
</table>

Circle. The square of the diameter multiplied by 7854 = area; (fig. 10.) i.e. \( AB^2 \times 7854 = \)
To reduce the statute measure to either of the customary measures, the following rules will apply:—first, if the customary measure is smaller than the statute, as the Devonshire for instance, say, the square of 15 is the number of statute acres, so is the square of 16.5 to the number of customary acres; secondly, if the customary measure, as the Cheshire for instance, say, as the square of 24 is to an acre, or number of acres, so is the square of 14 to the number of acres customary.

Before a measurer begins his work in the field, he should consider what lines are necessary to be measured, and the lines to be obtained for the content; taking such as the least walking forward and backward.

Having carefully measured such lines as will reduce the field to some of the simplest figures, before-mentioned, with such of their measuring lines as may be necessary, he will be enabled to find the content of each part, by the rules laid down in the former part of this article.

We would observe, that a measurer may divide the same field different ways, and obtain the content thereof by each. For instance, the field ABCDE (fig. 15), may be divided into a trapezium ADBC, and a triangle ADE.

Or, it may be divided into four triangles, as in fig. 15.

It may also be divided into six triangles, AEs, DAs, CAs, and Bed, and two trapezoids DDe, and BAs; as in fig. 16.

The calculations for the quantity of land in the same field, by the four respective methods of taking the dimensions, will stand as follow:

Fig. 14.

Trapezium ADBC = \( \frac{2}{2} \) \( \frac{2}{2} \) = 420000

Triangle ADB = \( \frac{a}{2} \) \( \frac{a}{2} \) =

\( \frac{780 \times 231}{2} \) = 97800

\( \frac{9.3756}{11.24} \) 9.3756

5 acr. 2 rds. 11 perches, as before.

Fig. 15.

Trapezium ADBC = \( \frac{2}{2} \) \( \frac{2}{2} \) \( \frac{2}{2} \) = 694400

Triangle ADB = \( \frac{a}{2} \) \( \frac{a}{2} \) =

\( \frac{1020 \times 470}{2} \) = 47900

\( \frac{2.1118940}{5.66990} \) 2.1118940

5 acr. 2 rds. 11 perches, as before.

The calculations for the quantity of land in the same field, by the four respective methods of taking the dimensions, will stand as follow:

Fig. 16.

Triangle AEs = \( \frac{2}{2} \) \( \frac{2}{2} \) = 48600

Triangle EDAs = \( \frac{2}{2} \) \( \frac{2}{2} \) = 148500

Triangle CDAs = \( \frac{2}{2} \) \( \frac{2}{2} \) = 23000

Triangle Bed = \( \frac{2}{2} \) \( \frac{2}{2} \) = 19200

Trapezoid DDe = \( \frac{2}{2} \) \( \frac{2}{2} \) = 241000

Trapezoid ADe = \( \frac{2}{2} \) \( \frac{2}{2} \) = 574480

\( \frac{11.118890}{3.66990} \) 11.118890

5 acr. 2 rds. 11 perches, as before.

We have hereunto confined our consideration to such figures only, whose sides are straight lines of considerable length; but, as the general boundaries of many pieces of land consist of short indentations, it is necessary to avoid the tediousness of computing the contents of a multitude of small triangles and trapezoids; to find such equalizing lines as shall constitute a triangle, or other figure, of equal area with the sum of all such triangles and trapezoids combined.

Suppose, then, that an irregular boundary of a field is of the form of fig. 18, composed of two triangles and four trapezoids.

Draw the line AB, and at A erect a perpendicular—Lay a parallel line from A to the third point. Move the upper part of the rule to the line AB, and note where it cuts the perpendicular, as at 4. From this point 1, divide the line into four equal parts, and mark the perpendicular at 2—From 2 draw the line AB, and raise it to 3, and mark the perpendicular at 4—From this point lay the rule to the line AB, and raise it to 5, and mark the perpendicular at 6. From 6 draw the line AB, and the triangle A5B, be equal in area to the aggregate of the two triangles and four trapezoids.

Examples.

Suppose that, on some well graduated scale, the base of the triangle A5B, was found to be 185, and perpendicular, 8, 110; the base, 8, of the adjoining trapezoid 250, and sum of its perpendiculas 103; the base, 4, of the next trapezoid is 120, and its perpendiculars 180; the base 6, and the perpendiculars of that trapezoid 100; the base of the next trapezoid, and the perpendiculars thereof 94; the base of the latter triangle, 15, and its perpendicular, 99; and that the content of the whole is required.

Suppose also, the content of the triangle ABC, whose base, 4, by the same scale, is 180, and perpendicular AC, 258, is required.
SURVEYING.

First. The double of the

Triangle
Base \(= 185 \, \text{X} \, 110 \) = 20550
Trapezoid \( = 290 \, \text{X} \, 160 \) = 46000
Do. \( = 120 \, \text{X} \, 120 \) = 14400
Do. \( = 395 \, \text{X} \, 190 \) = 71550
Do. \( = 300 \, \text{X} \, 349 \) = 104700
Triangle \( = 630 \, \text{X} \, 289 \) = 182070
\[ 20550 + 46000 + 14400 + 71550 + 104700 + 182070 = 383070 \]
\[ 2 \times 383070 = 766140 \]
Content, 2 ac. 0 rds. 24 perches. 245760

Second. The double of the triangle

\[ \text{ABC} = \text{AB} \times \text{AC} = 1810 \, \text{X} \, 385 = 430730 \]
\[ 2 \times 430730 = 861460 \]

Content, 2 ac. 0 rds. 24 perches, as before.

From whence it appears, that the content of the new triangle is the same as the aggregate contents of all the original triangles and trapezoids, to within the decimal of a perch.

In working with a chain and its offsets staff, a measurer does well in making a rough sketch in his field-book, large enough to admit of his writing down the lengths of all the necessary lines, whether for planning, or for casting off the content without a plan.

Where there is a general base line, with several perpendiculars raised thereon, it may be best to continue the receding throughout that line, and, by subtraction, find the intermediate distances between one perpendicular and another.

Example. Suppose from the sketch and dimensions of fig. 19, a true plan and the content of the field were required.

Beginning at A, draw a line to the tree at the upper end, and thereon prick off the distances, as in the sketch.

At the proper points erect the perpendiculars, according to their respective lengths; and the true figure will be as fig. 19. The whole content may be found, by seeking the separate content of each triangle and trapezoid, from the dimensions given in fig. 19, thus:

The double content of the triangle \( \text{a} \, \text{b} \, \text{c} \)
\[ 330 \, \text{X} \, 100 \] = 33000
The double content of the triangle \( \text{d} \, \text{c} \, \text{e} \)
\[ 2 \, \text{X} \, 500 \] = 10000
\[ 5 \, \text{X} \, 600 \] = 30000
\[ 3 \times 10000 = 30000 \]

The double content of the triangle AB\( \text{cd} \)
\[ 4 \, \text{X} \, 289 \] = 1156

The double content of the triangle B\( \text{d} \)C
\[ 3 \times 300 = 900 \]

The content 6 ac. 2 rds. 21 perches. 21428

Hitherto we have supposed all the measurements to be taken within the fields; but a measurer may sometimes use fields so circumstances, by woody ground, meres of water, &c, as not to admit of the necessary internal lines being taken. Such pieces of land may, however, be measured, by taking surrounding lines, making one or more right angles with each other, and raising perpendiculars from those lines to the angular points of the fields; by which a true plan may be constructed, and from thence the content found, either by equalizing the sides by the parallel ruler, or by deducting the contents of the small parts with, from the general content of the trapezium or surrounding figure: see fig. 21.

Example. A plan of the piece of woody ground

\[ = \text{the aggregate of all the small trapezoids; which taken from 824613 (the content of the surrounding trapezium), leaves 566410, = 5 } \text{acres, } 80 \text{perches, the content, as before.} \]

Thus far we have applied ourselves to single fields only, but we will now proceed to the measuring of two or more, lying contiguous to each other.

Example. From the dimensions given in the sketch, fig. 28, the contents of the fields A and B are required.

Field A \( = 620 \times 290 \times 1000 \)

\[ 2 \times 620 \times 290 \times 1000 = 4320000 \]

Field A \( = 185000 = 1 \text{acre}, 3 \text{rods, } 16 \text{perches, for the measure thereof.} \)

Field B \( = 740 \times 500 \)

\[ 2 \times 740 \times 500 = 370000 \]

The estate, fig. 21, may be measured by a general line, with normals erected thereon, in manner following: viz.

Beginning at the southern end, a measurer takes his principal line from A towards the tree on the northern limits of his work; and at every necessary point in that line, he sets off such perpendiculars as will lead him to the corners of each field, as in the figure. The dimensions taken in each field being as here given, the content of each may be found in manner following:

DIMENSIONS TAKEN.

<table>
<thead>
<tr>
<th>Base</th>
<th>Normals</th>
<th>Operations</th>
<th>Areas</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Aa</td>
<td>( a \times 790 \times 25 )</td>
<td>= 19750</td>
<td>19750</td>
</tr>
<tr>
<td>2 Aa</td>
<td>( a \times 790 \times 80 )</td>
<td>= 205000</td>
<td>205000</td>
</tr>
<tr>
<td>3 Aa</td>
<td>( a \times 790 \times 1500 )</td>
<td>= 1185000</td>
<td>1185000</td>
</tr>
<tr>
<td>4 Aa</td>
<td>( a \times 790 \times 12000 )</td>
<td>= 7980000</td>
<td>7980000</td>
</tr>
<tr>
<td>5 Aa</td>
<td>( a \times 760 \times 600 )</td>
<td>= 456000</td>
<td>456000</td>
</tr>
</tbody>
</table>

\[ 2 \times 19750 = 39500 \]
\[ 2 \times 205000 = 410000 \]
\[ 2 \times 1185000 = 2370000 \]
\[ 2 \times 7980000 = 15960000 \]
\[ 2 \times 456000 = 912000 \]

\[ 2 \times 39500 + 410000 + 2370000 + 15960000 + 912000 = 19855000 \]

\[ = \text{the aggregate of all the small trapezoids; which taken from 824613 (the content of the surrounding trapezium), leaves 566410, = 5 } \text{acres, } 80 \text{perches, the content, as before.} \]

Thus far we have applied ourselves to single fields only, but we will now proceed to the measuring of two or more, lying contiguous to each other.

Example. From the dimensions given in the sketch, fig. 28, the contents of the fields A and B are required.

Field A \( = 620 \times 290 \times 1000 \)

\[ 2 \times 620 \times 290 \times 1000 = 4320000 \]

Field B \( = 740 \times 500 \)

\[ 2 \times 740 \times 500 = 370000 \]

The estate, fig. 21, may be measured by a general line, with normals erected thereon, in manner following: viz.

Beginning at the southern end, a measurer takes his principal line from A towards the tree on the northern limits of his work; and at every necessary point in that line, he sets off such perpendiculars as will lead him to the corners of each field, as in the figure. The dimensions taken in each field being as here given, the content of each may be found in manner following:

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<td>19750</td>
</tr>
<tr>
<td>2 Aa</td>
<td>( a \times 790 \times 80 )</td>
<td>= 205000</td>
<td>205000</td>
</tr>
<tr>
<td>3 Aa</td>
<td>( a \times 790 \times 1500 )</td>
<td>= 1185000</td>
<td>1185000</td>
</tr>
<tr>
<td>4 Aa</td>
<td>( a \times 790 \times 12000 )</td>
<td>= 7980000</td>
<td>7980000</td>
</tr>
<tr>
<td>5 Aa</td>
<td>( a \times 760 \times 600 )</td>
<td>= 456000</td>
<td>456000</td>
</tr>
</tbody>
</table>

\[ 2 \times 19750 = 39500 \]
\[ 2 \times 205000 = 410000 \]
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\[ 2 \times 456000 = 912000 \]

\[ 2 \times 39500 + 410000 + 2370000 + 15960000 + 912000 = 19855000 \]

\[ = \text{the aggregate of all the small trapezoids; which taken from 824613 (the content of the surrounding trapezium), leaves 566410, = 5 } \text{acres, } 80 \text{perches, the content, as before.} \]
### SURVEYING.

<table>
<thead>
<tr>
<th>IV.</th>
<th>$c + f = 490 \times 1570 = 785500$</th>
</tr>
</thead>
<tbody>
<tr>
<td>V.</td>
<td>$c = 780 \times 53 = 40990$</td>
</tr>
<tr>
<td>VI.</td>
<td>$d = 310 \times 23 = 7130$</td>
</tr>
<tr>
<td>VII.</td>
<td>$de = 320 \times 1010 = 322000$</td>
</tr>
<tr>
<td>VIII.</td>
<td>$ef = 315 \times 70 = 22050$</td>
</tr>
<tr>
<td>IX.</td>
<td>$fp = 370 \times 70 = 26900$</td>
</tr>
<tr>
<td>X.</td>
<td>$xz = 230 \times 200 = 46000$</td>
</tr>
<tr>
<td>XI.</td>
<td>$zz = 300 \times 270 = 81000$</td>
</tr>
<tr>
<td>XII.</td>
<td>$zt = 40 \times 200 = 8000$</td>
</tr>
<tr>
<td>XIII.</td>
<td>$st = 210 \times 150 = 31500$</td>
</tr>
</tbody>
</table>

The plan of the estate being obtained by these dimensions, or for lines must now be drawn in each field, dividing it into such geometrical figures as will most readily give the content; as in fig. 26.

By dividing the fields as before directed, the content of each may be found as follows:

#### HOME PADDOCK. Double areas.

<table>
<thead>
<tr>
<th>Triangle</th>
<th>$a = 1590 \times 315 = 364000$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Do.</td>
<td>$b = 630 \times 565 = 353950$</td>
</tr>
<tr>
<td>Trapezoid</td>
<td>$c = 270 \times 563 + 250 = 217530$</td>
</tr>
<tr>
<td>Triangle</td>
<td>$d = 140 \times 250 = 35200$</td>
</tr>
</tbody>
</table>

#### RIVER MEAD.

| Trapezoid | $e = 680 \times 250 + 150 = 229500$ |

#### THE GARDEN.

| Trapezoid | $f = 710 \times 140 = 121400$ |

#### THE PLANE TABLE.

Land-measuring may, in some instances, be expedited by instruments which set off lines in their relative positions, and the angles of their intersection; one of these - the convenient instruments for these purposes, are the Plane-table and the Theodolite.

The Plane-table is composed of a smooth rectangular board, commonly of about 15 inches by 12; around which is a frame, that not only serves to keep the paper smooth on which the plan is to be drawn, but, being graduated into degrees, answering to a central point in the board, the angular bearing of any two lines, issuing from the station where the instrument is placed, may readily be ascertained; or the angle itself may be drawn on the paper. — A magnetic needle and compass-box is fixed to one side of the board, which serves to point out the bearing of any line to the magnetic meridian. — There is also, a brass index-rod, having sundry scales thereon, and also perpendicular sights at the end used herewith. The whole is supported on a three-legged stand, &c. movable on a brass ball and socket.

A land-measurer having planted his Plane-table at A, one of the inner angles of the field ABCDE, fig. 27, and from some assumed point on the paper (which may be considered as his station-point on the land) directed his sight along the boundary to B, and also to C, to D, and to E, and, by measuring these lines on the ground, finding them to be as follows, viz.: AB = 665, AC = 895, AD = 1635, and AE = 580; he may make a correct plan of the field and from thence, by dividing the other lines on the plan, as herefore directed, he may calculate the content thereof.

If the other sides of the same field, viz. BC, CD, and DE, &c. (fig. 27), had been measured, either on the ground, or on the plot, the content may be found by Rule 2, for the triangle.

A measure may take his observations from a point above the middle of a field, as at A (fig. 28), and take his angles of bearing to all the corners of the field, and measure the links to each corner, and from thence find the content for, suppose the $Z. BAC = 105^\circ$.

And that the line $AC = 1700$.

#### THE THEODOLITE.

The Theodolite is a circular instrument made of brass, graduated into degrees, &c. on which is an index-limb for taking horizontal angles, surmounted with an arch for vertical angles, and a telescopic sight. It has, usually, spirit-levels to adjust it by; and a compass, with angular scales, checking the bearings by the limb: the whole placed on three legs, and a ball and socket, or half-ball and parallel plates, to set it level.

In all cases of land-measuring, where angles are required to be taken, whether horizontal or vertical, no instrument is so well adapted thereto as the theodolite; its accuracy and dispatch for exceeding all other instruments used for that purpose, especially on large estates, where varieties of boundary, as well as inequality of surface, are met with.

In a single piece of land, the angular observations may all be made from one spot in a field.

In this case, the theodolite being set at the station A, fig. 31, and properly adjusted (as hereafter described), the first observation to the picket-staff at a, was $62^\circ$, from the north towards the east, and the length of the line $AA = 660$ links.

The second observation, to $b$, between the south and east, was $158^\circ$, and the length of the line $AB = 260$ links.

The third, to $c$, between the south and west, was $200^\circ$, the length 750.

And the fourth observation, to $d$, from the north towards the west, $293^\circ$, with the length 539.

From hence, with the help of a protractor, the plan may be drawn.

It is evident, that if from the observation $I$, the plan is to be constructed, the lines as described in fig. 27, to $B$, $C$, $D$, &c. shall be drawn, and the work of the theodolite be reduced to the measurement of these lines in the actual ground. It is evident, further, that the other parts of the field may be measured as above.
SURVEYING.

that of $a$ is subtended, the $\angle aAB$ will be found as $30^\circ$.

That if from the observation of $a$, that of $b$ is subtended, the $\angle aAB$ will be found $= 48^\circ$.

And also, that if the circular complement of the observation $a$ (which is $360^\circ - 320^\circ = 30^\circ 10'$) is added to the observation $a$, the $\angle aAB$ will be found as $39^\circ 20'$.

The whole together making (as it ought) the complete circle $360^\circ$.

The content may now be computed by Rule 3.

A measure may take the angle at each corner of a piece of ground, and measure the sides as he goes on, thus:—having set the needle to its $320^\circ$, and the limb to its $360^\circ$, he found by observation at $\Theta 1$, that looking to his picket at $\Theta 2$, the limb cut $310^\circ$ from the north towards the west, and his needle $129^\circ$.—At $\Theta 2$, having directed the theodolite to the back station, his observation forward was, on the limb, $45^\circ 30'$; from south to west, and on the needle $45^\circ 30'$ also.

At $\Theta 3$, the limb was at $185^\circ$ from south to east; he need not move his needle for insetting the angular observations, and the progressive distances from station to station, and then he will find his bearings (to set off with the then left side) such short lines as the flexures or angles of boundaries may require.

The sides of the page are employed in noting down such offsets and remarks, on either hand, as may be found necessary, and also in making sketches of side boundaries, where any deviations from a straight line occur. Far the more readily sketching such side boundaries, it is necessary to begin at the bottom of the page, and write upwards.

In order to exemplify the mode of practice with this excellent instrument, we will take the estate, fig. 33, and suppose the measurer to plant his instrument in the road at $\Theta 1$, and employing it, by bearing the head thereof truly horizontal by the spirit levels and adjusting screws; and setting the index part of the limb exactly at $390^\circ$, by moving the whole head about until the $360$ in the compass-box comes to the line in the north end of the needle, the instrument will thus be completely adjusted: here he is to lock all fast by the screw under the head of the legs.

The instrument thus adjusted, the measurer sends one of his assistants forward, as far as he can conveniently measure a straight line, as at $\Theta 2$. After lining then his angle of observation by his telescope, he finds it to be $69^\circ$ from the north towards the east, which he enters in his field-book, noting it with N.E. as a memorandum on which side of the meridians. He must now fix his limb to the other part of the head, by a screw for that purpose. His chain-men having laid the line in a direction to the picket at $\Theta 2$, the instrument next line the cross head across such offsets to the right and left as may be necessary.

At his station he finds, by measuring, on the paper, in pencilled figures, that he has the general line of the road; at $30^\circ$ and also a corner of $40$ links more, and $300$ broad: on the left of his station he has an offset of $10$ links. The chain-men proceeding on their line to $300$, he finds $d$ on the right to be the breadth on that side of the road, where is a gate, and $30^\circ$; which will determine the breadth of the road at that spot. At $400$ he will find $10$ on the right, and $20$ on the left, to be the breadth. At $700$ (the end of that line) he will find $100$ on the left, and $15$ on the right, to be the breadth; where also he will find a small road branch off to the right. Thus is the first station completed, and the cross head on the. 

To this spot (which is his second station) he brings his theodolite, and after setting it level, unlocks the under screw and turns the whole head about, through the telescope, behaves the back picket or station-staff. Here again, locking the head of his theodolite, he must unscrew the limb, and turn it about until, through the telescope, he has a view of the picket at $\Theta 9$; the angle to which he will find to be $55^\circ 10'$ from the north to the eastward, which he will enter in his field-book. Measuring on $\Theta 9$ is a bearing of the fence, and the theodolite, he has a view of the picket at $\Theta 9$; the angle to which he will find to be $25^\circ 10'$ from the north to the eastward, which he also enters in his field-book.

Supposing the lines were found to be $1000$ links, $400$ links, $160$ links, and $200$ links, the plan may be made, and the content found by the scale.

In extensive concerns, where all the fields in an estate are to be measured, the same method with suitable instruments must be taken with the theodolite, and the proceedings carefully noted down in the field-book, the pages of which are divided into three parts of an inch column being for insetting the angular observations, and the progressive distances from station to station, and then he will find his bearings (to set off with the then left side) such short lines as the flexures or angles of boundaries may require.

The sides of the page are employed in noting down such offsets and remarks, on either hand, as may be found necessary, and also in making sketches of side boundaries, where any deviations from a straight line occur. Far the more readily sketching such side boundaries, it is necessary to begin at the bottom of the page, and write upwards.

In the field-book for the quantity of the $\angle \Theta 3$, which, in the present case, is stated to be $69^\circ 0'$ north-westly. Look for this degree, on the circular edge of the protractor, and on the paper make a mark, with a fine pencil, running parallel to the base line.

On the left of the field-book for the $\angle \Theta 3$, which, in this case, is $25^\circ 10'$, where there is a mark, as before.

Thus do with all the other $\angle s$, until you come to the one nearest the eastward, and make a mark to close on some former part of the work.

All the angles being thus prick'd off, remove the protractor.

Consider wherefrom the beginning of the work should be pricked, so that the whole may come within the compass of the paper laid down; and there make a mark, noting it as $\Theta 1$, the beginning of the plot.

Lay down the parallel ruler from the central point where the protractor lay, to the mark on the pencilled circle denoted $\Theta 1$. Move the fore edge of the parallel ruler until it touches the point determined on for the beginning of the plot.—From thence draw an oblique or diagonal line (as mentioned, i.e. in this case, from the north to the eastward) about the length of the whole line of this $\angle$, drawn across the line of the plot, and back to the point on the compass circle denoted $\Theta 1$, as shown in the field-book, note that on the line marked at $10$ links, is the boundary-line of that side, where also is a
SUS, hog, a genus of quadrupeds, of the order Blumin. The generic character is, front teeth in the upper jaw four, converging, in the lower jaw six; projecting canine teeth, or tusks, in the upper jaw two, rather short; in the lower jaw two, long, exserted; snout truncate, prominent, movable; feet calve. The genus is in points of some an ambiguous nature, being allied to the porca, by its cloven hoofs, and to the fera, in some degree, by its teeth; yet differing widely from both in many respects. The internal structure of the feet also approaches to that of the digitated quadrupeds, while that of some other parts is peculiar to this genus alone. It may, therefore, be allowed to form at once a link between the cloven-footed, the whole hoofed, and the digitated quadrupeds.

1. Sus scrofa, common hog. The wild boar, the stock or original of the common hog, is a native of almost all the temperate parts of both Europe and Asia, and is also found in the upper parts of Africa. It is a stranger to the arctic regions, and is not indigenous to South America.

The wild boar inhabits woods, living on various kinds of vegetables, viz., roots, mast, acorns, &c. &c. It also occasionally devours animal food. It is, in general, considerably smaller than the domestic hog, and is of a dark brindled grey colour, sometimes blackish; but when only a year or two old, is of a pale rufous or dull yellowish brown cast; and when quite young, is marked by alternate dusky and white stripes disposed longitudinally on each side the body. Between the bristles, next the skin, is a finer or softer hair, of a kind of woolly or curly nature. The snout is somewhat longer in proportion than that of the domestic animal; but the principal difference is in the superior length and size of the tusks, which are often several inches long, and are capable of inflicting the most severe and fatal wounds.

The hunting of the wild boar forms one of the amusements of the great in some parts of Germany. Pork hunters will undertake a chase of some difficulty and danger; not on account of the swiftness, but the ferocity of the animal.

As the wild boar advances in age, after the period of two or four years, he becomes less dangerous, on account of the value of his tusks, which turn up, or make so large a curve or flexure, as often to render it impossible to thrust his tusks to the wound.

To describe particularly the common or domestic hog would be superfluous. It may be sufficient to observe, that this animal principally differs from the wild boar, in having smaller tusks, and larger ears, which are also somewhat pendant, and of a more pointed form. Of all quadrupeds the hog is the most graceful in his manners, and has therefore been properly uniformly considered in all nations as the emblem of iniquity. The Jews were strictly enjoined not to cut its flesh; and in many parts of the world, a similar prohibition is still in force; since the Mahometans agree in this respect with the Mosiac institution. In most parts of Europe, on the contrary, it constitutes a principal part of the food of mankind. This animal is of a remarkably prolific nature, and is sometimes known to produce as many as twenty at a birth.

The hog was unknown in America, on the discovery of that continent; but since its introduction, appears to flourish there as much as in the old world. The varieties into which the hog occasionally runs, chiefly relate to the colour and form of its ears. The so-called Chinese hog is of a very small size, with a pendulous belly: its colour is commonly black, and the skin often nearly bare, or less hairy than in the European kinds.

The variety called the Guinea hog is distinguished by having a smaller head than the common hog, with longer, slenderer ears, and naked tail reaching to the ground. Its colour is rufous, and its hair shorter, and finer than in other kinds. It is said to be most common in Guinea, and is considered by Linnaeus as a distinct species, under the title of Sus porcus.

But the most remarkable variety of the hog is that in which the hocks are entire and undivided. This is a mere accidental variety, which, is, however, observed to be more common in some countries than in others, and is according to Linnaeus, not unfrequent in the neighbourhood of Upsal in Sweden. It has been noticed by Aristotle and Pliny, and is said by the former to have been most common in Iliyria and Paroia.

The age of the domestic hog is said to extend from fifteen to twenty-five years, or even more.

2. Sus Ethliopicus, Athiopian hog. This animal is very much allied in its general appearance to the common hog, but is distinguished by a pair of large, flat, semicircular lobes or waffles, placed beneath the eyes: the snout is also of a much broader form, and is very strong and callous; its ears are large, and very slightly pointed: the tusks in the lower jaw are rather small; but those in the upper jaw are large, sharp, curved, and in the old animal bend upwards in a semicircular manner towards the forehead: there are no fore teeth; their place being supplied by very hard gums: the skin of the face, immediately below the eyes, or above the broad lobes before mentioned, is loose and wrinkled, and on each side the mouth is a callous protuberance. The body is of a strong form: the tail slender, slightly flattened, and thinly covered with scattered hairs. The general color of the whole animal is dusky or black.

This species is a native of the hotter parts of Africa, occurring from Sierra Leone to Congo, and to within about two hundred leagues of the Cape of Good Hope. It also occurs in the island of Madagascar.

It is a fierce and dangerous animal, and is said to reside principally in subterraneous recesses which it digs with its nose and hoofs. When attacked or pursued, it rushes on its adversary with great force; and strikes, like the common boar, with its tusks, which are capable of inflicting the most tremendous wounds.

3. Sus Africanus, Cape Virgin hog. The Cape Virgin hog has been generally confounded with the former species; but which, however, it appears to differ very considerably in having a head of a much longer and slenderer form, with the upper jaw extending beyond the lower. In the upper jaw are also two or three cutting teeth, and the lower tusks are very large and thick, but those of the former jaw much larger than those of the upper. The ears are rather narrow, pointed, and tufted.

SURVIVORSHIP. See LIFE ANNUL.
with long bristles or hairs: the whole body is also covered with long, weak, or fine bristles, of which those on the shoulders, belly, and thighs, are much longer than on other parts: the tail is tufted, and terminates in a long tuft of thick black hair. The color of the hair is a palish brown. Its general size is that of a common hog, but it is said sometimes to be found far larger. It is a native of Africa, extending from Cape Verde to the Cape of Good Hope. See Plate Nat. Hist. fig. 333.

4. Sus babouria. The babouria is nearly of the size of a common hog, but of a somewhat longer form, and with more slender limbs, and is covered, instead of bristles, with fine, short, and somewhat woolly hair, of a deep-brown or blackish color, interpersed with a few bristles on the upper and hinder part of the back. It is also distinguished by the very extraordinary position and form of the upper tusks, which, instead of being situated in the front, on the edge of the jaws, as in other animals, are placed externally, perforating the skin of the snout, and turning upward toward the forehead; and as the animal advances in age, become so extremely long and strong that the forehead continues to curve downward by which means they must of necessity lose their power as offensive weapons: the tusks of the lower jaw are formed as in the rest of the genus, and are very long, sharp, and curved; but not of equal magnitude with those of the upper. The upper tusks are of a fine hard grain, like that of ivory: the eyes are small; the ears somewhat erect, and pointed; the tail long, thick, and tufted, at the head with long hairs.

The babouria is a gregarious animal, and is found in large herds in many parts of Java, Ambonea, and some other Indian islands. Their food is entirely of a vegetable nature, and they often feed on the leaves of trees. When sleeping or resting themselves in a standing posture, they are said often to hook or support themselves by placing the upper tusks across the lower branches of the tree. When alarmed they will often plunge into a river, or even into the sea, near, and can swim with great vigour and facility, and to a vast distance. The voice of the babouria is said to resemble that of the common hog, but it is considerably shorter and weaker, and is not a strong or loud growling note. It is sometimes tamed by the inhabitants of the Indian islands, and the flesh is considered as a wholesome food. See Plate Nat. Hist. fig. 333.

5. Sus tajanus, pecary. The pecary is the only animal of this genus that is native of the new world, where it is chiefly found in the hottest regions. Its size is considerably smaller than that of a common hog, and it is of a short compact form. The whole animal is thickly covered, on the upper parts, with very strong dark-brown or blackish bristles, each marked by several yellowish-white rings; so that the colour of the whole appears dotted with minute freckles or specks, and round the neck is generally a white border or collar. The head is not so large; the snout long; the ears short and upright; the body nearly naked: there is no tail, and at the lower part of the back, or at some little distance beyond the rump, is a glansular organ surrounded by strong tubercles, in a somewhat radiated direction. From the orifice exudes a strong-smelling fluid, and this part has been supposed to be the navel of the animal: the tusks in this species are not very large.

The pecary is a gregarious animal, and in its wild state is fierce and active. It sometimes destroys the crops of the country, with great vigour, and often destroying the dogs which are employed in its pursuit. It feeds not only on vegetable substances, but occasionally on animals of various kinds, and is particularly an enemy to snakes and other reptiles; attacking and destroying even the rattlesnake, without the least dread or inconvenience, and dexterously skimming it, by holding it between its feet, while it performs that operation with its teeth. It is also remarkable that the common hog, when translated to America, will attack and destroy the rattlesnake. The pecary is considered as an agreeable food; but the dorsal gland must be cut away as the animal is killed; otherwise the whole flesh would be infected with an unpleasant flavour. See Plate Nat. Hist. fig. 336.

SUSPENSION, or Points of Suspension, in mechanics, are those points in the axis or beam of a balance, wherein the weight is supplied, or from which it is suspended.

In a law sense, suspension is a species of censure, whereby ecclesiastical persons are forbidden to exercise their office, or to take the profits of their benefices; or when they are prohibited in both of them for a certain time, either in whole or in part. Suspension is also said to relate to the faulty, viz. suspension ad injuriam ecclesiae, i.e. from hearing divine service.

SUTURE. See Surgery.

SWARETZIA, a genus of the class and order polyandria polyandria. The calyx is four-leaved; petals single, lateral, flat; legumone-cell, two-valved; seeds globular. There are six species, trees of the West Indies.

SWEARING, an offence punishable by several statutes: thus stat. 6 and 7 Will. III, cap. 11, or lib.) that if any person shall,, to any person, servant, or common soldier, he shall forfeit 1s. to the poor, for the first offence, 2s. for the second, &c.; and any person not a servant, &c. forfeits 2s. for the first offence, 4s. for the second, 6s. for the third, &c. to be levied by districts of goods.

SWEAT. See Perspiration.

SWEATING-SICKNESS, a disease which appeared first in England, in the year 1483. It seized different patients in different manners; for in some it first appeared with a pain in the neck, scapula, legs, or arms; whilst others perceived only a kind of warm vapour, or flatulence, running through those parts. And these symptoms were suddenly succeeded by a profuse sweat, which the patient could not account for. The internal parts became first warm, and were soon after seized with an incredible heat, which thence diffused itself to the extremities of the body. An intolerable thirst, and indisposition of the stomach, liver, and stomach, were the next symptoms, which were succeeded by an excessive head-ache; a delirium, in which the patient was very talkative; and after these, a kind of external, irresistible necessity of sleeping. For preventing this disease, temperance was ordered, and the choice of salutary aliments and drinks, and no crude pot-herbs nor salt-laffs to be used.

SWEET, in the sea-language, is that part of the mouth of a ship that begins to creak in at the rump-heads: also, when the hawser is dragged along the bottom of the sea, to recover any thing that is sunk, they call this action sweeping for it.

SWEETS, in the wine trade, denotes any vegetable substance, especially raisins, or other foreign or domestic fruit, which is added to wines, with a design to improve them.

SWEERTIA, marsh gentian, a genus of plants belonging to the class of peonies, and to the order of gentianaceous. See Plate Nat. Hist. fig. 336.

The perenn is a native of England. It is distinguished by radical oval leaves. It flowers in August.

SWETIENIA, mahogany, a genus of plants belonging to the class of deccamers, and to the order of malvaceous. They are large trees of the Cape of Good Hope, and the Cape of Good Hope.

It abounded formerly in the low lands of Jamaica, but now is found only on high hills and places difficult of access. It thrives in most soils, but varies in texture of growth and grain according to the nature of the soil. On rocks it is of a smaller size, but very hard and heavy, of a close grain, and beautifully polished; while the produce of the low and richer lands is observed to be more light and fine, a paler colour, and open grain; and that of mixed soils to hold a medium between both. The tree grows very full and straight, and is usually four feet in diameter; the flowers are of a yellow or saffron colour, and the fruit of an oval form, and about the size of a turkey's egg.

The wood is generally hard, takes a fine polish, and is found to answer better than any other soot in all kinds of cabinet-ware. It is now universally esteemed, and sells at a good price. It is a very strong timber, and answers very well in beams, joists, planks, boards, and shingles; and has been frequently put to those uses in Jamaica in former times. It is said to be used in ship-building; a purpose for which it is remarkably adapted, it not only costly, but very durable, capable of resisting gun-shots, and burying the shots without splintering.

The seed-vessel are of a curious form, consisting of a large cone splitting into five parts, and disclosing its winged seeds, disposed in the regular manner of those of an acorn. The seeds being winged, are dispersed on the wind, or falling into the chinks of the rocks, strike root; then creep out on the surface, and seek another chink, into which they creep and swell...
each a size and strength, that at length the species, and is forced to admit of the root's deeper penetration; and with this little mitre the tree increases to a stupendous size few years.

WIMMING, the act of sustaining the head in water, and of moving in it, in which on the air-bladder and fins of fishes bear a considerable part. See AIR-BLADDERS.

WIMMING, as applied to human beings, is the art of balancing the body on or near the surface of the water, and of making a passage through it; an art so useful, we might so necessary, that every young person ought to be instructed in it; and as it is also a wholesome and pleasant exercise, it ought to be regularly taught at schools, as well as other athletic exercises.

The art of swimming is so antient, that we can no accounts of its origin in the history of nations; nor are there any nations so barbarous but that swimming is known and practiced among them, and that in greater perfection than among civilized people. It is a proc. therefore, that the art, though not absolutely natural, will always be acquired by people in a savage state, from imitating the actions of the animals, most of whom swim naturally.

The cause of so much difficulty in this is, the common practice in the case. Very expert swimmers have recommended to those who wish to learn to imitate the motions of the frogs in moving through the surface of the water.

The art of swimming depends entirely on keeping the body in a proper balance, this is easily and almost insensibly acquired.

The great obstacle is the natural buoyancy of which people are in possession; this it is impossible to overcome by any exertion of the body. An attempt to go into water.

With regard to the real danger of drowning, it is a little; and on insubstantial occasions arises entirely from the above mentioned, as will appear from the wing observations by Dr. Franklin:

1st. That though the legs, arms, and head, human body, being solid parts, are specifically heavier than fresh water, the trunk, particularly the upper part, is its soundness, is so much lighter than water, that the whole of the body, taken together, is too light to sink wholly under water, some parts will come above until the lungs are filled with water; which happens from water into them instead of air, when pressed in the fright attempts breathing while mouth and nostrils are under water.

2dly. That the legs and arms are specially lighter than salt water, and will be supped by it; so that a human body could sink in salt water though the lungs were as above, but from the greater specific gravity of the body, the water will have the effect of increasing the buoyancy of the body.

That therefore a person throwing himself in his back in salt water, and extending arms, may easily lie so as to keep his mouth nostrils free for breathing; and by a small motion of his hands may prevent turning, if the motion of arms is not obstructed.

4thly. That in fresh water, if any man was himself on his back near the surface, cannot long continue in that situation, but proper action of his hands on the water.

G.J. Balances not such action, the legs and looser of the body will gradually sink till he comes into an upright position; in which he will continue suspended, the hollow of the breast keeping the head uppermost.

5thly. But if in this erect position the head is kept upright above the shoulders, and when we stand on the ground, the immersion will, by the weight of that part of the head that is out of the water, reach above the mouth and nostrils, perhaps a little above the eyes. It is possible that a man cannot long remain suspended in water with its head in that position.

6thly. The body continued suspended as before, and upright, if the head is leaned quite back, so that the face looks upwards, all the weight of the part of the head being then under water, and its weight consequently in a great measure supported by it, the face will remain above water quite free for breathing, will rise an inch higher every inspiration, and sink as much every expiration, but never so low that the water may come over the mouth.

7thly. If therefore a person unacquainted with swimming, and falling accidentally into water, could have presence of mind sufficient to avoid struggling and plunging, and to let the body take this natural position, he might expect that his arms, if no help would come; for as to the clothes, their additional weight while immersed is very considerable, the water supporting it; though when he comes out of the water, he would find them very heavy indeed.

The method of learning to swim is as follows: The person must walk into water so deep that it will reach to the breast. He is then to lie down gently on the belly, keeping the head and neck perfectly upright, the breast advancing forward, the thorax inflated, and the back bent; then withdrawing the legs from the bottom, and stretching them out, strike the arms forwards in unison with the legs. Swimming on the back is somewhat similar to that on the belly, with this difference; that the legs are here chiefly employed to move the body forwards, and the arms are often unemployed, for the progressive motion is derived from the movement of the feet.

In diving, after the plunge, a person uses the same action as before; only the head is bent downwards; and whenever he chooses to return to his former situation, he has nothing to do but bend back his head, and he will immediately return to the surface.

It is very common for novices in the art of swimming to make use of cords or bladders to assist in keeping the body above water. Some have utterly condemned the use of these; Dr. Franklin, however, allow that they may be of service for supporting the body while one is learning what is called the stroke, or that manner of drawing in and striking out the hands and feet that is necessary to produce the progressive motion. But (says he) you will be no swimmer till you can place confidence in the power of the water to support you: I would therefore advise the acquiring of that confidence in the first place, especially as it is by a little of the practice necessary for that purpose, have insensibly acquired the stroke, taught in a manner by nature.

The practice I mean is this: choosing a place where the water descends gradually, and walk cooly into it till it is up to your breast.
SYLOGISM, in logic, an argument or term of reasoning, consisting of the two premises and the conclusion. See LOGIC, MODE, &c.

SYMPHONIA, a genus of plants of the class of monadephia, and order of pentandria. There is one pit. The corolla is globular, the berry-like. There is only one species yet discovered; the globulifer, a tree of Surinam.

SYMPHONY, in music, properly denotes a concomance or concert of several sounds agreeable to the ear, whether vocal or instrumental, called also a harmony. See MUSIC.

SYMPHYSES, in anatomy, one of the kinds of junctures of articulation of the bones. See ANATOMY.

SYMPHYTUM, conyfrey, a genus of plants of the class of pentandria, and order of monadephia; and in the natural system ranking under the 41st order, superflora. The limb of the corolla is tubular and ventricose, and the throat is shut with avul-shaped rays. There are three species; the officinale, tuberosum, and orientale. The officinale is a British plant, the stem is about two feet high, round, branched, green, and rough. The radical leaves are large and rough; those on the stalk are decurrent, and alternate. The flowers grow on loose spikes, and are either of a yellowish or purple colour. It grows on the banks of rivers, and flowers from May to October.

SYMPLOCOS, a genus of plants of the class of polyadephia, and the order of polyandria; and in the natural system ranking under the 25th order, superflora. The limb of the corolla is tubular and ventricose, and the throat is shut with avul-shaped rays. There are three species; the officinale, tuberosum, and orientale. The officinale is a British plant, the stem is about two feet high, round, branched, green, and rough. The radical leaves are large and rough; those on the stalk are decurrent, and alternate. The flowers grow on loose spikes, and are either of a yellowish or purple colour. It grows on the banks of rivers, and flowers from May to October.

SYNCOPE, fainting. See MEDICINE.

SYNOCTE, in grammar, an elision or repetition of letter or syllable out of the middle of a word, as calidus for calidus, aspers for asperis, &c.

SYNGENESIS. See BOTANY.

SYNGNATHIUS, pipefish, a genus of fishes of the order osteichthyes; the generic character is, snout subcylindrical, with terminal mouth; body lengthenedit, jointed, mailed; ventral fins none.

1. Syngnathus acus, great pipefish. The fishes of the present genus are inhabitants of the sea, and are observed to frequent the shallower parts near the shore, feeding on the smaller worms and insects; they are easily distinguished by their slender habit, and angular jointed body. The syngnathus acus or great pipefish is usually seen of the length of twelve or fifteen inches, but is sometimes found, especially in the northern parts of the northern seas, of a greater length, measuring from two to three feet: it is of an extremely slender form, gradually tapering towards the extremity, and is of a pale yellowish-brown colour, varied through its whole length with broad alternate zones of a deeper or olive brown, with a few smaller variations intermixed: the scales or lamina with which the joints of the body are covered, appear, if narrowly inspected, to be finely radiated from the centre by numerous lines or streaks: the dorsal fin is placed but two-thirds of the body; the head is larger than the tail, and is thin, tender, shalhown; and the fish can be shelled with ease. The pectoral fins small, and slightly rounded, and the tail of similar shape and size. In spring, as in others of this genus, the ova are found lying in a longitudinal channel or division at the lower part of the abdomen, and are large in proportion to the size of the animal; from these are hatched the young, completely formed. Native of the European seas.

2. Syngnathus hippocampus, sea-horse pipefish. A fish of a highly singular appearance: general length from six to ten inches; body much compressed; colour greenish brown, varied with darker and lighter species; head large, thickish, and bent on the upper part, as well as along some of the first joints of the body, with several small, weak, lengthened spines or cirri, which are sometimes slightly raminated: snout slender: neck contracting suddenly beyond the head; body rather short, and contracting gradually towards the tail, which is long, quadrangular, and terminates in a naked or inflated tip. In its dry or contracted state this animal exhibits the fancied resemblance from which it takes its name, but in the living state its appearance is somewhat less striking, the head and tail being carried nearly straight. It is a native of the Mediterranean, Northern, and Atlantic seas.

SYRINGOTON, in music, a kind of sonata, a kind of sonata, consisting of two parts; the upper part is a melody, the lower a diminution of the melody. See SYMPHONY.

SYRINGOTON, in medicine, a kind of sonata, a kind of sonata, consisting of two parts; the upper part is a melody, the lower a diminution of the melody. See SYMPHONY.

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ed it into a fourth on each side, and a tone of the middle. This system did not, however, continue long confined to so few nations. Classical authors, as Plato, Pliny, and others, have left accounts of the system. Thus, for instance, Boethius informs us, added a fifth to the Pythagorean scale; Hyginus a sixth; Serapion a seventh, equal the number of the planets; and there is an eighth. But Pliny gives a different account of the progression of the ancient system; according to that writer, Teredo added three chords to the tetrachord, and Diocles joined to it an eighth, Tithonos a ninth.

Whichever of these accounts may be the true one, it seems pretty certain that the system of the Greeks was gradually extended, both upward and downward; and that it attained and exceeded the limits of the bis diapason, or double octave, an extent which they called systema perfectum, maximum, immensus, the great system, the perfect system. This entire system was composed of four tetrachords, three conjoint and one disjunct, and the chord called proslamanoskeion, which was added below these tetrachords to complete the double octave.

This general system of the Greeks remained nearly in this state till the eleventh century, when Guido made a considerable change, by adding a new chord below, which he called hypodiapasonmononomos; also a fifth tetrachord above, or tetrachord of the sur-sharp; and substituting hexachords in the place of the ancient tetrachords. Since the time of Guido, the general system has again been greatly extended, and divided into octaves; and which has long been adopted throughout Europe, and which the ear certainly recognises as the most natural of all possible partitions of the great scale of sounds.

SYSTOLE. See Anatomy.

SYZYGY. See Astronomy.

The nineteenth letter of our alphabet.


Amongst the antients, T. as a numeral, stood for one hundred and sixty; and with a bar at top, thus T6, it signified one hundred and sixty thousand. In music, T stands for tun, all, or altogether.

TABANUS, a genus of insects of the order Diptera. The generic character is, mouth armed into a flabby proboscis, two lips; root of winged by two pointed alpi, placed on each side of, and parallel to, the proboscis. There are 53 species.

The largest of the British species is the tabanus bovinus of Linnæus, having the appearance of a very large grey or pale-brown fly, often measuring near an inch in length, and marked down the back by a series of large, whitish, triangular spots, pointing forward; on each side also is an approach to a similar appearance, though fainter than that of the dorsal row. This insect, like the rest of the genus, is seen during the middle and the decline of summer; generally in the hottest part of the day. It is extremely troublesome to cattle, piercing their skin with the lancets of its trunk, and making its blood in such a manner as to cause considerable pain. It proceeds from a large dusty-yellowish larva, nearly resembling that of a tipula, and marked by transverse black or streaks. It resides under ground in moist meadows, &c. and changes to a cylindrical brownish chrysalis, with a roundish or very slightly pointed extremity; out of which, in the space of a month, proceeds the perfect insect. See Plate Nat. Hist. fig. 388.

2. Tabanus tropicus is of a smaller size than the preceding, and of a brown colour, with the sides of the abdomen bright ferruginous. It is a less common species than the former.

3. Tabanus pluvialis is of the size of a window-fly, but of a somewhat longer shape in proportion; and of a yellowish-brown colour. It is provided, with the wings of a similar cast, but marbled or variegated with very numerous whitish specks: this is a very troublesome insect during the latter part of summer, fastening on the legs, hands, &c. and causing considerable pain by the puncture of its proboscis; which is observed to be peculiarly teasing on the approach of rain.

4. Tabanus cacatius is an insect of singular beauty. It is of the size of a common window-fly, and of a yellowish-brown colour, varied with back; the wings are transparent, and marked by large black bands or patches, and the eyes are of the most vivid or lucid green, marbled with black spots and streaks. It is by no means uncommon during the autumnal season.

TABBY, in commerce, a kind of rich silk, which has undergone the operation of tabbying. See the next article.

TABBYING, the passing a silk or stuff through a calender, the rolls of which are made of iron or copper, variously engraved; which bearing unequally on the stuff, renders the surface unequal, so as to reflect the rays of light differently, making the representation of waves thereon.

TABELLA, TABLE. See Pharmacy.

TABERN.EMONTANA, a genus of plants of the class of pentaeridia, and order of monogynia; and in the natural system arranged under the 30th order, corticae. There are two horizontal folioles, and the seeds are immersed in pulp. There are 19 species, all of forest.

TABLES DORSALIS. See Medicine.

TABLE, in perspective, denotes a plane surface, supposed to be transparent, and perpendicular to the horizon. It is always imagined to be placed at a certain distance between the eye and the objects, for the objects to be represented thereon by means of the visual rays passing from every point thereof through the table to the eye; whence it is called perspective-plane.

TABLES, leaves of the twelve, were the first laws of the Romans; thus called either because the Romans then wrote with a style on thin wooden tablets covered with wax, or rather, because they were engraved on tablets, or plates of copper, to be exposed in the most noted part of the public forum. After the expulsion of the kings, as the Romans were then without any fixed or certain system of law, at least had none ample enough to comprehend the various cases that might fall between particular persons, it was resolved to adopt the best and wisest laws of the Greeks. One Hermomodo was first appointed to translate them, and the decemviri afterwards compiled and reduced them into ten tables. After much care and application, they were at length enacted and confirmed by the senate and an assembly of the people, in the year of Rome 339. The following year they found something wanting in them, which they supplied from the laws of the former kings of Rome, and from certain customs which long use had authorised; all these being engraved on two other tables made the law of the twelve tables, so famous in the Roman jurisprudence, the source and foundation of the civil or Roman law.

TABLE, among the jewellers. A table-diamond, or other precious stone, is that whose upper surface is quite flat, and only the sides cut in angles; in which sense a diamond cut tablewise, is used in opposition to a rose-diamond.

TABLE, in mathematics, systems of numbers calculated to be ready at hand for the expediting astronomical, geometrical, and other operations; thus we say tables of the stars; tables of sines, tangents, and secants; tables of logarithms, rhumbs, &c. sexagesimal tables.

TACAMAILACA. See Populus, and Resins.

TACCA, a genus of the class and order hexadriata monogynia. The cal. is six-part.
TACT, in a ship, a great rope having a
wale-knot at one end, which is seized or fas-
cued into the clew of the sail; so is recked
first through the chesstrees, and then is
brought through a hole in the ship’s side.
Just as the sail is carried forward the clew of
the sail, and to make it stand close by a wind;
and whenever the sails are thus trimmed, the
main-tack, the fore-tack, and main-ten, are
brought close by the board, and hauled as
much forward as they can be.
TACK-ABOUT, in the sea-language, is to
turn the ship about, or bring her head about,
so as to lie the contrary way.
TACKLE, or Tackling, among seamen,
designs all the ropes or cordage of a ship,
used in managing the sails, &c.
A more
restrained sense, tackles are small ropes running
in three parts, having at one end a pendant and a block; and at the other end a block and a hook, to hang goods upon that are to be carried into the ship or out of it.
TACTICS, in the art of war, is the
method of disposing forces to the best advantage
in order of battle, and of performing the several
military motions and evolutions. See WAR, art. 2.
Tactics, in the military art, a word
derived from the Greek, signifying order. Tac-
tics consist of a knowledge of order, disposi-
tion, and formation, according to the exigency
of circumstances in warfare operations.
General tactics are a combination or union of
first orders, out of which others grow of a
more extensive and complicated nature, to
suit the particular kind of contest or battle
which is to be given, or supported. Let it
not, however, be inferred from this, that evolu-
tions and tactics are one and the same.
They are closely connected, but there is still
a discernible difference between them.
Tactics may be comprehended under order and
disposition; evolution is the movement
which is made, and eventually leads to order.
The higher branches of tactics should be
thoroughly understood by all general officers;
but it is sufficient for inferior officers and
soldiers to be acquainted with evolutions.
Not that the latter are beneath the notice of
general officers; but that having already
acquired a knowledge of them, they ought to
direct their attention more immediately to
the former, carefully retaining at the same
time a clear apprehension of every species of
military detail, and consequently obviating the
many inconveniences and embarrass-
ments which occur from orders being awk-
awardly expressed by the general, and of
course ill understood by the inferior officer.
It may be laid down as a certain rule, that
unless a general officer makes himself ac-
quainted with all regular movements and dis-
positions, he preserves the necessary recol-
lections, it is morally impossible for him to
be clear and correct in his general arrange-
ments. Of all mechanical operations, found-
ad upon given principles, the art of war is
certainly the most complex, the most
elaborated, and the most capable of improve-
ment. Almost every other science and art
are comprehended in it; and it should be
the subject matter, the chief study, and the
ultimate end of a general’s reflections. He
must not be satisfied with a limited concep-
tion of its various branches; he should go
deply into all its parts, be aware of its mani-
fold changes, and know how to adapt move-
ments and positions to circumstances and
places.
It will be of little use to a general to have
formed vast projects, if, when they are to be
executed, there should be a deficiency of
ground; if the general movements of the
jury should be embarrassed by the irre-
regularity of some particular corps, by their over-
lapping each other, &c.; and if, through the
tardiness of a manoeuvre, an enemy should
have time to render his plan abortive by a
more prompt execution. A good general
must be aware of all these contingencies, by
making himself thoroughly master of tactics.
The Prussian tactics under Frederic the
Great, had for their principal object to con-
strain the French to diminish and cleave by
the weight of an enemy, not at one and the same
time, but one after another: whereas the tactics
which have been uniformly pursued by the
French, since the commencement of their
revolutions, and which have been promul-
gated as a universal principle, to attack all points with divided
forces, at one and the same time.
We thus
see, that the principles of extension have
been as much followed by the latter, as those
of contraction were studiously adhered to by
the former.
Tactics of Europe. The following obser-
vations respecting the tactics of Europe,
which we extract from a book entitled the
Elementary Principles of Tactics, page 137,
may not be uninteresting to our military
readers: In the time of the Romans, the Gauds
and other nations on the continent fought in the
phalanx order; it is this order which still pre-
vails throughout all Europe, except that it is
deficient in the advantages and utility which
Polybius ascribes to it, and is injured and
disgraced by defects unknown to the ancient
phalanx.
In Turenne’s days, troops were ranged 8
deep, both in France and Germany. Thirty
years after, in the time of Puysen, the
ranks were reduced to 5; in the last Flanders
war to 4; and immediately after to 3; at pre-
sent the ranks are reduced to 2.
This part of the progression from eight
to three being known, we easily conceive how
the files of the phalanx have been dimin-
ished from sixteen to eight in the ages preceding
Turenne. It is to be presumed, that this depth
was considered as superfuous; and it was
judged necessary to curtail it, in order to
extend the front. However, the motion is
of very little consequence, since we are now
reduced to three ranks; let us therefore en-
deavour to find out what qualities of the pha-
lanx have been preserved, and what might
have been added to it.
To shew that we have preserved the de-
fects of the phalanx; in the first place, we state
that two bodies of troops, one of eight thousand
men, ranged as a phalanx, sixteen deep; the
other a regiment of three battalions, consist-
ing only of fifteen hundred men, drawn up in
three lines nine deep.
To shew, that these two bodies shall be perfectly equal and alike
in extent of front, and shall differ in nothing
but in the depth of their files; the in-
conveniences and defects, therefore, occa-
sioned by the number of their fronts, are equal
in both troops, though the numbers are
very different; hence it follows, that in Eu-
rope, the essential defects of the phalanx are
preserved, and its advantages lost.
Let us consider the files of the body of eight thousand
be afterwards divided, and let it be reduced
to three in depth, its front will then be found
five times more extensive, and its depth five
times less; we may therefore conclude, that the
defects of the phalanx are evidently multi-
plied, and the advantage of the other
reduced to a very limited extent.
These are the two principal causes of the
little solidity or depth given to our batta-
lions.
We have now seen, that the defects of
the phalanx were transferred to our European
discipline, and its advantages and perfection
infinitely diminished. Our regulations are
therefore, much inferior to the phalanx, and
have nothing but the single effect of fire-arm
to counterbalance all its advantages.
To effect, however, of fire-arms, is an artificial
power, and does not originally belong to,
the manner of disciplining troops, the sole aim
of which should be to employ man’s natural ac-
tion. It is man, therefore, and not this fire-
which is to be considered as the principal
agent; and hence we infer, that the method
is very much inferior to the phalanx;
and still more to the Roman arrangement
which we have considered.
The light troops of both these people were
much heavier than our battalions, and had
more power and solidity for a shock or con-
front. However, the Roman discipline, notw.
withstanding its superiority, is not calculated
for our times; because, as we are obliged
to engage at a distance, ours, by its cannon
would destroy the Grecian order of battle in
a very short time, and would be exposed to
loss much less considerable itself, supposing
the artillery were placed on both sides
we should then, in order to perfect our ar-
rangements, endeavour to procure them all
the advantageous qualities of the legionary
regulations, as the only means of giving them
the superiority.
Many people are of opinion, that we imi-
itate the Romans; and that we give battle ac-
cording to their system, because our troops
are drawn up in lines, some of which are
multiplied. But it has been proved, that three
battalions have the same front, and the same
inconveniences, that eight thousand men, ranged in the pha-
lanx order. Our lines are formed by brigades,
regiments, or battalions, and the distance of one
corps for the other is equal to the front.

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764 TAC TAC TAC
c; con. six-pasted, inserted into the ca.;
stigma stellate; berry dry, hexagonal, &c.
There is one species, a herb of the East
Indies.

TACHOGRAPHY, the art of writing
fast o of short hand; of which authors have
invented several methods. See STENOGRA-
PHY.

TACK, a round, long, pointed, and
hardened point, which fastens the needle to
the fabric; a kind of tack for the upper
part of the head, the lower part of the
head, or the ear; the first and second
point of a shoemaker’s tool; and the
first point of a single-pointed tool.

TACKLE, Tack-about, TACK,
TACKLE, Tack-about, TACK,
TACKLE, Tack-about, TACK,
TACKLE, Tack-about, TACK,
of one of those corps: so that those lines, both full and vacant, are composed of detachments equal in front and in defects; each has a phalanx of six, eight, or twelve thousand men. Our orders of battle, consequently, can be no more at most than that kind of medium between those of Greece and Rome.

Tactics, maritime, or manoeuvres at sea. With respect to naval tactics, or the art of fighting at sea, it is confessedly less antient than tactics on shore; but what is generally called海军 is in truth Mankind. Mankind were accustomed to contend for the possession of territory long before they determined on, or even dreamed of, making the sea a theatre of war and bloodshed.

Setting aside the many fabulous accounts which are extant concerning naval tactics, we shall remain satisfied with what has been transmitted to us by the Roman writers of the fifth and sixth centuries of that republic. We shall there find specific details of the different preparations which were practised in the sea during the Punic war. In those times naval armaments began to be regularly fitted out; ships of different forms and sizes were constructed; and certain offensive and defensive machines, or what served as a species of artillery, were placed upon them. They had already been drawn out according to system; being divided into certain proportions which were then called divisions, but are now named squadrons, and the person who commanded them, exerted all their skill and genius to gain advantages over their enemies, by opportunely getting to windward, by seizing the favourable occurrence of the tide, or by manoeuvring in advantageous situations.

At the battle of Actium, Augustus, finding himself inferior to Mark Anthony in the number of his ships, had the sagacity to draw up his line of battle along the entrance of the gulf of Ambrac, and thereby to make up for his deficiency. This naval manoeuvre, as well as that of getting a windward of the enemy, in order to bear down upon him with more certainty and effect, exists to the present day.

We act precisely upon the same principles in both cases, by which the ancients were governed; with the additional advantage, in fighting to windward, of covering the enemy's line with smoke from the discharge of ordnance and fire-arms. The French call this being in possession of the closed line.

In those times, ships were boarded much sooner than they are at present. Most engagements at sea are now determined by cannon-shot. Among the ancients, when two ships endeavoured to board each other, the rowers drew from the oars, to prevent them from being broken in the shock.

The manoeuvre which was practised on this occasion, was for the ship that got to windward of its adversary, to run upon its side, with the prow; which being armed with a long sharp piece of iron, made so deep an impression in it, that the ship thus attacked, generally sunk. The voyages which were afterwards made on the ocean, rendered it necessary that this armament be more still, and were double-decked; and since the invention of gunpowder, tiers of guns have been substituted in the room of rows of oars.

On the decline and fall of the Roman empire, the Saracens got the ascendency in naval tactics. They took advantage of this superiority, and extended their conquests on all sides. The tract belonging to the Mediterranean, together with the adjacent islands, fell under their dominion. Mankind are indebted to them for considerable improvements in naval tactics.

It was only under Charlemagne, that the Europeans can be said to have paid any great attention to their navy. That monarch kept up a regular intercourse with the caliphs of the East; and having just grounds to apprehend an invasion from the Normans, he constructed vessels for the defence of his coasts.

During the reign of the first French kings belonging to the third race, naval tactics were little attended to, on account of the small extent of maritime coast which France possessed at that period. It was only in the days of Louis the Younger, and of Louis surmised the Saint, that we discover any traces of a considerable fleet, especially during the crusades.

Under Charles the Fifth, and his successor Charles the Sixth, the French got possession of several sea-ports, and had command of a long line of coast. Yet neither they nor the English, with whom they were frequently at war, had at that period any thing like the fleets which are now fitted out.

The discovery of America by Columbus, and the more lucrative possession of the East Indies, induced the principal courts of Europe to increase their naval establishments, for the purpose of settling colonies, and of bringing home, without the danger of molestation or piracy, the wealth and produce of the eastern and western worlds.

The French marine was far from being contemptible under Francis the First; but it grew into considerable reputation during the administration of cardinal Richelieu, in the reign of Louis the Thirteenth; and continued to increase until the reign of Louis, which was so gloriously won by the English, under William the Third. From that epoch it began to decline; while the English, on the other hand, not only kept up the reputation of their armed forces, but added to their pre-eminency, which was their predecessors, but rendered themselves so thoroughly skilled in naval tactics, that they have remained masters of the sea to this day. See War, art of.

TEN, in zoology, a genus of animals belonging to the class of vernix, and order of intestina. The body is long, depressed, and jointed like a chain, and contains a mouth and visceria in each joint. According to the number of their joints, there are ninety-two species; all which inhabit the intestines of various animals, particularly of quadrupeds.

Seven species of Tenia are peculiar to man: 1. Accommodating, which is found in various parts of the body, is broad, and has bursae in the hinder part; inhabits the liver, the placenta uterina, and the sac which contains the suprarenal fluid of human persons. 2. Cellulosa, which is included in the carotegua, and the cellular substance of the muscles; is about an inch long, half an inch broad, and one-fourth of an inch thick, and is very tenacious of life. 3. The dentata, has a pointed head; the large joints are streaked transversely, and the small joints are all dilated; the oscaum or opening in the middle of both margins is somewhat raised. It is narrow, ten or twelve for long, and broad for long, and its ovaria are not visible to the naked eye; and the head underneath resembles a heart in shape. It inhabits the intestines. 4. The licea, is white, with joints very small and deciduous; the ova, which is solitary. It is from eighteen to one hundred and twenty feet long; its joints are streaked transversely; its ovaria are disposed like the petals of a rose. 5. The vulgaris, has two lateral mouths in each joint; it attaches itself so firmly to the intestines, that it can scarcely be removed by the most violent medicines; it is slender, and has the appearance of being membraneous; it is somewhat peculiar, from ten to sixteen feet long, and about four lines and a half broad at one end. 6. The lutea, which chiefly inhabits the liver of the trout, but is also to be found in the intestines of the human species. 7. The solium, has a marginal mouth, and is commonly found in the ovilia, found in the liver and omentum of sheep. See Plate Nat. Hist. fig. 389.

The structure and physiology of the tenia are curious, and it may be amusing as well as instructive to consider it as a single animal designed to feed upon such juices of animals as are already animalized; and is therefore most commonly found in the alimentary canal, and in the upper part, where there is the greatest alimentation with the natural food of the tenia. As it is thus supported by food which is already digested, it is destitute of the complicated organs of digestion. As the tenia solium is most frequent in this country, it may be proper to describe it more particularly.

It is from three to thirty feet long, some sixty feet. It is composed of a head in which are a mouth adapted to drink up fluids, and a pair of jaws for seizing the head a fixed situation. The body is composed of a great number of distinct pieces articulated together, each joint having an organ by which it attaches itself to the neighbouring part of the body, and thus, in a manner, the head are always small, and they become gradually enlarged as they are farther removed from it; but towards the tail a few of the last joints again become diminished in size. The extremity of the body is terminated by a small semicircular joint, which has no opening in it.

The head of this animal is composed of the same kind of materials as the other parts of its body; it has a rounded extremity, which is considered to be its mouth. This opening is continued by a short duct into two canals; these canals pass round every joint of the animal's body, and convey the aliment. Surrounding the opening of the mouth are a number of projecting radii, which are of a fibrous texture, whose direction is longitudinal. These radii appear to serve the purpose of tentacula for fixing the orifice of the mouth, and muscles expand the cavities of the mouth, from their being inserted along the brim of that opening. After the rounded extremity, or head, has been narrowed into the neck, the lower part becomes flattened, and has two small tubercles placed upon each fluted.
side; the tubercles are concave in the middle, and appear destined to serve the purpose of suckers for attaching the head more effectually. The internal structure of the joints composing the head is partly vascular and partly cellular; the substance itself is white, and somewhat resembles in its texture the coagulated lymph of the human brain.

The alimentary canal passes along each side of the animal, forming a cross or four drops, or a part of the animal's body which they inhabit, various remedies are advised for removing them; many of which are ineffectual, and others very injurious by the violence of their operation. Drastic purges seem to operate upon tanta, partly by irritating the external surface of their bodies, so as to make them quit their holds, and partly by the violent contractions produced in the intestine, which may sometimes divide the bodies of tanta, and even kill them by bruising. The most effectual remedy, however, has been found to be the digitalis in substance.

TAGEÊS, French marigold, a genus of plants of the lupin and order of polygonia superlum; and in the natural system ranging under the 40th order, composita. The receptacle is naked; the pappus consists of five erect awns or beards; the calyx is monophyllous and achene, and tubular; and there are four persistent florets of the ray. There are three species, the palata, erecta, and minuta; of which the two first have been cultivated in the British garden, at about 936, for it is mentioned in Gerard's Herball, which was published that year. They are both natives of Mexico.

The erecta, or African marigold, has a stem subdividing and spreading, and has formed itself into a great many varieties: 1. Pale yellow, or brim-stone colour, with single, double, and fistulous flowers. 2. Deep yellow, with single, double, and fistulous flowers. 3. Orange-coloured, with single, double, and fistulous flowers. 4. Middling African, with orange-coloured flowers. 5. Sweet-scented African. These are all very subject to vary; so that unless the seeds are very carefully gathered from the finest flowers, they are apt to degenerate; nor should the same seeds be too long sown in the same garden, for the same reason; therefore those who are desirous to have these flowers in perfection, should exchange their seeds with some person of integrity at a distance, where the soil is of a different nature, at least every other year. If this is done, the varieties may be continued in perfection.

TALT, or EASTERN TALT, are either general or special. Talt general, is where lands and tenements are given to one and the heirs of his body begotten, which is called talt general; because, how often soever such done may be married, his heirs, by every such marriage, are capable of inheriting the estate talt. Tenant in talt special, is where the gift is restrained to certain heirs of the grantee, and not to all in general, which may happen in several ways. Estates talt are likewise diversified by the distinction of male and female, as if lands are given to a man and the heirs male of his body begotten; this is an estate in talt, male special; but if to a man and the heirs female of the body of his present wife begotten, this is an estate in talt, female special. So in case of a gift in talt male, the female line shall not inherit; and so converso.

As the word heirs is necessary to create a fee, so the word body or some other words of inheritance necessary to make a fee talt, and ascertain to what heirs the estate is limited. Therefore, if the words of inheritance or procreation are omitted, although the others are inserted, this will not make an estate talt. As if an estate is granted to a man and the issue of his body, this is only an estate for life, the words of inheritance being wanting; and a grant to a man, and his heirs male or female, is an estate in fee simple, not in fee talt, as there are no words to ascertain the body from whence they shall issue.

Though in wills, where greater latitude is given, an estate talt may be devised by the words, to a man and his heirs male, or other irregular modes of expression. The incidents to a tenancy in talt are principally these: 1. A tenant in talt may commit waste on an estate without being imprisoned for the same. That the wife shall have her dower of the estate talt. 3. That the husband of a female tenant in talt may be tenant by courtesy. 4. An estate talt may be barred or destroyed by fine, a recovery, or a legal warranty, descending with assets to the heir.

And by stat. 26 Hen. VIII. c. 13. all estates talt (in common with all estates of inheritance) are forfeited to the king on conviction of high treason. By stat. 32 Hen. VIII. c. 29, certain leases which do not tend to prejudice of the heir are allowed to bind the issue in talt. A stat. of the same year, c. 36, declares a fine duly levied by a tenant in talt to be a complete bar to all persons claiming under such entail.

And lastly, by 33 Hen. VIII. c. 39, all estates talt are liable to be charged for debts to the king by record or special contract. This is the reason why they may not be sold for the debts contracted by a bankrupt; and by the construction put on stat. 43 Eliz. c. 4, an appointment by tenant in talt, of the lands entailed to a charitable use, is good without limitation.

TALT, in the Turkish customs, (boshaws of three talls, sc.) See TUG.

TALC. Though this term has often been a synonym of mica in mineralogy, it is adopted by the moderns, to denote a stony substance which differs from it, especially in an uncertainty sensible to the touch, and in the vitreous electricity which it communicates to sealing-wax by friction, whilst mica gives it the reflection necessary to make the four varieties of this stone; precisely, the laminary tale, or Venice tale; the foliated tale, or chalk of Brimmon; compact tale, as the hard stone; these three first give the positive or vitreous electricity to sealing-wax. The fourth variety, or the steatite tale, communicates the negative or resinous electricity to it by friction.

The characters of this stone are, a specific gravity 2.5834 and 2.9902; a texture easy to be split into sheets; a soft and unctuous surface; the primitive form of a right rhomboidal prism, its bases having angles of 120 degrees and 60 degrees, and in which sections parallel with these bases are
1. Talpa Europaea, the common mole. The whole form of the mole is eminently calculated by nature for its obscure and subterranean life. The body is fusiform, cylindrical; the snout slender but very strong and tenacious; the head not distinguished from the body by any appearance of neck; the legs so extremely short as scarcely to project perceptibly from the body; the skin is smooth and tougher in proportion than in other quadrupeds, and the fur with which it is covered equally surpasses that of other animals in fineness and softness. The muscular strength of the mole is very great, and it is enabled to force itself into the ground with an extraordinary degree of celerity. The general length of the mole is about five inches and three quarters, exclusive of the tail, which measures one inch. This animal supposed to possess the power of hearing in an exquisite degree; and if at any time it emerges from its subterranean retreat, instantly disappears on the approach of any danger. When first taken, either by digging it out or by slaughter, it is silent, and prepares for defence by exerting the strength of its claws and teeth. According to the count de Buffon, so lively and recalcitrant an attachment subsists between the mole and its young, that they seem to dread of discharging all other society.

The mole is furnished with eyes so extremely small that it has been doubted whether they were intended by nature for distinct vision, or rather for conveying the image of the creature to a degree of notice of the approach of light as might sufficiently warn it of the danger of exposure. Galen, however, seems to have been of a different opinion, since he ventures to affirm that the eyes of the mole are furnished with the crystalline and vitreous humours, encompassed with their respective tunic ; so accurate an anatomist was that great man, even unassisted by glasses.

The mole is reported to feed not only on worms, insects, &c. but also on the roots of vegetables; but it is certainly more carnivorous than fungivorous. It is even a very fierce and voracious animal in particular circumstances; and as thus far observed, by sir Thomas Brown, that whatever these animals are contented with under ground, yet, when above it, they will sometimes tear and cut one another; and in a large glass case, wherein a mole, a toad, a rat, and a dead frog, were inclosed, we have known (says he) the mole to dispatch them, and to devour a good part of them both.

The mole is with difficulty kept alive in a state of confinement, unless constantly supplied with a provision of damp mould to reside in.

Like other animals of a black colour, the mole is sometimes found perfectly white, or cream-coloured, and sometimes spotted. In a memoir relative to the mole, published by M. de la Flaffe, it appears that four varieties may be reckoned, viz. the white mole, the rufous or tawny mole, the greenish-yellow or citron-coloured mole (found in some parts of France), and, lastly, the spotted mole, which is variegated either with white or tawny spots or patches. The mole brings four or five young.

The greatest misfortune that befalls the mole is, the sudden overflowing of rivers, when they are said to be seen swimming in great numbers, and using every effort to obtain a more elevated situation; but a great many of them perish by this occasion, as well as the young, which remain in their holes.

Linnaeus, in the twelfth edition of the Systema Naturae, affirms that the mole produces the greatest number of young of any single species, and that the same observation is repeated in the Gmelinian edition of that work. This, however, is flatly contradicted by the count de Buffon, who observes, that the mole sleeps so little during winter, that it raises the earth in the same manner as in summer; and that the country people remark that the thaw approaches, because the moles make their holes. They endeavour to get into warm grounds, gardens, &c. during this season more than at others.

This animal is said to be unknown in Ireland, and Siberia it arrives at a larger size than in Europe. The fur is so soft and beautiful, that it would make the most elegant fur cloth, which is not the difficulty a curtain and dressing the skin deter from experiments of this nature.

2. Talpa radiata, radiated mole. This is somewhat smaller than the common mole, and is of a dusky or blackish colour. In general form it resembles the preceding species, being of broad fore legs with long claws; the hind legs scaly and with much weaker claws; the nose long, and bent at the end; with a circular series of radiated tetrads; the length from nose to tail, about three inches and three quarters. It is an inhabitant of North America, forming subterraneous passages, in different directions, in uncultivated fields, and is said to feed on roots. This species is the borex cristatus of Linnaeus; being placed in that genus on account of its teeth, in despite of its appearance. It is, perhaps, in reality, no other than a variety of the former species, or a sexual difference.

TAMARINDUS, the tamarind-tree, a genus of plants arranged by Linnaeus under the class of triandria, did not occur in monogynia; but Woodville, Schreber, and other late botanists, have found that it belongs to the class of monadelphia, and order of triandria. In the natural system it is maintained by Mr. Tournefort. There is only one species, the Indica, which is a native of both Indies, of America, of Arabia, and of Egypt, and was cultivated in Britain before the year 1633.

The tamarind-tree rises to the height of thirty or forty feet, sending off numerous large branches, which stand to a considerable extent, and have a beautiful appearance; the trunk is erect, and covered with rough bark, of a greyish or ash-colour; the leaves are small and pinnaed, and of a greenish yellow colour; the flowers grow on such an extensive kind, and grow in lateral clusters; the calyx consists of four leaves, and the corolla of three petals, which are of a yellowish hue, and are beautifully diversified with red veins. The fruit is a pod of a roundish compressed form, from three to five inches long, containing two, three, or four seeds, lodged, in a dark pulpy matter. The tamarind is easily raised with us from the stones even of the preserved fruit, and is a beautiful stone-plant, rising to the height of four or five feet.

The pulp of the tamarind, with the seeds,
The fruit, of which the use of was first learned the Arabs, contains a larger proportion of acid, with the saccharine matter, than is usually found in the fructus acido-dulces, and is therefore not only employed as a laxative, but also for abating thirst and heat in various climatic complaints, and for correcting putrid disorders, especially those of a bilious kind; in which the cathartic, antiseptic, and refrigerant qualities of the fruit have been found equally useful. When intended merely as a laxative, it may be of advantage to join it with muum, or purgatives of a sweet kind, by which its use is rendered more effectual. Three drachms of the pulp are usually sufficient to open the body; but to prove moderately cathartic, one or two ounces are required. It is an ingredient in electuarium e casisi, and electuarium e semo or lenticulare.

TAMARIX, the tamarisks, a genus of plants in the class of pentandria, and order of trixioid, and in the natural system ranging under the order of the Diottyceae. The calyx is quinquepartite; the petals are five; the capsule is unilocular and trivalvular, and the seeds pappose. There are 4 species.

The bark and leaves of the tamarisk-tree are moderately astringent, but never prescribed in the present practice.

TAMBOUR, in fortification, is a kind of work formed of palisades, or pieces of wood, ten feet long and six inches thick, planted close together, and driven two or three feet into the ground; so that when finished it may have the appearance of a wooden rampart. Loop-holes are made six feet from the ground, and three feet above, about eight inches long, two inches wide, and six inches between. Behind is a scaffold five feet wide, on which the soldiers stand upon. They are frequently made in the form of arms, mounted on the arms of the covert-way, at the salient angles, in the grooves, half-moons, and ravelins, &c.

TAN, in fortification, are also solid pieces of earth which are made in that part of the covert way that is joined to the parapet, and lies close to the traversies, being only three feet distant from them. They serve to prevent the covert way from being embanked, and obstruct the enemy's view towards the traversies. In the construction of the covert way, they answer the same purposes that works on crenellau would.

Tambour likewise means in fortification, a single or isolated traverse, which serves to close up that part of the covert way where communication might have been made in the plaza for the purpose of going to some detached work.

It also signifies, both in French and English, a little box of timber-work coverd with a clieling, within the porch of certain churches, both to prevent the view of persons passing by, and to keep off the wind, &c. by means of folding-doors. In many instances it is the same as archch.

TAMUS, black, brown, a genus of plants of the class of diccia, and order of hexandra, and in the natural system ranging under the 11th order, sarmentaceae. The male and female flowers are both separet; there is no corolla; the flower is 6-locular, and consists of three sepals, three petals, and three stamens; it is dioecia, and contains two seeds. There are only two species. The communis, or common black broony, is a native of England. It has a large root, which sends forth several long slender stems; the leaves are large, heart-shaped, dark green, and grow on long footstalks; the flowers are greenish, and the berry red. It flowers from May to August, and is frequent in hedges.

TAN, the bark of the oak, chopped and ground in a tannin-mill into a coarse powder, to be used in the tanning of leather.

Deyouex was, perhaps, the first chemist who ascertained the peculiar nature of tan, or tanning. He pointed out in his analysis of nutgalls, as a peculiar resinous substance, but without assigning it any name. Seguin soon after engaged in a set of experiments on the art of tanning leather; during which he discovered that tan has the property of precipitating glue from its solutions in water, and of combining with the skins of animals. This led him to suppose it the essential constituent of the liquids employed for the purpose of tanning leather, the main tanning and tanning principle given it by the French chemists. But it is to Mr. Proust that we are indebted for the investigation of the nature and properties of tan, and of the methods of obtaining it in a separate state. Much curious and important information has likewise been obtained by the experiments of Mr. Davy on the constituent parts of astringent vegetables, and on their operation in tanning.

Tan exists in a great number of vegetable substances; but it may be procured most readily and in the greatest purity from nutgalls and catechu.

Nutgalls are excrences formed on the leaves and bark of the puncture of an insect which deposits its eggs on them. The best are known by the name of Aleppo galls, shipped in large quantities in this country for the use of the dyers, calico-printers, &c. and when exposed to the air, they are oxidized on the surface, of an olive-green colour, and an excessively disagreeable taste. They are in a great measure soluble in water; what remains behind is tasteless, and possesses the properties of the fibre of wood. A very great proportion of the water is necessary to carry off everything soluble. Deyouex found that a French pound of nutgalls required 96 French pints of water, applied in 20 different portions one after the other, and allowed to remain in a considerable time. This, reduced to our standard, gives us about 150 English pints to a pound troy of nutgalls.

From the analyses of Deyouex and Davy, it follows that the soluble part of nutgalls consists chiefly of five substances, namely, tan, extract, mucilage, gallic acid, and gallat of lime. Mr. Davy found that 500 grains of Aleppo galls formed with water a solution which yielded by slow evaporation 185 grains of matter. This he found composed of

- 130 tan
- 31 gallic acid and extract
- 12 mucilage and extract
- 12 lime and saline matter

183.

So that the tan constitutes rather more than two-thirds of the whole.

According to Mr. Davy, the strongest infusion of galls is of the specific gravity 1.069; and when evaporated at a temperature below 200° yields a mass composed of 95 per cent. of gallic acid and extract. But at a boiling heat most of the gallic acid is dissipated or destroyed, and a portion of the extract is rendered insoluble in water.

Catechu, or terra japonica as it is also called, is a substance obtained by decoction and evaporation from a species of the nitmous which abounds in India. It has a reddish brown colour, and an astringent taste, leaving an impression of sweetness; it is not altered by exposure to the air. There are two varieties of it; one from Bombay, which has the lightest colour, and a specific gravity of 1.39; and one from Bengal, which is the colour of chocolate; its specific gravity is 1.28. This substance was examined by Deyouex, and found to consist chiefly of tan, combined with a peculiar species of extract.

Tan obtained from the infusion of nutgalls is a brittle substance, of a brown colour. It breaks with a vitreous fracture, and does not distil moisture with it. Its taste is exceedingly astringent. It is very soluble in water. The solution is of a deep-brown colour, a very astringent and bitter taste; and has the colour which distinguishes a solution of nutgalls. If fruits, when agitated, like a solution of soap, but does not feel mucinous. Tan is still more soluble in alcohol than in water. The solution has a deep-brown colour and an astringent taste.

When heated, it blackens, emits carbonic acid gas, and in the open air bursts, leaving a smell of burnt lime.

From the experiments of Proust, Davy, and Deyouex, we learn that it is capable of combining with oxygen; but at the same time it is either decomposed altogether, or its nature, completely altered. Thus nitric acid, when thrown into a yellowish-brown matter soluble in alcohol, and similar in its properties to an extract. Oxymuriac acid produces similar effects; and Mr. Prae has observed, that
the peroxide of tin changes it also into an extract, perhaps by communicating oxygen.

The action of the metals upon tan does not seem to be great; but almost all the metallic oxides have an affinity for it, and are capable of combining with it to form nearly insoluble in water. Hence the reason why the infusion of nutgalls precipitates metallic solutions so readily. These compounds have been hitherto in a great measure overlooked by chemists. The following observations contain the facts at present known.

When the peroxide of tin or zinc is boiled in the infusion of galls, it acquires a dull yellow colour, and abstracts all the constituents from the infusion, leaving behind only pure water. The oxides thus combined with tan, &c. are partly soluble in nauritic acid, and the solution indicates the presence of tan and gallic acid. When the peroxide of tin is allowed to act upon the cold infusion, it abstracts all in a few days. Whose Mr. Pronst affirms, that in that case the gallic acid is mostly destroyed, and a portion of the tan brought to the state of extract.

When the metallic salts are mixed with the infusion of galls, the precipitate is formed, combined with the tan, the extract, and the acid of the infusion; and, according to Davy, it contains also a portion of the acid of the metallic salt.

Tan produces no change upon the solution of sulphur of iron; but when it is mixed with a solution of the oxysulphate of iron, a deep blue coloured precipitate immediately appears, consisting of the tan combined with the oxide. This precipitate, when dried, assumes a black colour. It is decomposed by acids.

When too great a proportion of oxysulphate of iron is poured into a solution of tan, the sulphuric acid, set at liberty by the combination of the iron and tan, is sufficient to redissolve the precipitate as it appears; but the precipitate obtained in this way, contains, through saturating this excess of acid with potass. When the experiment is performed in this manner, all the oxysulphate of iron which remains in the solution is undecomposed. Care must be taken not to add an excess of the solution to the liquid from which the tan is to be separated; because the compound of tan and gelatine is re-dissolved by the solution of gelatine. According to the analysis of Mr. Davy, this compound, when dried in the temperature of 150°, is composed of 54 gelsine 46 tan 100.

It appears, from the experiments of Mr. Davy and Mr. Chenevix, that tan is sometimes formed in vegetables by the action of heat. Thus no tan can be detected in the decoction of coffee-beans, unless they have been roasted; but in that case their decoction precipitates gelatine.

From the experiments of Mr. Davy, we infer that most of the different classes of bodies capable of combining with tan are nearly in the following order:

Earth, Acid, Alkalies, Neutral salts, Gelatine,

But the order of the individual substances belonging to each of these classes remains still to be ascertained.

Tan affects particularly the bark of trees: but it also exists in the sap and in the wood of a considerable number, and even in the leaves of many. It is very seldom that it exudes spontaneously; yet this seems to be the case with a variety of kio.

It has been ascertained by Mr. Biggin, that when the barks of trees are examined at different seasons, they vary in the quantity of tan. The quantity varies also with the age and size of the tree. The greatest proportion of tan is contained in the inner barks. The epidermis usually contains none.

The following table exhibits the proportion of solid matter extracted by water from different vegetable substances, and the quantity of tan contained in that solid matter, as ascertained by the experiments of Mr. Davy.

<table>
<thead>
<tr>
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<tbody>
<tr>
<td>White inner bark of old oak</td>
<td>108</td>
<td>72</td>
</tr>
<tr>
<td>Young oak</td>
<td>111</td>
<td>77</td>
</tr>
<tr>
<td>Spanish chestnut</td>
<td>89</td>
<td>63</td>
</tr>
<tr>
<td>Leicester willow</td>
<td>117</td>
<td>72</td>
</tr>
<tr>
<td>Entire bark of oak</td>
<td>61</td>
<td>39</td>
</tr>
<tr>
<td>Entire bark of Spanish chestnut</td>
<td>53</td>
<td>21</td>
</tr>
<tr>
<td>Leicester willow</td>
<td>71</td>
<td>33</td>
</tr>
<tr>
<td>Elm</td>
<td>13</td>
<td>11</td>
</tr>
<tr>
<td>Common willow</td>
<td>16</td>
<td>12</td>
</tr>
<tr>
<td>Sicilian sumach</td>
<td>16</td>
<td>12</td>
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<tr>
<td>Malaga sumach</td>
<td>150</td>
<td>79</td>
</tr>
<tr>
<td>Souchong tea</td>
<td>48</td>
<td></td>
</tr>
<tr>
<td>Bombay catechu</td>
<td>26</td>
<td>26</td>
</tr>
<tr>
<td>Bengal catechu</td>
<td>23</td>
<td>23</td>
</tr>
<tr>
<td>Nutgalls</td>
<td>127</td>
<td></td>
</tr>
</tbody>
</table>

TANACETUM, tansy, a genus of plants of the class of synagenesia, and order of polygamous, and in the natural system ranging under the 40th order, composite. The receptacle is naked; the pappus somewhat emarginated; the calyx imbricated and hemispherical; the flrets of the radius are tri-lobed, and scarcely dis-tinguishable. There are nine species; of which one only is a native of Britain, the vulgar, or common tansy. Of this species there is a variety with curled leaves, which is therefore called curled tansy. The tansy has a bitter taste, and an aromatic smell, disagreeable to many people. It is esteemed good for warming and strengthening the stomach; for which reason the young leaves have obtained a place among the culinary herbs, their juice being an ingredient in puddings, &c. It is rarely used in medicine, though extolled as a good emmenagogue. A drachm of the dried flowers has been found very beneficial in hysterical disorders arising from suppression. The seeds and leaves were formerly in considerable esteem for destroying worms in children, and are reckoned good in cholics and flatulencies.

TANACETUM, a genus of the angiosperma order, in the didynamia class of plants, and in the natural method ranging under the 45th order, putaminae. The calyx is monophylous, tubulate, truncate, and entire; the corolla long, monopetalous, and white; the tube cylindrical; the lymi erect, spreading, and nearly equal; the nut a berry, covered with a thick, large, oblong, internally divided into two parts; in the pulp are contained a number of seeds. There are only two species of this genus, the juroba and pahastaticum, both natives of Jamaica. They grow by the sides of rivers, and climb on trees and bushes.

TANAGRA, tanger, in ornithology, a genus of birds belonging to the order of passerises. The beak is conical, acuminate, emarginated, almost triangular at the base, and inclining a little towards the point. Dr. Latham has described 44 species, all of which are of foreign extraction. See Plate Nat. Hist. f. 398.
Tangent, in geometry, is defined, in general, to be a right line which touches any arc of a curve, in such a manner that no right line can be drawn between the tangent and the arc. See Plate Miscd. fig. 229.

The tangent of an arc is a right line drawn perpendicular to the arc at the end of a diameter, passing to one extremity of the arc, and terminated by a right line drawn from the centre through the other end of the arc, and called the secant.

The tangent of a curve is a right line which only touches the curve in one point, but does not cut it.

In order to illustrate the method of drawing tangents to curves, let AGC (fig. 227) be a curve of any kind, and C the given point from where the tangent is to be drawn. Then conceive a right line, $mC$, to be carried along uniformly, parallel to itself, from A towards Q; and let, at the same time, a point $p$ so move in that line, as to describe the given curve AGC; also let $mM$, or $Cp$, express the fluxion of $AM$, or the velocity wherewith the line $mc$ is carried; and let $sc$ express the corresponding fluxion of $CM$, or the velocity of the point $p$, in the line $mp$: moreover, through the point $C$ let the right line SF be drawn, meeting the axis of the curve, AQ, in F.

Now it is evident, if the motion of $p$, along the given curve, be supposed to be the same equitable at C, the point $p$ would be at S, when the line itself had got into the position $sc$; because, by the hypothesis, $Cm$ and $sc$ express the distances that must be described by the two uniform motion in the same time. And if $sc$ is assumed to represent any other position of that line, and the contemporary position of the point $p$, it will have an equipollent velocity of the same distance $Ce$, and $es$, gone over in the same time by the two motions, will always be to each other as the velocities, or as $Ce$ to $as$. Therefore, since $Cm = sc$, $C = as$ (which is a known property of similar triangles), the point $p$ will always fall in the right line $FC$ fig. 228; whence it appears, that if the motion of the point $p$ along the line $mc$ was to become uniform at C, that point would then move in the right line CS, instead of the curve-line CG. Now, seeing the motion of $p$, in the description of curves, must either be an accelerated or retarded one: let it be first considered as an accelerated one, in which case the arc CG will fall wholly above the line $FC$; but, because the distance of the point $p$ from the axis AQ, at the end of any given time, is greater than it would be if the acceleration was to cease at C; and if the acceleration is continued, it will be always found in the said right line $FS$. But if the motion of the point $p$ is a retarded one, it will appear, by argument in the same manner, that the arc CG will fall wholly below the right line CD, as in fig. 229.

This being the case, let the line $mg$, and the point $p$, along that line, be now supposed to move back again, towards A and $m$, in the same manner they proceeded from thence; then, since the velocity of $p$ did before increase, it must now, on the contrary, decrease; and therefore a point, at the end of a given time, after re-passing the point C, is not so near to AQ, as it would have been had the velocity continued the same as at C, the arc $Ch$ (as well as $CG$) must fall wholly above the right line $FC$, and the point $p$ would be $as$ instead of $es$ (which is a known property of similar triangles). The point $p$ will always fall in the right line $FS$ as before. But if the motion of the point $p$ is a retarded one, it will appear, by argument in the same manner, that the arc $Cg$ will fall wholly below the right line $CD$, as in fig. 229.

In a preceding article (Tan), it was stated that gelatine with tannin, or the tanning principle of vegetables, formed a combination which is insoluble in water. Upon this depends the art of making leather; the gelatinous part of the skin combining with the tannin of the bark, forms that leather.

The process which has long been used in this country is as follows: The leather tanned in England consists chiefly of three sorts, known by the names of butts or backs, hides, and skins. Butts are generally made from the stoutest and heaviest ox-hides, and are generally made from the stoutest and heaviest ox-hides, and are managed as follows: after the horns are taken off, the hides are laid smooth in heaps for one or two days in the summer, and for five or six in the winter; they are then hung on poles in a close room called a smoke-house, in which is kept a smouldering fire of wood; this occasions a small degree of purification, by which means the hair is easily got off, by spreading the hide on a sort of wooden horse or beam, and scraping it with a crooked knife. The hair being taken off, the hide is thrown into a pit or pool of water, to cleanse it from the dirt, &c., which being done, the hide is again spread on the wooden beam, and the grease, loose or extra-fat, &c., carefully scrubbed out or taken off; the hides are then put into a pit of strong liquor, called ooze, prepared in pits kept for the purpose, by infusing ground bark in water; this is termed colouring; after which they are removed into another pit, called a scouring, which consists of water strongly impregnated with vitriolic acid, or with a vegetable acid prepared from rye or barley. This operation (which is called raising), by drawing out the fluid of the hides, occasions them more readily to imbibe the oozc, the effect of which is to combine with the gelatinous part of the skin, and form with it leather. The hides are then taken out of the scouring, and sprinkled with water, filled a bander, with a quantity of ground bark strewn between each. After lying a month or six weeks, they are taken up; and the decayed bark and liquor being drawn off out of the pit, it is filled again with strong oozc, when they are put in as before, with bark between each hide. They now lie two or three months, at the expiration of which the same operation is repeated; and they remain four or five months, when they again undergo the same process, and after being three months in the last pit, are completely tanned; unless the hides are so remarkably stout as to want an additional pit or layer. The whole process requires ten or twelve months, and sometimes two years, according to the substance of the hide, and discretion of the tanner.

When taken out of the pit to be dried, they are hung on poles; and after being compressed by a steel pin, and beaten together by wooden hammers, called battes, the operation is complete; and when thoroughly dry, they are fit for sale. Butts are chiefly used for the soles of stout shoes.

The leather which under the denomination of hides, is generally made of cow hides, or the lighter ox-hides, which are thus managed: After the horns are taken off, and the hides washed, they are put into a pit of water, saturated with lime; where they remain a few days, when they are taken out, and the hair scraped off on a wooden beam, as before described; they are then washed in a pit or pool of water, and the loose flesh, &c., taken off, and the hides are then shifted into a pit of weak oozc, where they are taken up, and put down (which is technically termed handling) two or three times a day, for the first week; every second or third day they are shifted into a pit of fresh oozc, somewhat stronger than the former, till the end of a month or six weeks they are put into a strong oozc, in which they are handled once or twice a week with fresh bark for two or three months. They are then removed into another pit, called a layer, in which they are laid smooth, with bark ground very fine, strewn between each hide. After removing here two or three months, they are generally taken up, when the oozc is drawn out, and the hides put into a pit with fresh oozc and fresh bark, where, after lying two or three months more, they are completely tanned; except a very few stout hides, which may require an extra layer; they are then taken out, and hung on poles, and being hammered and smoothed by a steel pin, are then dry, fit for sale. These hides are called crop hides; they are from ten to eighteen months in tanning, and are used for the soles of shoes.

Skins is the general term for the skins of calves, seals, hogs, dogs, &c. These, after being washed in water, are put into lime-pits, as before mentioned, where they are taken.
The resemblance between the oxides of tantalum and columbium is striking. The only property in which they differ is the insolubility of the first in acids; but we know not what acids Ekeberg tried, and Mr. Hatton's "full solution of columbium in nitric acid.

Tantalus, or irlenis, a genus of birds of the order Grallae. The generic character is bill long, subulate, rufous ascended; face naked; nostrils oval; feet four-toed, palmar opposite. This is a rare species. The most remarkable are:

1. The loculator, or wood ibis: (1) face bluish; bill reddish; legs, quill and tail feathers, black; body white. (2) Head and neck white, varied with yellow; body black; belly crimson. (3) Wing feathers white, with a black blotch in the middle. Inhabit New Holland, and the warmer parts of America. It is three feet long; is very slow in flight, and stupid; sits on trees, and feeds on herbs, seeds, fruits, fish, and reptiles. The flesh is very much esteemed.

2. The leucophaeus, or white-headed ibis, inhabits India; and every year before the rainy season sets in, it sheds its rosy feathers.

3. The ibis, or Egyptian ibis, inhabits in vast numbers the lower part of Egypt, and is held sacred by the inhabitants; it is clearing the land of reptiles and insects, which are left after the inundation of the Nile. It rests in an erect posture, and is said to destroy the young of the crocodile.

4. The melanocephalus, or black-headed ibis, is a very beautiful bird that inhabits India. See Puste Nat. Hist. f. 391.

Tantalus's Cup. See Hydraulics.

Tapestry. See Tendrillae.
groove from one end to the other, capable of containing a long round piece of wood, fastened therein with hooks. The use of it is to tie the ends of the warp to. The warp, which may be from one or two inches thick, is wound on the upper roller; and the work, as fast as woven, is wound on the lower. Withinside the planks, which are seven or eight feet high, 14 or 15 inches broad, and three or four thick, are holes pierced from top to bottom, in which are put thick pieces of iron, with hooks at each end, serving to sustain the cost-stave: these pieces of iron have also holes pierced, by putting a pin in which, the stake is drawn nearer or set further off; and thus the costs or threads are stretched or loosened at pleasure. The cost-stave is about three inches diameter, and runs all the length of the loom; on this are fixed the costs or threads, which make the threads of the warp cross each other. It has much the same effect here, as the spring-stave and threadles have in the common looms. The costs are little threads fastened both ends of the warp, in a kind of sliding knot, which forms a sort of mesh or ring. They serve to keep the warp open for the passage of brocades woven with silks, woollens, or other matters used in the piece of tapestry. The last piece, or threads, are a number of little sticks of different lengths, but all about an inch in diameter, which the workman keeps by him in baskets, to serve to make the threads of the warp cross each other, by passing each cross thread through these, and crowed may retain their proper situation, a packthread is run among the threads, above the stick.

The loom being thus formed, and mounted with its warp, the first thing the workman does, is to draw on the threads of this warp, the principal lines and strokes of the design to be represented on the piece of tapestry; which is done by applying cartons, made from the painting he intends to copy, to the side that is to be the wrong side of the piece and back, with a blacklead pencil, following and tracing out the contours thereof on the thread of the right side, so that the strokes appear equally both before and behind.

As for the original design the work is to be finished by, it is hung up behind the workman, and wound on a long staff, from which a piece is unwound from time to time as the work proceeds.

Besides the loom, &c. here described, there are three other principal instruments required for working the silk or the wool of the wood within the threads of the warp; these are a broach, a reed, and an iron needle.

The broach is made of a hard wood, seven or eight inches long, and two-thirds of an inch thick, ending in a point with a little handle. This serves as a shuttle; the silks, woollens, or cottons, which are to be used in the work, being wound on it.

The reed or comb is also of wood, eight or nine inches long, and an inch thick on the back, whence it grows less and less to the extremities of the teeth, which are more or less apart, according to the greater or less degree of fineness of the intended work. Lastly, the needle is made in form of the common needle, only larger and longer. Its use is to press close the silks when there is any line or colour that does not fit well.

All things being prepared for the work, and the workman ready to begin, he places himself on the wrong side of the piece, with his back towards the design; so that he works on what he does, and being obliged to quit his post, and go to the other side of the loom, whenever he would view and examine the piece, to correct it with his pressing-needle. To put silk, &c. in the warp, he has to turn and looks at the design; then, taking a broachful of the proper colour, he places it among the threads of the warp, which he brings cross each other with his fingers, by means of the costs or threads fastened to the staff; then, as he repeats every time he is to change his colour, having placed the silk or wool, he beats it with his reed or comb; and when he has thus wrought in several rows over each other, he goes to see the effects they have in order to reform the contours with his needle, if there should be occasion. As the work advances, it is rolled upon the lower beam, and they urrel as much warp from the upper beam above to the lower, as is the like they do of the design behind them.

When the pieces are wide, several workmen may be employed at once.

We have two things to add: the first is, that the thread does go on much more slowly than the low-warp, and takes up almost twice the time and trouble. The second is, that all the difference that the eye can perceive between the two kinds, consists in this: the warp there is wound to a new fillet, about one-twelfth of an inch broad, running on each side from top to bottom, which is wanting in the high warp.

But, for the satisfaction of our readers, we shall here describe the principal parts of the loom for the manufacture of tapestry of the high warp, or that in a situation perpendicular to the horizon. The loom consists,

1. Of two strong upright posts fixed in the floor; these support (2) two rollers, of which the upper end holds the chain, the lower holds the tapestry, which is rolled upon it according as the work goes forward: the threads are fastened at their ends to a sheet, or thick rod, which is lodged in an iron groove in the lower roller.

2. The two tauters, one called the great tauter, for turning the upper roller; the other, the little tauter, for turning the lower roller.

3. The pole of the leashes, which runs quite across the chain, takes up all the leashes, and brings them to the workman's hand. These leashes are little strings, tied by a slip-knot to each thread of the chain, to be raised up according as the chain sinks down; they serve to draw the particular thread with which the Weaver wants. He holds the thread separate from the rest, and passes a spindle of such a wood and colour as he thinks proper; then he lets the spindle hang down, and hinders the thread from running off by a slip-knot. After having taken one or two threads of the fore part of the chain by another leesh, he brings the threads of the opposite side to him. By this alternative work he constantly makes them cross one another; and as there are more or less less apart, the greater or less degree of fineness of the intended work. Lastly, the needle is made in form of the common needle, only larger and longer. Its use is to press close the silks when there is any line or colour that does not fit well.

pass the pole of the leashes.

6. The crossrod. 7. A little chain, each loop of which contains four or five threads of the warp, and keeps them perpendicular. 8. An iron hook, to pass the broach, or the crossrod, or the brougher-quill, to pass the threads of the woof, which is wound on it. 10. The comb to strike in the work. 11. The end of the deset let into the roller, in a groove.

When the chain is mounted, the draughtsman traces the principal outlines of the picture, which is to be wrought with black chalk on the fore and back side of the chain. The Weaver in the upright way having prepared a ground, or thread of all the threads of all the colours, goes to work, placed on the back part, as in the flat way, or in the manufacture of the low warp. He has behind him his drawings, on which he frequently looks, that he may find time to time to see how his work succeeds on the right or fore side, which the other cannot do.

TAPIR, a genus of quadrupeds of the order bellus. The generic character is, front teeth in both jaws, ten; canine teeth in both jaws, single, incurved; grinders in both jaws, five on each side, very broad; feet with three hoofs, and a fifth fore foot.

Tapi Herean American, American tapir. The tapir, with respect to the size of its body, may be considered as one of the largest of all the native quadrupeds of South America, except the lately discovered equus bisulcus of Molina, its body being nearly equal to a horse. In its general form it bears some distant resemblance to the hippopotamus, and in the earlier editions of the Systema Naturae was ranked by Linnaeus in that genus, under the title of hippopotamus terrestris. By others it has been considered as more allied to the hog, and has been called cac aquaticus multhius, or water-hog with ingered hoof; but, in reality, the tapir cannot properly be associated, otherwise than by a distant general alliance, with any other quadruped, and forms a peculiar genus. It is of a gregarious nature, and inhabits the woods and rivers of the eastern parts of South America; occurring abundantly in the country of the Amazons; feeding chiefly by night, and eating sugar-canes, grasses, and various kinds of fruit. Its colour is an obscure brown, the skin itself being of that cast, and covered sparingly with somewhat short hair: the young animal is said to be commonly spotted with white. The male is distinguished by a kind of short proboscis or trunk, formed by the prolongation of the upper lip to some distance beyond the lower; this part is extensive, wrinkled at the sides, and in some degree resembles of that the elephant on a smaller scale, though not of the same tubular structure. The neck is very short, and furnished above with a rising mane; the body is thick and heavy; the back much arched; the legs short; the fore feet divided into four toes with pointed hoofs; the hind into three only; the tail is very short, thickish, and bristled. The female is said to be destitute of the proboscis.

In its manners this animal is perfectly harmless; endeavouring merely to save itself by flight when pursued, plunging into some river if at hand, and swimming with great readiness, and even continuing for a considerable time under water, in the manner
of the hippopotamus. The young is easily tamed, and may be rendered domestic, as is said to be the case in some parts of Guiana. In feeding, the tapir makes use in the same manner as the rhinoceros of its upper lip, to grasp the stems of plants, leaves, &c. Its most common activity, when at rest, is sitting on its rump, in the manner of dogs.

The tapir has been occasionally imported alive into Europe. The flesh is considered by the South Americans as a wholesome food, though not very pleasant or delicate, and the skin serves for various purposes where a strong leather is required. The Indians make shields of it, which are said to be so hard that an arrow cannot pierce them. This animal sleeps much by day in the retired parts of the woods, and is shot by the Indians with poisoned arrows. When attacked by dogs, it is said to make a very vigorous resistance. Its voice is a kind of whistle, which is easily imitated, and thus the animal is often deceived and trepanned. It is rather slow in its motions, and of a somewhat inactive disposition.

The tapir produces but one young at a birth, of which it is extremely careful; leading it early to the water, in order to instruct it in swimming, &c. See Plate Nat. Hist. fig. 392.

TAPPING. See SURGERY.

TAR. See Pinus, Resins, and Buiru-zen.

TARANTULA. See Aranea.

TARCHONANTHUS, pter-bane, a genus of plants belonging to the class of cryptogams, and to the order of polygonalas, and in the natural system ranging under the 40th order, composite. The receptacle is villous, and the pappus plukey; the calyx is monophyllous, turbinated, and half divided into seven segments. There are only three species known: the emopinius, glaber, and cricoide.

TARE, is an allowance for the outside package, that contains such goods as cannot be unpacked without detriment; or for the papers, threads, bands, &c. that bind any goods imported loose; or, though imported in casks, chests, &c. yet cannot be unpacked and weighed net.

TARGONIA, a genus of plants of the class of cryptogams, and natural order of algae. The calyx is bivalved, including a globular body. There is only one species; the hypophylla, which is a native of Great Britain.

TARGUM, a name whereby the Jews call the Chaldee paraphrases, or expositions of the Old Testament, in the Chaldean language.

TARIF, or Tariff, a table or catalogue, containing the names of different sorts of merchandise, with the duties to be paid, as settled by authority, among trading nations.

TARUS. See ANATOMY.

TARTAR, or, according to the new chemists, Tartrat, is obtained in a state of impurity, incrusted on the bottom and sides of casks in which wine has been kept. It is afterwards purified by dissolving it in boiling water, and filtering it while hot. On cooling, it deposits the pure salt in very irregular crystals. In this state, it is sold under the name of crystals or cream of tartar. This salt attracted the peculiar attention of chemists, probably in consequence of the eulogies bestowed on it by Paracelsus. It is called tartar, says he, because it produces the oil, water, tincture, and salt, which burn the patient as he puts does. According to him, it is the principle of all the sulfurous, or sulphuric acid. In every remedy, and all things contain the germ of this. This ridiculous theory was combated by Van Helmout, who gives a pretty accurate account of the formation of tartar in wine-casks. It was known to Van Helmout, and even to his predecessors, that potass could be obtained from tartar; but it was long a disputed point among chemists, whether the allah existed in it ready-formed. Duham, Margraf, and Rouelle, at last established that point beyond a doubt; but the other component part of tartar was unknown, or very imperfectly known, till Scheele pointed out the method of extracting it.

The crystals of tartar are very small and irregular. According to Mentat, they are prisms, somewhat flat, and mostly with six sides. Tartar has an acid, and rather unpleasant taste. It is very brittle, and easily reduced to powder. Its specific gravity is 1.03. It is soluble in about 40 parts of cold water, and in about 30 parts of boiling water. It is not altered by exposure to the air; but when its solution in water is allowed to remain for some time, the salt is gradually decomposed, a mucous matter is deposited, and there remains in solution carbonat of potass coloured with a little oil. This decomposition was first accurately described by Berthollet in 1782.

When tartar is heated, it melts, swells, blackens, and the acid is entirely decomposed. The same changes take place when the salt is distilled in close vessels. The phenomena of this distillation have been described by Scheele, distillation was the only method thought of for obtaining any knowledge of the tartric acid. These products are an enormous quantity of gas, consisting of carbonic acid and carburetted hydrogen, an oil, and an acid; and, according to some chemists, carbonat of ammonia. The acid obtained was long considered as a peculiar body, and was denominated pyro-tartaric acid by the French chemists in 1787. But Fourcroy and Vaquelin have lately demonstrated, that it is no other than acetic acid contaminated with a little empyreumatic oil.

Tartar, according to Bergman, is composed of

TARTARIC ACID. Scheele was the first who obtained this acid in a separate state. He communicated a property for obtaining it to Retzias, who published it in the Stockholm Transactions for 1770. It consisted in boiling tartar with lime, and in decomposing the tartrat of lime thus formed by means of hydrochloric acid.

1. The process employed at present for obtaining tartaric acid, which is the same with that of Scheele, is the following: Dissolve tartar in boiling water, and add to the solution powdered chalk, and all effervescences cease, and the liquid ceases to redden vegetable blue. Let the liquid cool, and then pass it through a filter. A quantity of tartar of lime (which is an insoluble white powder) remains upon the filter. Put this tartrat, previously well washed, into a glass cucurbit, and pour in a quantity of sulphoric acid equal to the weight of the chalk employed, which must be diluted with water. Allow it to digest for twelve hours, stirring occasionally. The sulphuric acid displaces the tartrat; sulphat of lime remains at the bottom, while the tartaric acid is dissolved in the liquid part. Decant off this last, and try whether it contains any sulphuric acid. This is detected by a little acetate of lead; a precipitate appears, which is insoluble in acetic acid if sulphuric acid is present, but soluble if it is absent. If sulphuric acid is present, the liquid must be digested again on some more tartar of lime; if not, it is to be slowly evaporated, and about one-third part of the weight of the tartar employed is obtained of crystallized tartaric acid.

2. The form of its crystals is so irregular, that every chemist who has treated of this subject has given a different description of them. According to Bergman, they generally consist of divericating lamelle; according to van Pucken, they assume oftenest the form of long-pointed prisms; Spelimen and Corvinus obtained them in groups, some of them lance-shaped, others needle-formed, others pyramidal. Moreau obtained them needle-like. Their specific gravity is 1.220 to 1.230.

3. Crystallized tartaric acid does not experience any change in the open air, but heat decomposes it altogether: in the open fire it burns without leaving any other residuum than a spongy charcoal, which generally contains a little lime. When distilled in close vessels, it is converted into carbonic acid gas and carburetted hydrogen gas, a coloured oil, and a reddish acid liquor, which was formerly distinguished by the name of pyro-tartaric acid, but which Fourcroy and Vaquelin have lately ascertained to be merely acetic acid impregnated with oil.

4. Tartaric acid dissolves readily in water. Bergman obtained a solution of the specific gravity of which was 1.230. Moreau observed, however, that crystals formed spontaneously in a solution, the specific gravity of which was 1.084. It is not liable to spontaneous decomposition when dissolved in water, unless the solution is considerably diluted.

5. Neither its action on oxygen gas nor on simple combustibles and incombustibles has been examined; but it is probable that it is not capable of producing any volatile change on them. It is capable of oxidizing iron and zinc, and even mercury; but it does not act

11
TAX

upon antimony, bisnuth, tin, lead, copper, silver, gold, or platinum. Its action on the other metallic bodies has scarcely been examined.

6. It combines with alcalis, earths, and metallic oxides, and forms salts known by the name of tartrats.

7. The action of the greater part of the other acids on it is unknown. Hermstid has ascertained, that it may be converted into oxalic acid by distilling it repeatedly with six times its weight of nitric acid. By this process he obtained 360 parts of oxalic acid, from 100 parts of tartaric acid.

8. From this result, and from the product obtained when tartaric acid is distilled, it is evident that it is composed of oxygen, carbon, and hydrogen. Fourcroy informs us, that Vauquelin and he have ascertained that these ingredients are combined in it in the following proportions:

70.5 oxygen
19.0 carbon
10.5 hydrogen

100.0

The affinities of this acid follow the same order as those of oxalic acid.

The crystals in a state of purity, has scarcely been put to any use; but some of the compounds into which it enters are much employed in medicine. This acid has the property of combining in two different proportions with a great number of bases. With potass, for instance, in one proportion, it forms a salt pretty soluble in water, called tartar of potass; but when added in a greater proportion, it forms tartar, a salt very imperfectly soluble in water. By this property, the presence of tartaric acid, in any acid solution, may easily be detected. All that is necessary is, to drop in slowly a little solution of potass; if tartaric acid is present, tartar immediately precipitates in the form of a white gritty precipitate.

TARTRATES, salts formed with the tartaric acid.

TAURUS. See Astronomy.

TAX. See Revenue, Customs, &c.

TAXUS, the Yew-tree, a genus of plants of the class of dicere, and order of monadelphia; and in the natural system ranging under the 31st order, conifer. There is no male calyx or corolla; the staenia are numerous; the anthere petalated and ocellated. The female has no corolla nor style, and only one seed with a calyce resembling a berry very entire. There are four species; of which the buccata, or common yew-tree, is a native of Britain, France, Switzerland, &c. and of North America. It is distinguished from the other species by linear leaves which grow very close, and by the receptacles of the male flowers being subglobose. The wood is reddish, full of veins, and flexible, very hard and smooth, and almost incorruptible. Its hardness renders it very proper for turners and cabinet-makers. Its berries are often eaten by birds, and are therefore not poisonous; but there is a report that the leaves are poisonous to cattle, and many facts are mentioned of horses and cows having eaten them. Others, however, deny these facts. It is of no great height, but the trunk grows to a large size. Mr. Pennant has taken notice of a very remarkable de-
mall tract of land before several persons of the highest rank at the court of France.

It was, however, till the French revolution, that the telegraph was applied generally to useful purposes. M. Chappe, and his colleague, had invented the telegraph first used by the French about the end of 1793, knew any thing of Amonton's invention or not, it is impossible to say; but his telegraph was constructed on principles nearly similar. The manner of using this telegraph was as follows: At the first station, which was on the roof of the palace of the Louvre at Paris, M. Chappe, the inventor, received in writing, from the committee of public welfare, the words to be sent to Lille, near which the French army at that time was. An upright post was erected on the Louvre, at the top of which were two transverse arms, moveable in all directions by a single piece of mechanism, and with inconceivable rapidity. He invented a number of positions for these arms, which stood as signs for the letters of the alphabet; and these, for the greater celerity and simplicity, he reduced in some letters, as follows:

The grammarian will easily conceive that sixteen signs may supply all the letters of the alphabet, since some letters may be omitted not only without detriment but with advantage. The advantage which would be thereupon in the mode of that list could be changed every week; so that the sign of B for one day might be the sign of M the next; and it was only necessary that the person at the extremities should know the key. The instructions to operators were only given in such a manner that those which were so distinct, so marked, so different from one another, that they were easily remembered. The construction of the machine was such, that each signal was uniformly given in precisely the same manner at all stations; it did not depend on the operator's manual skill; and the position of the arm could never, for any signal, be a degree higher or a degree lower, its movement being regulated by pulleys, to the last station.

M. Chappe, having received at the Louvre the sentence to be conveyed, gave a known signal to the second station, which was Mont Martre, to prepare. At each station there was a man or a few men who were fixed, and the person on watch gave the signal of preparation which he had received, and this communicated successively through all the line, which brought them all into a state of readiness. The person at Mont Martre then received, letter by letter, the sentence from the Louvre, which he repeated with his own machine; and this was again repeated from the next height, with inconceivable rapidity, to the final station at Lille.

The first description of the telegraph was brought from Paris to Frankfort on the Maine by a former member of the parliament of Bourdeaux, who had seen that which was erected on the mountain of Belvile. As given by Dr. Hutton from some of the English papers, it is as follows: AAA is a beam or mast of wood placed upright on a rising ground (Plate Miscel. fig. 231), which is about 15 or 16 feet high. BBB is a balance made from the centre AA. This balance-beam may be placed vertically or horizontally, or any how inclined, by means of strong cords, which are fixed to the wheel D, on the edge of which is a double groove to receive the two cords. This balance s about eleven or twelve feet long, and nine inches broad, having at the ends two pieces of wood CC, which likewise turn upon an arm, and are made so that passing through the axis of the main balance, otherwise the balance would derange the cords; the pieces C are each about three feet long, and may be placed either to the right or left, straight, or with the balance-beam. By means of these three the combination of movement is very extensive, remarkably simple, and easy to perform. Below is a small wooden box, in which a person is employed to receive the movements of the machine. On the prominence nearest to this, another person is to repeat these movements, and a third to write them down. The time taken up for each movement is twenty seconds; of which the motion alone is four seconds, the other sixteen the machine is stationary. Two working models of this instrument were executed at Frankfort, and sent by Mr. W. Playfair to the duke of York, and hence the plan and alphabet of the machine was sent to London.

Various experiments were in consequence tried upon telegraphs in this country; and one was soon after set up by government in a chain of stations from the admiralty-office to the sea-coast. It consists of six octagon boards, each of which is pointed upon an axis in a frame, in such a manner that it can be either placed vertically, so as to appear with its full size to the observer at the nearest station as in fig. 232, or it becomes invisible to him by being placed horizontally, as in fig. 233, so that the narrow edge alone is exposed, which narrow edge is from a distance invisible. Fig. 232 is a representation of this telegraph, with the parts all shut, and the machine ready to work; T, in the officer's cabin, is the telescope pointed to the next station. Fig. 233 is a representation of the machine not at work, and with the ports all open. The opening of the first port expresses the letter A, the second B, the third c, the fourth d, the fifth e, the sixth f, &c.

Six boards make 36 changes, by the most plain and simple mode of working; and they will make 27 more if more were necessary; but as the real superiority of the telegraph over all other modes of making signals communicated, is its making it visible, we do not think that more changes than the letters of the alphabet, and the ten arithmetical cyphers, are necessary; but, on the contrary, that those who work the telegraphs should avoid communicating by words or signals agreed upon to express sentences; for that is the sure method never to become expert at sending un(expected intelligence accurately.

This telegraph is, without doubt, made up of the best number of combinations possible; and the second would have been of no use at all, would it have been useless. It has been objected to it, however, that its form is too clumsy to admit of its being raised to any considerable height above the building on which it stands; and that, if it could not to change in direction, and consequently cannot pass from one point to another.

Several other telegraphs have been proposed to remedy these defects, and perhaps others to which the instrument is still liable. The dial-plate of a clock would make an excellent telegraph, as it might exhibit 144 signs so as to be visible at a great distance. A telegraph on this principle, with only six divisions instead of twelve, would be simple and cheap; and might be placed on thirty feet high above the building without any difficulty: it might be supported on one post, and therefore turn round, and the contrast of colours would always be the same.

We shall now conclude this article with a short notice of Mr. John Garnet's most simple and ingenious contrivance. This is merely a bar or plank turned upon a centre, like the sail of a windmill; and being moved into any of the positions, which are the same as the letters or other marks. The consequence is obvious; the telescope being turned round till its wire-covers or becomes parallel to the bar, the index of the former necessarily points at the same letter or mark in its circle, as that of the latter, and the communication of sentiment is immediate and perfect. The use of this machine is so easy, that it has been put into the hands of two common labouring-men, who had never seen it before, and they have immediately held a quick and distant conversation together.

The more particular description and figure of this machine, are as follows. ADIE (fig. 234) is the telegraph, on whose centre of gravity C, about which it revolves, is a fixed pin, which goes through a hole or socket in the arm upright post G, and on the opposite side of which is fixed an index I. Connecting to C, on the same post, is fixed a wooden or brass circle, of six or eight inches diameter, divided into forty-eight equal parts, twenty-four of which represent the letters of the alphabet, and another twenty-four, so that the index, by means of the arm AB, may be moved to any letter or number. The length of the arm should be 24 or 3 feet for every mile of distance. Two revolving lamps of different colours suspended occasionally at A and B, the ends of the arm, would serve equally at night.

Let us (fig. 235) represent the section of the outward tube of a telescope perpendicular to its axis, and the like section of the sliding or adjusting tube, on which is fixed an index L. On the part of the outward tube next to the observer, there is fixed a circle of letters and numbers, similarly divided and situated to the circle in fig. 234; then the index I, in the shape of the same number, is turned so that the index may be turned to any letter or number. Now there being a cross hair, or fine silver wire, fixed in the focus of the eye-glass, in the same direction as the index I; so that when the arm AB (fig. 233) is fixed to the telescope, placed at a distance through the telescope, the cross hair may be turned, by means of the sliding tube, to the same direction of the arm AB; then the index I (fig. 233) will point to the same letter or number, on its own
circle, as the index I (fig. 234) points to on the telegraphic circle.

If, instead of using the letters and numbers to form words at length, they are used as signals, the amount of the information is increased a hundred thousand different signals.

TELEPHIUM, TRUE ORIGIN: a genus of plants of the class of pantandria, and order of trigynia; and in the natural system ranking under the 5-th order, merisculer. The calyx is perfectly lobed, there are five petals, which are inserted into the receptacle; the capsule is unilocular and trivalvular. There are two species, the Imperati and opposition. TEMPLE. See Ottics.

TELLER, an officer of the exchequer, in ancient records called taller; there are four of these officers, whose duty is to receive all sums due to the king, and to give the clerk of the exchequer a bill to charge him therewith. They likewise pull all money due from the king, by warrant from the auditor of the receiver; and make weekly and yearly books, both of their receipts and payments, which they deliver to the lord treas-

TELLINA, a genus of vermes testacese: the generic character is, the animal a tetys; shell bivalve, generally sloping on one side; in the fore-part of one valve a convex, of the other a concave fold; hinge with usually three teeth, the lateral ones smooth in one shell. There are about 100 species, divided into three sections: A ovate and thickish, B ovate and compressed, and C suborbicular. The tellina folicae is of section B, having the shell oval, with rough edges, the flattened sides serrate. It inhabits the Indian Ocean and is rare. See Pl. Nat. Hist. fig. 303.

TELLURIUM, a mineral found in Tansylvania, which Muller of Reichenbach examined in 1782, and concluded, from his experiments, that the ore, which had been distinguished by the names of metallic acidum, aurum paradoxicum, and aurum album, contains a new metal different from every other. Being dissatisfied with his conclusions, he examined by a specimen of it to Klaproth; but the specimen was too small to enable that illustrious chemist to decide the point. He ascertained, however, that the metal in question is not antimony. The experiments of Muller appeared so satisfactory, that they induced Mr. Kirwan, in the second edition of his Mineralogy, published in 1796, to give this metal a separate place, under the name of sylvanian. Klaproth published an analysis of the ore in 179, and completely confirmed the conclusions of Muller. To the new metal, which constitutes 0.925 of the ore, he gave the name of tellurium; and this name has been generally adopted. Gmelin examined the ore in 1799, and his experiments coincide almost exactly with those of Muller and Klaproth. By these philosophers the following properties of tellurium have been ascertained: Its colour is bluish-white, intermediate between gold and lead; its texture is laminated like antimony; and its brilliancy is considerable. Its hardness has not been ascertained. Its specific gravity, according to Klaproth, is 6. It is very brittle, and may be reduced to powder. It melts when raised to a temperature somewhat higher than the fusing-point of lead. If the heat is increased a little, it boils and evaporates, and attaches itself in brilliant drops to the upper part of the retort in which the experiment is made; and it emits a curious and arseneous, the most volatile of all the metals. When cooled slowly, it crystallizes.

When exposed to the action of the blowpipe upon charcoal, it takes fire, and burns with a lively blue flame, the colour of which are green; and it is completely volatilized in the form of a white smoke, which, according to Klaproth, has a smell not unlike that of radishes, but which Gmelin could not observe. This oxide is the oxide of tellurium, which may be obtained also by dissolving the metal in nitro-muriatic acid, and adding potas slowly till the oxide precipitates. This oxide is easily melted by heat into a straw-coloured mass of a radiated texture. When made into a paste with oil, and heated slowly, it changes into charcoal, without changing, with the action of a weight suspended from its extremity. Metals differ exceedingly from each other in tenacity. Iron wire, for instance, both an inch in diameter will stand without breaking, about 5000 lbs. weight; whereas a single strand of lead of the same diameter will not support above 200 lbs.

TENABLE. This word literally means stable. A military column on which was performed in the times of the ancients. In page 206 of Observations on the Military Art, we have the following account of it: A phalang, attacked by a lozenge or triangular wedge, built its right and left forward by a half-quarter conversion, each wing on their common centre; and when they found themselves opposite the sides of the enemy's arrangement, they each marched on their own sole, right before them; by which means they both could face the enemy together, at the same time, while the head was engaged and at blows with the centre of the phalanx that had kept its ground. Such instructions authors have left us of the design and effects of this formation.

The tellurium had considerable advantage over the triangular wedge; but, according to chevalier Foulard, it was not equally efficacious against the column. The latter could alter the direction of its march, and fall upon one of the wings, whether in motion or not, or detach the section of the tail or rear to take its wings in flank, while it was occupied in making the quarter-conversion. The column and talenaid attacked the enemy together, at the same time, while the head was engaged and at blows with the centre of the phalanx that had kept its ground. Such instructions authors have left us of the design and effects of this formation. The tellurium was unquestionably an excellent manoeuvre, and strictly conformable to a very wise maxim, which directs us to multiply our strength and efforts as much as possible against one point. We sometimes, indeed, make use of it in war without being sensible
of its advantages. This, however, does not hinder the manoeuvre from being well performed; for, as the nature of ground and not being level like a sheet of paper, the soldier, in ranging his troops, according to the advantages of the situation, does not form a perfect enfilade, such as may be drawn or sketched out, but one that shall cut the wind, which produces the same effects; and this is what should be sought on all occasions.

**TENAILLES.** In fortification, are low works made in the ditch before the curtains. There are three sorts of them, viz.: the first are the faces of the bastions produced till they meet the more much lower; the second have faces, flanks, and a curtain; and the third have only faces and flanks.

**TENAILLE, single,** a work whose front is advanced towards the country, having two faces, forming a re-entering angle; its two long sides terminate on the counterscarp, opposite to the angle of the shoulder.

**TENAILLE, double,** is a work whose front, having two faces, re-enters, and three salient angles; its long sides are likewise parallel, and terminate on the counterscarp, opposite to the angle of the shoulder. In both the single and double tenailles there is a slight flank or salient, formed at the re-entering angle, because the height of the parapet hinders the soldiers from discovering before that angle. Therefore tenailles should only be made when there is not room enough to make horn-works. The ramparts, parapets, ditches, covert-way, and glacis of tenailles, are the same with other works.

**TENAILLE of a place,** is what is comprised between the points of two neighbouring bastions; as the faces, flanks, and curtains. Hence it is said, the enemy attacked the whole tenaille of a place, when they made no attacks on the faces of the two bastions.

**TENANT,** signifies one who holds or possesses lands or tenements by any kind of right, either in fee, for life, years, or at will.

**TENCH.** See **CYPRINUS**.

**TENDER,** is an offer to pay a debt, or perform a duty. In every plea of tender, where money is the thing demanded by the action, and the debt or duty is not discharged by the tender and refusal, money may be brought in without leave of the court; but, if other things as well as money may, where a tender is pleaded, be brought into court: his is with more propriety called bringing into court generally, than a bringing money into court. In all other cases, the issue of the court must be had before money can be brought into court. The rule under which his leave is granted, is, as in the case of a judgment by a mortgagee, founded upon a particular act. In other acts, as, for instance, the rule is founded upon that discretionary power, which is, for the furtherance of justice, vested in the court. By the discretionary rule, it is sometimes ordered, that upon bringing money into court, all proceedings in action shall be stayed. At other times it is ordered, that the money brought into court shall be stuck out of the plaintiff's declaration, and at the plaintiff shall not, at the trial of the case, be permitted to produce evidence as to this money. This rule, by which the money brought into court is ordered to be struck out of the declaration, is from its being more Vol. II. frequently granted, than that by which it is ordered, that the proceeding shall be stayed, called the common rule. 5 Bac. Abr. 1.

If bank notes have been offered, and no objection made on that account, it has been considered by the court of king's bench as a good tender. 3 Durnf. and East, 554.

**TENDER, small ship in the service of men of war, for carrying of men, provisions, or any thing else that is necessary.**

TENDONS, are white, firm, and tenacious parts, continuous to the muscles, and usually forming their extremities.

**TENEBRIO, a genus of insects of the order Coleoptera.** The general character is, antennae moniliform, with the last joint rounded; thorax plano-convex, margined; head exserted; wing-sheaths stiltish. In this genus, of which there are more than 100 species, the body is obovate-oval, and in most species somewhat pointed at the extremity; it may be observed also that several species are destitute of wings. Among the European tenebriones one of the most remarkable is the *tenebrio monolopis,* a black insect measuring about an inch in length, with powerful short antennae, which, while at their extremities project a little beyond the body; this insect also perfectly connotes and undivided, forming a complete covering to the body, being carried over the sides to some distance beneath, and the insect is totally destitute of real or under wings. It is usually found in dark, neglected places, beneath boards, in cellars, &c.; and, if handled, especially if crushed, diffuses a highly unpleasant smell.

**Tenebrio globosus** is perhaps not a Linnean species, unless it is the *tenebrio* globosus of that author. It is seen in the hottest part of the summer about walls and pathways, and is distinguished by the remarkably globular appearance of the body; it is totally black, the under parts having sometimes a slight violaceous cast, and the joints of the feet, which are remarkably broad, are of a dull brown: the whole insect is of a very smooth, but not polished, surface, and usually measures about three quarters of an inch in length; in the winter it varies considerably, some specimens, probably the males, being considerably smaller. The antenna in this insect are beautifully moniliform, all the joints being globular.

**Tenebrio modicor** is an insect often seen in houses; it is one of the smaller kinds, and is coal-black, of a lengthened shape, with longitudinally striated wing-shells, and proceeds from a larva commonly known by the name of the meal-worm, from its being frequently found in flour, &c. It is of a yellowish white colour, about an inch long, slender-bodied, and of a highly polished surface, and is considered as the favorite food of the night- ingale when kept in a cage of captivity: it is said to remain two years before it hanges into a chrysals.

The genus *tenebrio* is numerous, and some of the exotic species much resemble the general appearance of those in Europe, but are much larger. Many others are small insects, and the genus has received, by later discoveries, such ascensions, that it has been divided into several distinct genera.

**TENEMENT.** In the common acceptation, is applied only to houses and other build-ings; but in its original, proper, and legal sense, it signifies every thing that may be held, provided it is of a permanent nature, whether it is of a substance, or of an unsubstantial and ideal kind. Thus frank tenement, or freehold, is applicable not only to lands and other solid objects, but also to offices, rents, commons, &c., and as lands and houses are tenements, so is an advowson a tenement; and a franchise, or office, a right of common, a peerage, or other property of the like unsubstantial kind, are all of them, legally speaking, tenements. 2 Black. 17.

**TENEMENTS LEGATIS, a writ that lies to London, or any other corporation;** is that men may dempe tenements as well as goods and chattels by their last will, for the hearing any controversy touching the same, and for rectifying the wrong.

**TENESMUS.** See **MEDICINE.**

**TENNIS,** a play at which a ball is driven by a racket, and the persons who would become players at tennis, provided they understand the rudiments of the game, as to form some judgment of the players, or at least to know who wins and who loses, we may presume to give so plain a description of it, that no one can make a loss, if ever he should bet or play. As to the executive part, it requires great practice to make a good player, so that nothing can be done without it; all we presume to do, is to give an insight into the game, by which a person may not see a total stranger to it when he happens to be in a tennis-court.

The game of tennis is played in most capital cities in Europe, particularly in France, where the custom is to derive its origin. It is esteemed with many to be one of the most antient games in Christendom, and long before king Charles I.'s time it was played in England.

This game is as intricate as any game whatever; a person who is totally ignorant of it may look on for a month together, without being able to make out how the game is decided. We shall begin therefore by describing the court in which it is played.

The size of a tennis-court is generally about 99 or 97 feet by 33 or 34, there being no exact dimension ascribed to its proportion, a foot more or less in length or width being of no consequence. A line or net hangs exactly across the middle, over which the ball must be struck, either with a racket or board, to make the stroke good. Upon the entrance of a tennis-court, there is a long gallery which goes to the dens, that is, a kind of front gallery, where the spectators usually stand; into which whenever the ball is struck, it tells for a certain stroke. This long gallery is divided into different compartments or galleries, each of which has its particular name, as follows; from the line towards the dens are the first gallery, door, second gallery, and the last gallery, which is called the service side. From the dens to the last gallery are the figures 1, 2, 3, 4, 5, 6, at a yard distance, which the chaces are marked, and is one of the three long parts of the game, as will appear in the following description.

On the other side of the line are also the first gallery, door, second gallery, and last...
TENNIS.

The chances on the hazard-side proceed from the ball being returned either too hard or not quite hard enough; so that the ball after its first rebound falls on this side of the blue line, or line which describes the hazard-side chaces; in which case it is a chance at 1, and there is no chance depending.

When they change sides, the players, in order to win this chance, must put the ball over the line in any way, so that his adversary cannot return it. When there is no chance on the service-side, the players put over the line from the service-side, without being returned, reckon for a stroke.

As the game depends chiefly upon the marking, it will be necessary to explain it, and to recommend those who play at tennis to have a good and unbiased marker, for on him the whole set may depend: he can mark in favour of the one and against the other in such a manner, as will render it two to one to the first player, starting, though even played. Instead of which the strokes should be very attentive to the chaces, and not be any way partial to either of the players.

This game is marked in a very singular manner, which makes it at first somewhat difficult to understand. The first stroke, third, third 30, the third 40, and the fourth game, unless the players get four strokes each; in that case, instead of calling it 40 all, it is called deuce; after which, as soon as any stroke is got, it is called advantage; and when the strokes become equal again, deuce again, till one of the other gets two strokes following, which win the game; and as the games are won, they are marked and called; as one game, two games, and so to one, &c. towards the set, of which so many of these games it consists.

Although but one ball at a time is played with, a number of balls are made use of at this game to avoid trouble, and are handed to the players in baskets for that purpose; by which means they can play as long as they please without ever having occasion to stop for a ball.

As to the odds at tennis, they are by no means fixed, but are generally laid as follow:

Upon the first stroke being won between even players, that is, fifteen love, the odds of the single game 7 to 4

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The odds of a four-game set when the first game is won, are 3 to 2.

When two games love | 4 1
Three games love | 2 1
When two games to one Three games to one | 2 1

The odds of a six-game set when the first game is won, are 2 to 1.

When two games love | 4 1
Four games love | 1 1
Five games love | 2 1
When two games to one Three games to one | 2 1
Four games to one | 2 1
Five games to one | 2 1
When three games to two Four games to two | 4 1
Five games to two | 2 1
When four games to three Five games to three | 2 1
The odds of an advantage-set when the game is won by the player, are 2 to 1.

When two games love | 3 1
Three games love | 1 1
Four games love | 1 1
Five games love | 2 1
Three games to one | 2 1
Four games to one | 2 1
Five games to one | 2 1
When three games to two Four games to two | 4 1
Five games to two | 2 1
When four games to three Five games to three | 2 1
When five games to four Five games to five | 2 1
When six games to five | 2 1

The foregoing odds, as beforefised, are general laid; but the chaces intezner make the odds very precarious; for example, when there is a chance at half a yard, and a set is five games all, and in every other respect equal, the odds are a good five to four; and if it were six games five, and forty thirty, with the same chace, the odds would then be a guinea to a shilling; so that it is plain that the odds at this game differ from those of any other; for one stroke will ruin the set, that is, it will take all the five games all, from an even wager to three to two, and so in proportion to the stage of the set.

There are various methods of giving odds at tennis, in order to make a match equal; and that they may be understood, we shall give the following list of them, with their respective meanings, so that any person may form a judgment of the advantage received or given.

The lowest odds that can be given, excepting the choice of the side, is what they call a bisque, that is, a stroke to be taken or scored whenever the player, who receives the advantage, thinks proper: for instance, suppose a critical game of the set to be forty thirty, by taking the stroke of forty thirty, they give the adversary so in respect of two bisques, &c.

The next greatest odds are fifteen, that is, a certain stroke given at the beginning of each game.

After these, half thirty, that is, fifteen one game, and so on to the next. Then follow the whole thirty, forty, &c.

There are also the following kind of odds which are given, viz. Round services: those are services given round the penthouse, so as to render it easy for the players to return it.

Half-court, that is, being obliged or confined to play within the compass of the walls, or sides of the court. This is a considerable advantage, given by him so confined, but the straight half-court is the greatest.

Touch-no-wall, that is, being obliged to play within the compass of the walls, or sides of the court. This is a considerable advantage, given by him so confined, but the straight half-court is the greatest.

Touching the hazards, that is, barring the dedans, gallery, or the last gallery on 9.
the hazard-side, or any particular one or more of them.

There are the common kind of odds or advantages given; but there are many others, which are according to what is agreed by the players; such as playing with board against racket, cricket-bat against racket, &c.

The guard is a weapon played by four persons, two partners on each side. In this case, they are generally confined to their particular quarters, and one of each side appointed to serve and strike out; in every respect, the game is played in the same manner as when two only play.

Any thing more to be said upon this subject would be needless, as nothing can be recommended, after reading this short account of tennis, but practice and attention, without which no one can become a proficient at the game.

TENON, in building, &c. the square end of a piece of wood, or metal, diminished by one-third of its thickness, to be received into a hole in another piece, called a mortise, for jointing or fastening the two together. It is made in various forms, square, dove-tailed, for double mortises, &c.

TENOR, of writing, &c. is the substance or purport of them, or a transcript or copy.

TENOR, in music, the second of the four parts in harmonical composition, reckoning from the bass. The tenor is the part most accommodated to the common voice of man, from which circumstance it has sometimes, by way of preference, been called "the human voice." Its general compass extends from C above G to G the treble-cliff note.

The tenor was formerly the plain-song, or principal part in a composition, and derived the name of tenor from the Latin word teno, I hold; because it held or sustained the air, point, substance, or meaning, of the whole cantus, and every part superadded to it was considered but as its auxiliary. It appears that the contrary practice of giving the air to the soprano, or treble, had its rise in the tendency of the ancient music to revolve musical themes round a central point, and to introduce them into musical performances; since which it has been universally adopted both in vocal and instrumental music.

TENOR-CLIFF, the name given to the C cliff when placed on the fourth line of the slave. See CLIFF.

TENOR VIOIN, or Viola, a stringed instrument resembling the violin, but lower in its scale, having its lowest note in C above G gamut. In concert this instrument takes the part next above the bass.

TENSE, tense, in grammar, an inflection of verbs, wherein they are made to signify or distinguish the circumstance of time, in what they affirm.

TENSION, the state of a thing stretched. Thus animals sustain and move themselves by the tension of their muscles and nerves. A chord or string gives an acute or deeper sound, as it is in a greater or less degree of tension, that is, more or less stretched or tightened.

TENT, in surgery, a roll of lint worked into the shape of a nail, with a broad flat head. See LINT, LINT-ROLL.

TENTER, a railing used in the cloth-manufacture, to stretch out the pieces of cloth, stuff, &c. or only to make them even, and set them square. It is usually about four feet in length, and exceeds that of the longest piece of cloth. It consists of several long pieces of wood, placed so that the lower cross-piece of wood may be raised or lowered, as is found requisite, to be fixed at any height, by means of pins. Along the cross-pieces, both the upper and under one, are hooked nails, called tenter-hooks, driven in from space to space.

TENTHREDO, a genus of insects of the order hymenoptera. The generic characteristic is, mouth with jaws, without proboscis; wings flat, swelled or slightly inflated; piercer consisting of two serrated and scarcely projecting lamine; scutellum with two distant granules. The larvae of the genus are remarkable for their great resemblance to those of the order lepidoptera or real caterpillars, from which however they may in general be readily distinguished by their more numerous feet, which are never fewer than sixteen, exclusive of the three first or thoracic pairs. When disturbed or handled, they usually roll themselves into a flat spiral. They feed, like the caterpillars of the lepidoptera, on the leaves of plants, and undergo their metamorphosis in very much the same case or enclopmen, prepared in autumn, out of which in the ensuing spring emerges the complete insect.

The tenthredines form a very numerous genus, and may be divided into tribes or sections, according to the form of the antenna, which are in some cladaved, in others filiform, &c. Among the principal species may be numbered the tenthredo lutea of Linnaeus, which anocedes from a large twin larva, of a finely granulated surface, with a double row of black specks along each side, and a dusky dorsal line bounded on each by yellow: it feeds on various species of willow, &c. The parchment-case in which it envelops itself in autumn is of a pale yellowish-brown colour, and the chrysalis, which is of a pale dinsky or brownish cast, exhibits the limbs of the future fly, which is equal in size to a common caterpillar, and of a yellow colour, barred with black: the antenna rather short, and strongly cladaved.

The tenthredo americana of Linnaeus is somewhat smaller than the preceding, and of a cinnamon-brown colour, with the under part of the abdomen rusous or dull orange: like the former, its caterpillar is of a green colour, and of a finely roughened surface covered with numerous whitish specks.

The larvae of the smaller tenthredines are often very injurious to different kinds of exculent vegetables, as turnips, &c. &c. There are nearly 200 species of this insect.

TENTHS, that yearly portion or tribute which all ecclesiastical livings antiently paid to the king, but in the tenure of this word, which is a very extensive one, is usually restrained by coupling other words with it: this is sometimes done by words which denote the duration of the tenant's estate; as if a man held them 100 years, it is called tenure in fee-simple. At other times the tenure is coupled with words pointing out the instrument by which an inheritance is held: thus, if the holding is by copy of court roll, it is called tenure by court roll.

At other times, this word is coupled with other words that shew the principal service by which an inheritance is held: as where a man held by knight's service, it is called tenure by knight's service.

TERANUS, a genus of the phaladiace decandria class and order of plants: the keel is very small, concealed within the calyx; stamina alternate, five, barren; stigma sesile, there are two species, creeping plants of Jamaica.

TEREBELLA, a genus of vermes molusca. The generic characteristic is, body oblong, creeping, naked, often enclosed in a tube furnished with lateral tufts and branches; mouth placed before, furnished with lips, without teeth, and protending a clavate proboscis; feelers numerous, ciliate, capillary, seated round the mouth. There are eleven species.

TEREDO, in natural history, a genus of vermes belonging to the order of lepideacae. The animal is a tenerry; there are two valves, calcareous, hemispherical, and cut off before, and two lanceolated. The shell is minute, exuding, and tapering, and furnished with a hard wood. There are only three species, the navalis, urticulis, and clava. See Plate Nat. Hist. fig. 394.

The navalis, or ship-worm, which has a very slender smooth cylindrical shell, inhabits the Indian seas, whence it was imported into Europe. It penetrates easily into the stoutest oak-planks, and produces dreadful destruction to the ships by the holes it makes in their sides; and it is to avoid the effects of this insect that vessels require sheathing.

The head of this creature is well prepared by nature for the hard offices which it has to undergo, being coated with a strong armour, and furnished with a mouth like that of the leech, by which it pierces wood as that animal does the skin. A little above this it has two horns which seem a kind of continuation of the shell; the neck is as strongly provided for the reception of the proboscis as the head, being furnished with several strong muscles; the rest of the body is only covered by a very thin and transparent skin, through which the motion of the intestines is plainly seen by the naked eye; and by means of the microscope several other very remarkable particulars become visible there. This creature is wonderfully minute when newly excluded from the egg; but it grows to the length of four or six inches, and sometimes more.

When the bottom of a vessel, or any piece of wood which is constantly under water, is inhabited by these worms, it is full of small holes; but no damage appears till the outer parts are cut away; then their shells habitually come into view. These animals are capable of forming such large space for enclosing the animal, and surrounding it with water. There is an evident care in these creatures never to injure one another's habitations, by which means each case is preserved, and extended in such pieces of wood as have been found eaten by them into a sort of honeycomb, there never is seen a passage or communication between any two of the shells, though the woody structure from them either without or below a piece of writing-paper. They penetrate some kinds of wood more easily than others.
They make their way most quickly into fir and alder, and grow to the greatest size. In the oak they make small progress, and appear squatter and blebile, and their shells much discoloured.

Since each of these animals is lodged in a solitary cell, and has no access to those of its own species, it has been matter of surprise how they should increase to so vast a multitude. Upon dissecting them, it appears that every individual has the parts of both sexes, and is therefore supposed to propagate by itself.

The sea-worms, which are pernicious to our shipping, appear to have the same office allotted to them in the waters which the termites have on the land (see Termes). They will appear, on a very little consideration, to be most important beings in the great chain of creation, and pleasing demonstrations of that infinitely wise and gracious Power which formed, and still preserves, the whole in such wonderful order and beauty; for if it was not for these and such animals, tropical rivers, and indeed the ocean itself, would be choked with the bodies of trees which are annually carried down by the rapid torrents, as many of them would last for ages, and perhaps centuries. Of which, happily, we cannot in the present harmonious state of things form any idea; whereas now being consumed by these animals, they are more easily broken in pieces by the waves; and the fragments which do not disintegrate become specifically lighter, and are consequently more readily and more effectually thrown on shore, where the sun, wind, insects, and various other instruments, speedily promote their entire dissolution.

TERMES. See Anatomy.

TERM, in geometry, is the extreme of any magnitude, or that which bounds and limits its extent. So the terms of a line, are points; of a superficies, lines; of a solid, superficies.

Terms, of an equation, or of any quantity, in algebra, are the several names or members of which it is composed, separated from one another by the signs + or −. So, the quantity \( 2a + 3b - 3x \), consists of the three terms \( a \), \( 3b \), and \( -3x \). In an equation, the terms are the parts which contain the several powers of the same unknown letter or quantity; for if the same unknown quantity is found in several members in the same degree or power, they shall pass but for one term, which is called a compound one, in distinction from a simple or single term. Thus, in the equation

\[
\begin{align*}
x^2 + 4a - 3b &= 0, \\
x &= a - \frac{3b}{x},
\end{align*}
\]

the four terms are \( x^2 \), \( 4a \), \( -3b \), and \( a - \frac{3b}{x} \); of which the second term \( a - \frac{3b}{x} \) is compound, and the other three are simple terms. To express a product, or of a fraction, or of a ratio, or of a proportion, &c. are the several quantities employed in forming or composing them. Thus, the terms of the product \( ab \), are \( a \) and \( b \); of the fraction \( \frac{a}{b} \), are \( a \) and \( b \); of the ratio \( a:b \), are \( a \) and \( b \); of the proportion \( a:b = c:d \), are \( a, b, c, \) and \( d \).

Terms, are those spaces of time wherein the courts of justice are open for all that complain of wrongs or injuries, and seek their rights by course of legal action, in order to their redress; and during which, the courts in Westminster-hall sit and give judgments, &c. but the high court of parliament, the chancery, and inferior courts, do not observe the terms; only the courts of king's-bench, common pleas, and exchequer, the highest courts at common law. Of these terms there are four in every year, viz: Hilary term, which begins the 23d of January, and ends the 12th of February, unless on Sundays, and then the day after; Easter term, which begins the Wednesday next after Easter-day, and ends the Monday next after Ascension-day; Trinity term, which begins the Friday after Trinity Sunday, and ends the Wednesday next after; and Michaelmas term begins the 6th and 7th of September.

There are in each of these terms stated days, called days in bank, that is, days of appearance in the court of common pleas, called usually bancum, or commune bancum, to distinguish it from bancum regis, or the court of king's-bench. They are generally at the distance of about a week from each other, and regulated by some festival of the church. On some of these days in bank, all original writs must be returnable, and therefore they are generally called the return of that term. 3 Black 227.

The first return in every term is, properly speaking, the first day in that term; and in the case of errors, extremely rare, of which happily, we cannot in the present harmonious state of things form any idea; whereas now being consumed by these animals, they are more easily broken in pieces by the waves; and the fragments which do not disintegrate become specifically lighter, and are consequently more readily and more effectually thrown on shore, where the sun, wind, insects, and various other instruments, speedily promote their entire dissolution.

TERMES. See Anatomy.

TERM, in Oxford. Hilary, or Lent term, begins on Jan. 14, and ends the Saturday before Palm Sunday. Easter term begins the tenth day after Easter, and ends the Thursday before Whit Sunday. Trinity term begins the Wednesday after Trinity Sunday, and ends after the act, sooner or later, as the vicar-chancellor of the place, Michaelmas term begins on Oct. 10, and ends Dec. 16.


TERMES, the white ant, a genus of insects of the order apetera; the generic character is, legs six, formed for running; eyes two; antennæ simple; mouth furnished with two jaws. The different species of living termites are very small, compared with those of the warmer regions of Africa and America; and instead of assembling in multitudes, as in those climates, are usually observed single. The same is observable in the termite, Pulsatorius of Linnaeus, a diminutive insect, of a whitish colour, and which, from its general resemblance to the insects of that genus, has by Derham and some other naturalists been distinguished by the title of a species, but I am of opinion that it is much more frequent, during the summer months, in houses, particularly where the wainscot is in any degree decayed, and is remarkable for causing a long-continued sound, exactly resembling the ticking of a watch. It is a very common insect in collections of dried plants, &c. which it often injures greatly. It is of so tender a frame as to be easily destroyed by the slightest pressure, and is an animal of very quick motion, which makes it very hard to find; it is small, and bears a complete resemblance to a common mite, being furnished with eight legs, and beset with long hairs. After a certain time it casts its skin, and appears in the very different form of a decider kind. Some individuals of this species become winged when arrived at their full growth; the wings, which are four in number, being very large, of a slightly indescent appearance, and variegated with blackish and brown clouds or spots. It is in the beginning of July that this change takes place, and at this time several may be seen with the wings half-grown; in a few days they seem to obtain their full size.

Mr. Derham imagines the ticking sound which these animals produce, to be analo-

gous to the call of birds to their mates during the breeding-season; and there seems to be no reason to call a species by the truth of this observation. We may add, that this sound, as well as that produced by the pinus fati-

dicus, or death-watch, seems to afford a con-

vincing proof of the faculty of hearing in insects, which some naturalists have been inclined to deny.

Of the exotic termites the most remarkable seems to be the termes bellicosus, whose his-

tory is described by Mr. Smeathman in the Philosophical Transactions.

With the good order of their subterranean cities, they will appear foremost on the list of the wonders of the creation, as most closely imitating mankind in provident industry and regular government, and being by nature, and by manner of living, which is in large communities that erect very extraordinary nests, for the most part on the surface of the ground, whence their excursions are made through subterranean passages covered with galleries, which they build whenever necessity obliges, or plunder in-

duces, to march above ground; and at
a great distance from their habitations carry on a business of depredation and destruction, scarcely credible but to those who have seen it.

The termites resemble the ants also in their provident and diligent labour, but surpass them as well as the bees, wasps, andr, and all other animals, in the arts of building; as much as if any other and other cultivated savages. It is more than probable they exceed them as much in sagacity and the arts of government; it is certain they shew more substantial instances of their ingenuity and industry, than any other animals; and do in fact lay up vast magazines of provisions and other stores; a degree of prudence which has of late years been denied, perhaps without reason, to the ants.

Their communities consist of one male and one female (who are generally the common parents of the whole, or greater part, of the rest); and of three order of insects, apparently of very different species, but really the same, which together compose great commonwealths, or rather monarchies, if we may be allowed the term.

The different species of this genus resemble each other in form, in their manner of living, and in their good and bad qualities, but differ as much as birds in the manner of building their habitations or nests, and in the choice of the materials with which they compose them.

There are some species which build upon the surface of the ground, or part above and part beneath; and one or two species, perhaps more, that build on the stems or branches of trees, sometimes aloft at a vast height. Of every species there are three orders: first, the working insects, which, for brevity, we shall generally call labourers; next the fighting ones, or soldiers, which do no kind of labour; and last, of all the winged ones, or perfect insects, which are male and female, and are now much less numerous than the first two.

The nests of the termites bellicosus are so numerous all over the island of bananas, and the adjacent continent of Africa, that it is scarcely possible to stand upon any open place, such as a plantation, or other clearing, where one of these buildings is not to be seen within fifty paces, and frequently two or three are to be seen almost close to each other. In some parts near Senegal, as mentioned by M. Altonson, their number, magnitude, and closeness of situation, make them appear like the villages of the natives.

These buildings are usually termed hills, by natives as well as strangers, from their outward appearance, which is that of little hills more or less conical, generally pretty much in the form of sugar-loaves, and about ten or twelve feet in perpendicular height above the common surface of the ground.

These hills continue quite bare until they are six or eight feet high; but in time the dead barren clay, of which they are composed, becomes fertilized by the genial power of the elements in these proclive climates, and the addition of other materials, brought by the wind; and in the second or third year, the billock, if not over-shadowed by trees, becomes, like the rest of the earth, almost covered with grass and other plants; and in the fourth year it may be burnt by the rays of the sun, it is not much unlike a very large lady-cock.

Every one of these buildings consists of two distinct parts, the exterior and the interior. The exterior is composed of a number of dome, large and strong enough to inclose and shelter the interior from the vicissitudes of the weather, and the inhabitants from the attacks of natural or accidental enemies. It is always, therefore, much stronger than the interior, which is the habitable part, divided with a wonderful kind of regularity and contrivance into an amazing number of apartments for the residence of the king and queen, and the nursing of the young. In the latter there is a small space for the magazines, which are always found well filled with stores and provisions.

From these habitations, galleries again ascend, and lead out horizontally on every side, and are carried under ground near to the surface a vast distance; for if you destroy all the nests within one hundred yards of your house, the inhabitants of those which are left unmolested farther off, will nevertheless carry on their subterranean proceedings, and invade the goods and merchandises contained in it by sap and mine, and do great mischief if you are not very circumspect.

It has been observed, that there are of species of these insects; of some of these orders the working insects or labourers are always the most numerous; in the termites bellicosus there seems to be at least one hundred labourers to one of the fighting insects. The state of one-fourth of an inch long, and twenty-five of them weigh about a grain; so that they are not so large as some of our ants. The second order, or soldiers, have a very different form from the labourers, and have been by some authors supposed to be the males, and the former neutrals; but they are, in fact, the same insects, only they have undergone a change of form, and approached one degree nearer to the perfect state. They are now much less numerous than the males, and equal in bulk to fifteen of the labourers.

There is now likewise a most remarkable circumstance in the form of the head and mouth; for in the former state the mouth is evident, and the jaws and holding-beads; but in this state, the jaws being shaped just like two very sharp awls, a little jagged, they are incapable of any thing but piercing or wounding, for which purposes they are very effectual, being as hard as a crab's claw, and placed in a strong horned head, which is of a nut-brown colour, and larger than all the rest of the body together, which seems to labour under great difficulty in carrying it; on which account perhaps the animal is incapable of climbing up perpendicular surfaces.

The third order, or the insect in its perfect state, varies its form still more than ever.

The head, thorax, and abdomen, differ almost entirely from the same parts in the labourers and soldiers; and, besides this, the animal is now furnished with four fine large brownish, transparent, wings, with which it is at the time of emigration to wing its way in search of a new and perhaps more suitable place, to make their nests without finding one winged insect, for those are to be found only just before the commencement of the rainy season, when they undergo the last change, which is preparatory to their hibernation.

In the winged state they have also much altered their size as well as form. Their bodies now measure between six and seven tenths of an inch in length, and their wings a foot above two inches, and from tip to tip they are equal in bulk to about thirty labourers, or two soldiers. They are now also furnished with two large eyes placed on each side of the head, and very conspicuous: if they have any force, they are not easily to be distinguished. Probably in the two first states, their eyes, if they have any, may be small, like those of moles, for as they live, like these animals, always under ground, they have as little occasion for these organs, and it is not to be wondered at that we do not discover them; but the case is much altered when they arrive at the winged state in which they are to roam, though but for a few hours, through the wide air, and explore new and distant regions. In this form the animal comes abroad during, or soon after, the first tornado, which, at the latter end of the dry season, proclaims the approach of the ensuing rains, and seldom waits for a second or third shower, if the fire, as is generally the case, happens in the night, and brings much wet after it.

The quantities that are to be found the next morning will go over the surface of the earth, as well as the earth itself, more, or very little, as is necessary for their wings are only calculated to carry them a few hours, and after the rising of the sun not one in a thousand is to be found with four wings, unless the morning continues very rainy, and then and then the animal is seen winging its way from one place to another, as if solicitous only to avoid its numerous enemies, particularly various species of ants which are hunting on every spray, on every leaf, and in every possible place, for this unhappy race, of which probably not a pair in many millions get into a place of safety, fulfill the first law of nature, and lay the foundation of a new community.

The termites arboreus, those which build in trees, frequently establish their nests within the roofs and other parts of houses, to which they do considerable damage, if not timely extirpated. The large species are not only much the most destructive, but more difficult to be guarded against, since they make their approaches chiefly under ground, descending below the foundations of houses and stores at several feet from the surface, and rising again either in the houses, or entering at the bottoms of the posts, of which the sides of the buildings are composed, bore quite through them, following the course of the fibres to the top, or making lateral perforations and cavities here and there as they proceed.

While some are employed in gutting the posts, others ascend from them, entering a ratter or some other part of the roof. If they once find the thatch, which seems to be a favourite food, they soon bring up wet clay, and build their pipes or galleries through the roof in various directions, as long as it will support them; sometimes eating the palm-tree leaves and branches of which it is composed, and perhaps sand, which is very pleasing to them, the rattan, or other running plant, which is used as a cord to tie the various parts of the roof together, and that to the posts which support it; thus, with the assistance of the rain, which during the rainy season are apt to shelter themselves there, and to burrow through it, they very soon ruin.
the house by weakening the fastenings, and exposing it to the weat. In the mean time the posts will be perforated in every direction, as full of holes as that timber in the bottoms of ships which has been bored by the worms; the fibres and knotty parts, which are so prominent, being left to the last.

They sometimes, in carrying on this business, seem to find that the post has some weight to support, and then if it is a convenient track to the roof, or is itself a kind of wood again, they bring their mortar, and all or most of the cavities leaving the necessary roads through it, and as fast as they take away the wood, replace the vacancy with that material; which being worked together by them closer and more compactly than human strength or art could ram it, when the house is pulled to pieces, in order to examine if any of the posts are fit to be used again, those of the softer kinds are often reduced almost to a shell, and all or a greater part of the timber, from wood to the core, as in and as hard as many kinds of free-stone used for building in England. It is much the same when the termites bellicose get into a chest or trunk containing clothes and other things: and if the house is great, or they are afraid of ants or other enemies, and have time, they carry their pipes through, and replace a great part with clay, running their galleries in various directions. The tree termites indeed, when they get within a box, often make a nest there, and being once in possession, destroy it at their leisure.

When the termites attack trees and branches in the open air, they sometimes work at a great rate of doing it. If a stake in a hedge that has not taken root and vegetated, it becomes their business to destroy it. If it has a good sound bark round it, they will enter at the bottom, and eat all but the bark, which will remain, and exhibit the appearance of a solid stick (which some vagrant colony of ants or other insects often shelter in till the winds disperse it); but if they cannot trust the bark, they cover the whole stick with mud, and then it loses, as if it had been dipped into thick mud that had been dried on. Under this covering they work, leaving no more of the stick and bark than is barely sufficient to support it, and frequently not the smallest particle; so that upon a very small tap with your walking-stick, the whole stake, though apparently as thick as your arm, and five or six feet long, loses its form, and disappearing like a shadow, falls in small fragments at your feet.

The first object of admiration which strikes one upon opening their hills, is the behaviour of the soldiers. If you make a breach in a slight part of the building, and do it quickly with a strong hoe, or pick-axe, in the space of a few seconds a soldier will run out, and walk about the breach, as if to see whether the enemy is gone, or to examine what is the cause of the attack. He will sometimes go again, as if to give the alarm; but generally, in a short time, he is followed by a large body, who rush out as fast as the breach will permit them; and so they proceed, the number increasing, as long as any one continues battering their building. It is not difficult to describe the rage and fury they show. In their hurry they frequently miss their hold, and tumble down the sides of the hill, but recover themselves as quickly as possible; and, being blind, bite every thing they run upon, and make a cracking noise, while some of them beat repeatedly with their forces upon the building, and make a small vibrating noise, something shriller and quicker than the ticking of a watch. If they get hold of any one, they will in an instant let out blood enough to weigh against their whole body; and if it is the leg they wound, you will see the stain upon the stocking extend an inch in width. They make their hooked jaws meet at the first stroke, and with that hold, but suffer themselves to be pulled away leg by leg, and piece after piece, without the least attempt to escape. On the other hand, keep out of their way, and give them no interruption, and they will in less than half an hour retire into the nest, as if they supposed the wonderful monster that damaged their castle to be gone beyond their reach. Before they are all got in you will see the labourers in motion, and beginning to vary their directions toward the breach, every one with a burthen of mortar in his mouth ready-tempered. This they stick upon the breach as fast as they come up, and do it with so much dispatch, that, though there are thousands, or rather millions, of them, they never stop or embarrass one another; and you are most agreeably deceived, when, after an apparent scene of hurry and confusion, a regular precision, gradually filling up the chasm. While they are thus employed, almost all the soldiers are retired quite out of sight.

A renewal of the attack, however, instantly changes the scene. At every stroke we hear a loud hiss; and on the first the labourers run into the many pipes and galleries with which the building is perforated, which they do so quickly that they seem to vanish, for in a few seconds all are gone, and the soldiers rush out as numerous and as victoriously as before.

Previously to breeding, a very surprising change takes place in the body of the queen or breeding animal. The abdomen of this female, in the spring, especially, gradually extends and enlarges to the enormous size, that an old queen will have increased so as to be fifteen hundred or two thousand times the bulk of the rest of her body, and twenty or thirty thousand times the bulk of a labourer. Mr. Smethurst conjectures the animal is upwards of two years old when the abdomen is increased to three inches in length, and has sometimes found them of near twice that size. The abdomen is now of an irregular oblong shape, being contracted by the muscles of every segment, and is become one vast matrix full of eggs, which make long circumvolutions through an immovable quantity of very minute vessels that circulate round the inside in a serpentine manner, which would exercise the ingenuity of a skilful anatomist to dissect and develop. This singular matrix is not more than two or three inches in length and size, than for its persistal nectar, which resembles the undulating of waves, and continues incessantly without any apparent effort of the animal; so that one part or other alternately is rising and sinking in perpetual succession, and the matrix seems never to rest, but is always protruding eggs to the amount of sixty in a minute, or eighty thousand and upward in one day of twenty-four hours. These eggs are instantly taken from the body by the attentions of the soldier, there are always, in the royal chamber and the galleries adjacent, a sufficient number in waiting) and carried to the nurseries, which in a great nest may some of them be four or five feet distant in a straight line, and are consequently much farther by their winding galleries. Here, after they are hatched, the young are attended and provided with every thing necessary until they are able to shift for themselves, and take care of themselves.

TERMINALIA, a genus of plants of the class of polyandria, and order of monoecia. The male calyx is quinquipartite; there is no corolla; the stigma in ten number. The homopterous flower is the same with that of the male; there is one style; the fruit, which is a drupe or plum, is below, and shaped like a boat. There are six species.

TERMINATOR, in astronomy, a name sometimes given to the circle of illumination, from its property of determining the boundaries of light and darkness.

TENSTROEMIA, a genus of the class and order polyandria monogynia. The calyx is five-parted; the corolla one-petalled, with the five lobes on the top; berry two-celled. There are five species, trees of the East and West Indies.

TERRA PONDEROSA. See BARYTES.

TERRIL FELLUS, son of the earth, a student of the university of Oxford, formerly appointed, in public acts, to make jesting and satirical speeches against the members thereof to tax them with any growing corruptions, &c.

TERRA-PLEIN, or TERRE-PLAIN, in fortification, the top, platform, or horizontal surface, of the rampart, upon which the cannon are placed, and where the defenders perform their office. It is so called because it lies level, having only a little slope outwardly to counteract the recoil of the cannon. Its breadth is from 24 to 30 feet; being terminated by the parapet on the outer side, and inwardly by the inner talus. The cover earth, or cover, is a magnet turned of a spherical figure, and placed so that its poles, equator, &c. do exactly correspond with those of the world. It was so first called by Gilbert, as being a just representation of the great magnetic globe we inhabit. Such a terrella, it was supposed, if nicely poised, and hung in a meridian like a globe, would be turned round like the earth in 24 hours by the magnetic particles pervading it; but experience has shown that this is a mistake.

TERRIER, a book or roll, wherein the several lands, either of a private person, or of a town, college, church, &c. are described. It should contain the number of acres, and the site, boundaries, tenant's names, &c. of each piece or parcel.

TESSELATED PAVEMENTS, those of rich mosaic work, made of curious square stones, bricks, or tiles, called tesselle from their resemblance to tiles.

TEST, a vessel used in metallurgy for absorbing the sooty of metallic bodies when melted. See CUPellation, Chemistry, and Metallurgy. Some of the German vessels used in this purpose are called crucibles, a sort of friable opaline stone, called white spathe, which appears to be a species of gyp-
sum, or of the stones from which plaister of Paris is prepared. The spath is directed to be calcined with a gentle fire, in a covered vessel, till the slight cracking, which happens at first, has ceased, and the stone has fallen into part into powder, and then reduced powder, which is passed through a fine sieve, and moistened with so much of a weak solution of vitriol as is sufficient for making it hold together. Gsell, however, finds, that if the stone is of the proper kind, which can be known only by trials, calculation is not necessary. Scheffer observes, that these kind of tests are liable to solen or fals souder in the fire, and that this inconvenience may be remedied by mixing with the uncalcined stone somewhat less than equal its weight, as eight-ninths, of such as has been already used and is penetrable by the scoria of the lead, taking only that part of the old test which appears of a green-grey colour, jecting the red crust on the top. Tests or cupels made of the spath are said not to require so much caution in heating and heating them as the common ones: it appears, however, from Scheffer's account, that they are less durable and quantable than the others; though greatly superior to those of wood ashes. Vegetable ashes, which stand pretty well the testing of silver, can scarcely bear any very great quantity of gold, this metal requiring a considerably more resistance to it than bone ashes answer so effectually, and are among us so easily procurable, that it is not needful for the miner to search for any other materials; though those who work off large quantities to gain a little silver or gold contained in it, may possibly, in places remote from populous cities, avail themselves of substances similar to the spath above mentioned.

The test, for its greater security, is fixed in the mould in which it was formed; which is sometimes a shallow vessel made of crucible earth or red iron; more commonly an iron hoop, with three bars arched downwards across the bottom, about two inches deep, and of different widths, from three or four inches to fifteen or more, each material to the other; but bone-ashes answer so effectually, and are among us so easily procurable, that it is not needful for the miner to search for any other materials; though those who work off large quantities to gain a little silver or gold contained in it, may possibly, in places remote from populous cities, avail themselves of substances similar to the spath above mentioned.

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which cannot be allowed to constitute a part of the animal character, since in different individuals, either from age, or other circumstances, these parts are found to vary in number, there being sometimes five claws instead of four on the fore feet. The tail is about the same length with the legs, or rather shorter, with the exception of a very small wad, and terminates in a naked horny pointed tip or process.

This animal lives to a most extraordinary age; several well attested examples are described of its having considerably exceeded the period of the human race, one of the most remarkable instances is of a tortoise introduced into the archbishop's garden at Lambeth, in the time of archbishop Laud, and as near as can be collected from its story, about the year 1630, which continued to live till the year 1733, when it was supposed to have perished rather from accidental neglect on the part of the gardener, than from the mere effect of age. This tortoise has had the honour of being commemorated by Derham, and many other writers, and its shell is preserved in the library of the palace at Lambeth.

The general manners of the tortoise, in a state of domestication in this country, are very agreeably detailed by Mr. White, in his history of Selborne. "A land-tortoise," says Mr. White, "which has been kept thirty years in a little walled court, retires under-ground about the middle of November, and comes forth again about the middle of April. When it first appears in the spring, it discovers very little inclination for food, but in the height of summer it grows voracious; and then, as the summer declines, its appetite declines; so that for the last weeks in autumn it hardly eats at all. Milky plants, such as lettuce, dandelions, sow-thistles, &c. are its principal food. On the first of November 1771, I remarked that the tortoise began to dig the ground, in order to form its hybernaculum, which it had fixed on just beside a great tuft of heath flowers. It scrapes out the ground with curiously shaped claws, and this continues doers and its legs is ridiculously slow, little exceeding the hour-hand of a clock. Nothing can be more avidious than this creature, night and day it eats the earth, and continues, great body into the cavity; but as the moon of that season proved unusually warm and sunny, it was continually interrupted, and called forth by the heat in the middle of the day; and though I continued there till the thirtieth of November, yet the work remained unfinished. Harsher weather, and frosty mornings, would have quickened its operations. No part of its behaviour ever struck me more than in these two times, always expresses with regard to rain: for though it has a shell that would secure it against the wheel of a loaded cart, yet does it discover as much solicitude about rain as a lady dressed in all her best attire, shrugging away the first sprinklings, and running its head up in a corner. If attended to, it becomes an excellent weather-glass; for as sure as it walks elate, and in a manner on tip-toe, feelings with great impatience, so sure will it rain before night. It is totally a diurnal animal, and never pretends to stir after it becomes dark.

"The tortoise," adds Mr. White, "like other reptiles, has an acrid stomach, as well as tongs, and can refrain from eating, as well as breathing, for a great part of the year. It was much from its acridity, in discerning those that do it kind offices. For soon after the good old lady comes in sight who has waited on it for more than thirty years, it hobblestowards its benefactress with awkward slowness; but remained stranger. This, not only the "ox knew not her young," but the "ass his master's crib," but the most absolute and top of beings distinguishes the land that feels it, and is touched with the feelings of gratitude. This creature not only goes under the earth from the middle of November to the middle of April, but sleeps great part of the summer: for it goes to bed in the longest days at four in the afternoon, and often does not stir in the morning till late. Besides, it retires to rest for every shower, and does not move at all in wet days. When one reflects on the state of this strange being, it is a matter of wonder Providence should bestow such a seeming waste of longevity on a reptile that appears to relish it so little as to squander away more than two-thirds of its existence in a joyless slumber, and be lost to all sensation for months together in the profoundest of all slumbers! Though habituated to warm weather, he avoids the hot sun; because when once got heated, would, as the poet says of solid armour, "cold with safety." He therefore spends the more sultry hours under the umbrellas of a large cabbage-leaf, or amidst the waving forests of an alliago stigmos. But as he avoids heat in the summer, so in the decline of the year, he improves the faint autumnal beams, by getting within the reflection of a fruit-tree wall; and though he has never read that planes inclining to the horizon receive a greater share of warmth, he inclines his shell by tilting it against the wall, to collect and admit every feeble ray."

2. Testudo marginata, marginated tortoise.

The general colour of this animal is a dark or blackish bay; the middle or convex part of the pieces composing the disk, being more or less dashed or variegated, in an irregular manner, with yellow: the marginal pieces are also variegated with the same colour, which predominate in water of deep green or water without visible divisions, which are pretty distinctly striated or furrowed, and from their peculiar width or dilatation form the chief part of the specific character. The under shell is of a pale yellow colour, each division being marked on its upper commissure by a transverse blackish band, running into a pair of pointed or subtriangular processes, extending nearly to the next or inferior division. The outline of the shell, if viewed from a front angle, will be found to be much longer in proportion than that of the testudo greca, accompanied by a slight contraction or sinking in each side.

The true native country of the animal seems not very distinctly known. Mr. Schoepf is inclined to think it an American species.

3. Testudo Indica, Indian tortoise. This very large terrestrial species, which is omitted by Linnaeus in the twelfth edition of the Systema Naturae, was first described by Perrault in the History of Animals published by the Royal Academy of Paris in 1722. The specimen was taken on the coast of Coromandel, and measured four feet and a half from the tip of the nose to the tail; and its height or convexity was fourteen inches: the shell itself was three feet long and two broad, and, like every other part of the animal, was of a dull-brown colour, the shell is invested of a large and dissimilar piece, and the edge on the fore part was rather reflected, for the easier motion of the animal's head: the head was seven inches long; the mandibles serratcd, and furnished with an internal row of denticali; the fore feet are undivided, thick, and armed with five blunt claws: the hind legs were eleven inches long; the feet tetradactylus, and armed with three claws: the tail six inches thick at the base, fourteen inches long, and terminated by a horny curved process.

4. Testudo lariata, lari-tortoise. This, which is supposed by the count de Cepede to be the testudo lariata of Linnaeus, is said to be extremely common in many parts of Europe, as well as Asia, being found in India, Japan, &c. It is, in general, not more than seven or eight inches long from the tip of the nose to that of the tail, and about three or four inches in breadth: the disk consists of thirteen pieces, which are striated and slightly pointed on the margin, and along the middle range runs a longitudinal carina: the margin consists of twenty-three pieces, bordered with slight striae: the colour of the shell is blackish, more or less: deep in different specimens, and the skin itself is similar: the feet are webbed, and there are five toes before, and four behind. Like other tortoises, it sometimes utters a kind of broken or interrupted hiss. This species, according to de Cepede, is no more common than in France, and is particularly plentiful in Languedoc, and in many parts of Provence; and in a lake of about half a league wide, situated in the plain of Durance, were found such vast quantities, that the neighbouring peasantry have in a manner supported by them for more than three months together.

Though this species is aquatic, it always lays its eggs on land; digging for that purpose a hollow in the ground, and covering the hole with earth. It is of a less soft than those of the sea-tortoises or turtles, and the colour less uniform. When the young are first hatched they measure about six lines in diameter. This animal walks much quicker than the land-tortoise, especially when on even ground. It grows for a long time, and has been known to live more than twenty-four years. The taste which it has for small snails, and such kind of wingless insects as frequent the neighbourhood of the water in which it inhabits, makes it useful in a garden, which it delivers from noxious animals, without doing any mischief itself. Like other tortoises, it may be rendered domestic, and may be kept in a basin or receptacle, filled with water, so contrived on the edges as to give it room to rest upon; when it wishes to wander about for prey. The count de Cepede adds, that though useful in gardens, it is found to be a very troublesome insect in fish-ponds; attacking and destroying the fish: biting them in such a manner, that they become enfeebled by loss of blood, and then dragging them to the bottom and devouring them; having only the bones and some of the carunculated parts of the head, and sometimes the air-bladder also, which
Floating on the surface, give notice of the enemies with which the pond is infested.

5. Testudo picta, painted tortoise. The remarkable colours of the shell of this species are sufficient to distinguish it from all others: the shell is large, oval, or of a flattened or slightly convex form, and of a chestnut-brown colour, paler or darker in different individuals, and consisting, as usual, of thirteen segments, each of which is of a form approaching to square, and pretty deeply edged or bordered with paler shades: a stripe of the same colour also runs down the middle of the dorsal segments, while the marginal pieces, which are twenty-five in number, are each marked by a secalic spot of the same colour at the edge, surrounded by two, or sometimes by three yellow bands, following the direction of the first-mentioned spot, and thus forming so many semi-elliptic yellow zones or stripes on each piece. The neatness and accuracy of these, as well as of the yellow borders on the large or middle segments of the shell, vary, as may be supposed, on different individuals, and in general seem most distinctly expressed on the smallest specimens. This ceases, however, in the middle-sized tortoises: the shell measuring from four to six inches in length, or somewhat more; the head is moderately small, and covered with a smooth skin; blackish above, but yellow on the sides, and also by the ears, part, and very elegantly streaked in a longitudinal direction, with several double rows of black streaks: the legs are blackish, and marked with two longitudinal yellow stripes: the claws are sharp, and very powerful, surrounded with several lateral furrows and roughish points; the marginal pieces are twenty-three in number; the head is large, and of a brown colour, variegated on the sides with white: the legs short, sinewy, and covered with short claws, on the fore feet five distinct toes, connected to the very tips by a web, and terminated by so many sharp, crooked claws: the hind feet have only four toes, with sharp claws, and sometimes a fifth toe, resembling an appearance of a small unarmed fifth or spurious toe: the tail is short, conical, scaly, pointed, and but little exceeding the margin of the shell in length: the under shell is yellowish, spotted, and variegated with brown. See Plate Nat. Hist. fig. 399.

8. Testudo scabra, rough tortoise. The shell of the species quoted by Linnaeus in his description of T. scabra is figured in its natural size in the work of Seba, who affirms that it never grows larger than represented in his figure; measuring about two inches and a half in length, and near two inches in breadth; being of a corded figure, or somewhat elongated, the head is light reddish, pretty variegated on the head and shell with white lines and spots, in a kind of flanny or wavy pattern: the feet are marked with red specks, and each toe has five long, sharp claws: the head is very prominent, and the eyes small: down the back of the disk are represented in Seba's engraving three very conspicuous white lines or carinæ; so that the title of tri- carinata would apply to this, as well as to the species so denominated by Mr. Schoepf.

9. Testudo ferox, fierce tortoise. This remarkable species is distinguished by the unusual nature of its shell, which is hard or coriaceous, while the edges gradually degenerate into a flexible coriaceous verge: this shell is obscurely marked with five or six transverse bands, and granulated with small spots or prominences, which gradually enlarge as they approach the leathery or flexible edge: the head is rather small, and of an unusual shape, being somewhat trigonal, with the snout very much lengthened, and the eye placed at an angle, by the nostrils, and projecting much beyond the lower mandible: the neck, when retracted, appears very thick, and surrounded by many wrinkles or folds of skin; but when extended, is of very great length, so as nearly to equal that of the whole shell: the legs are short, thick, and covered with a wrinkled skin: the feet are all furnished with strong and broad webs, connecting the three last toes of each; the three first on each foot are furnished with pretty strong claws, but the remaining ones are unarmed; and besides the real or proper toes, there are two spurious or additional ones on the hind, and one on the fore feet, serving to strengthen and expand the web to a greater degree: the tail is short, pointed, and being large and round, the corners very small and round. The colour of this animal on the upper parts is a deep-brownish olive, and on the under parts white; the shell being marked beneath in a very elegant manner, with ramifications of vessels disposed upon it. The species is found in Pennsylvania, Carolina, &c. and, contrary to the nature of most others of the tribe, is possessed of very considerable vigour and swiftness of motion, springing forwards towards its assailant, when disturbed or attacked; and exhibiting great activity and alacrity. Its length is about a foot and half, or more, and its breadth about fifteen inches. It was first described by Dr. Garden, who communicated it to Mr. Pennant, by whom it was introduced into the Philosophical Transactions. Specimens examined by Dr. Garden weighed twenty-five pounds, but it is said to grow so large as to seventy pounds. The individual mentioned by Dr. Garden laid fifteen eggs during the time it was kept, which were exactly spherical, or nearly an inch in diameter, and fifteen more were found on dissection. Its flesh is said to be extremely delicate, being equal, if not superior, even to the flesh of the green turtle.

The great soft-shelled turtle, described by Mr. Bartram in his Travels, appears to be the same with this. It is said by Mr. Bartram to be of a flat form, two feet and a half long, and a foot and a half broad: the shield soft and cartilaginous on each side, and this part becomes gelatinous on being dried: the fore and hind part of the shield is beset with round horny warts or tubercles: the sternum or under shell semicartilaginous, except on the middle, where it is bony; the head large and clubbed, and the nose extended, truncated in the manner of a hog's snout: the eyes large, and seated at its base: mouth wide; the edges tuning and wrinkled, and bearded by several long processes, which are extensible at the pleasure of the animal, and give it an ugly and forbidding aspect. Mr. Bartram's figure also represents the throat and part of the neck as furnished with similar warts. Mr. Bartram adds, that it is food of the muddy parts of rivers, &c. hiding itself among the roots and leaves of water-plants, and thence springing on its prey, stretching out its neck to an incredible length, and seizing with wonderful celerity young birds, &c. &c. It is found in all the rivers, lakes, and pools, of East Florida, weighing from thirty to forty pounds. The warts or processes on each side the neck may constitute perhaps a species different from this species, green turtle; they are not to be found in that described by Dr. Garden and Mr. Pennant. See Plate Nat. Hist. fig. 399.

10. Testudo serpentina, snake tortoise. This species, first described by Linnaeus, appears to have been very obscurly known;
having been figured in no work of natural history till it was introduced into Mr. Scho-eps's publication. It is a native of North America, where it inhabits stagnant waters, growing to the weight of fifteen or twenty pounds. It feeds by preying on fish, ducklings, &c. &c. seeing its prey with great force, stretching out its neck and hissing at the same time. Whatever it seizes in its mouth it holds with great force, and will suffer itself to be raised up by a stick rather than quit its hold. The head is large, depressed, triangular, and covered with a scaly and warty skin: the orbits of the eyes are oblique; the mouth wide; the mandibles sharp; the neck covered by scaly warts, and appearing short and thick when the animal is at rest, but when in the act of sprincing on its prey, is stretched out to a third part of the length of the shell: the toes of all the feet are distinct, but connected by a web; and are five in number on the fore-feet, and four on the hind; all armed with claws longer than the toes themselves: the tail is straight, and about two-thirds the length of the shell; it is completely covered with the upper part with sharp bony scales directed backwards and gradually decreasing to the tip, while the sides and under part are covered with smaller scales: the under part of the body is covered by a loose, wrinkly, well-scaled soft scales and granules: the shell is slightly depressed, of an oval form, and consists of thirteen pieces in the disk, each of which rises behind into a kind of projection or obtuse point, and is bordered and radiated all round, and held in different directions: the general colour of the whole is a dull chesnut-brown, lighter or paler beneath.

This animal conceals itself in muddy waters in such a manner as to leave out only a part of its back, like a stone or other inanimate object, by which means it the more easily obtains its prey. Mr. Pennant, in the supplement to his Arctic Zoology, mentions this as a new species, under the name of seratus tortoises. He says, it is called by the native of China, 'Limeus is.-has been mistaken in supposing it a native of China.

Sea-tortoises, or turtles. The marine tortoises, or turtles as they are commonly called, are distinguished from those of the preceding division by their very large and long bony-scaled feet, in which are inclosed the bones of the toes; the first and second alone on each foot being furnished with visible or projecting claws, the others not appearing beyond the edge. The shell, as in the land-tortoises, consists of a strong bony covering, in which are imbedded the ribs, and which is coated externally by hard horny plates, in one or two species much thicker or stronger than those of the land-tortoises.

Testudo coriacea, coriaceous turtle. Of all the marine tortoises this appears to grow to the largest size, having been sometimes seen of the length of eight feet, and of the weight of a thousand pounds. It differs from the others in the form of its body, which is longer in proportion, and still more in its external covering, which, instead of being of a horny nature, as in others, is of a substance resembling strong leather, marked over the whole surface into small, obscurely subhexagonal and pentagonal subdivisions or lines, which do not take away from the general smoothness of the surface. Along the whole length of this covering or leathery shield run five distinct, strongly prominent, tuberculated ribs or ridges; and indeed if those parts of the body which are visible above water, are taken into account, we may say there are seven ridges on the shield. There is no under or thoracic shell, so that the animal might form a distinct genus from the rest of the tortoise tribe. The head is large, and the upper mandible prolonged at the tip in such a manner as to give the appearance of two large teeth or processes, between which, when the mouth is closed, is received the tip of the lower mandible. The fins or legs are large and long, and covered with a tough leathery skin: the tail is rather short and sharp-pointed. The general colour of the whole animal is dusky brown, paler beneath. This singular species is a native of the Mediterranean sea, and has at different periods been taken on the coasts both of France and England. In the month of August, in the year 1729, a specimen was taken about three leagues from Nantz, not far from the mouth of the Loire: it measured seven feet one inch in length, three feet seven inches in breadth, and two feet in thickness. It is said to have utter'd a hideous noise when taken, so that it might be heard to the distance of a mile. Its mouth at the same time foaming with rage, and exhaling a noisome vapour. In the year 1778, a specimen was taken on the coast of Languedoc, which measured seven feet five inches and a quarter, which was taken on the coast of Cornwall, which, according to Dr. Borlace, "measured six feet nine inches from the tip of the nose to the end of the shell; ten feet four inches from the extremes of the fore fins extended; and was judged to weigh eight hundred pounds weight." The fine specimen lately in the Leverian Museum was of similar weight, and was taken on the coast of Dorsetshire.

This species is found not only in the European sea, but in those of South America also, and occasionally appears about some of the African coasts.

According to Cepede, the coriaceous tortoise is one of those with which the Greeks were well acquainted, and he supposes it to have been the species particularly used in the construction of the ancient lyre or harp, which was at first composed by attaching the strings or wires to the shell of some marine tortoise. We may add, that the ribs or prominences on the back of the shell bear an obscure resemblance to the strings of a harp, and may have suggested the name of luth or lyre, by which it is called among the French, exclusive of the use to which the shell was antiently applied.

The coriaceous tortoise, says Mr. Pennant, is reputed to be extremely fat, but the flesh coarse and bad: the Carthagians, however, will eat no other species.

It may be added, that the small sea-tortoise described by Mr. Pennant, in the Philo-losophical Transactions for the year 1771, is evidently no other than the young of this animal. See Plate Nat. Hist. fig. 305.

2. Testudo mydas. The green turtle, so named, not on account of its being externally green, but from the green tinge which its fat frequently exhibits when the animal is taken in its highest state of perfection, may be considered as one of the largest of this genus, often measuring above five feet in length, and weighing more than five or six hundred pounds. It frequents in a somewhat heart-shaped form, or pointed at the extremity, and consists of thirteen dorsal segments or divisions surrounded by twenty-five marginal pieces. Its colour is a dull pale-brown, more or less variegated with deeper undulations, but not exhibiting those strong and beautiful colours which so peculiarly distinguish that of the T. imbricata, or hawk's-bill turtle, which affords the tortoise-shell used for ornamental purposes in various manufactories, having neither sufficient strength nor beauty: but so much is the flesh esteemed, that the inhabitants of the West Indian islands have long considered it as one of the most excellent articles of food, and have gradually succeed- ed in introducing a similar taste among some of the European nations. In our own country in particular it is in the highest estimation, and is regularly imported in considerable quantity from the Metropolis.

The introduction of the green turtle as an article of luxury into England is of no distant date, and perhaps can hardly be traced much farther than about fifty or sixty years backward. Formerly the nature of the sea-tortoises understood by the Europeans before that period, if the different kinds were in general confounded by navigators, who-accounts relative to their charac-teristics, a food vain to the species which they happened to take for that pur- pose; some insisting that the turtle was a coarse and unpalatable diet, while others considered it as of the highest degree of excel- lence. "Of the sea-turtles," says Catesby, "the most in request is the green turtle, which is esteemed a most wholesome and delicious food. It receives its name from the fat, which is of a green colour. Sir Hans Sloane informs us, in his History of Jamaica, that forty sloops are employed by the inhabitants of Port Royal, in Jamaica, for the catching them. The markets are there supplied with turtle in great quantities. The Bahama-rians carry many of them to Carolina, where they turn to good account; not because that plentiful country wants provisions, but they are esteemed there for their flesh, and for the delicacy of their flesh. They feed on a kind of grass, growing at the bottom of the sea, commonly called turtle-grass. The inhabit-ants of the Bahama Islands, by often practice, and very expert at catching turtles, particu-larly the green turle. In April they go, in little boats, to Cuba and other neighbour- ing islands, where, in the evening, especially in moonlight nights, they watch the going and returning of the turtle to and from their nests, at which time they turn them on their backs, where they leave them, and proceed on, turn-ing all they meet; for they cannot get on their feet again when once turned. Some are large that three men to turn over them. The way by which the turtle, which are most commonly taken at the Bahama is-lands is by striking them with a small iron peg of two inches long, put in a socket, at the end of a staff of twelve feet long. Two men generally set out for this work in a little light boat or canoe, one to row gently and steer the boat, while the other stands at the
head with his striker. The turtle is sometimes discovered by their swimming with their head and back out of the water, but they are often discovered lying at the bottom, a fathom or more deep. If a turtle perceives he is discovered, he starts up to make his escape: the men in the boat pursuing him, endeavour to keep sight of him, and recover again by the turtle putting his nose out of the water to breathe: thus they pursue him, one paddling or rowing, while the other stands ready with his striker. It is sometimes half an hour before he is then beaten to one at once to the bottom, which gives them an opportunity of striking him: which is by piercing him with an iron peg, which slips out of the socket, but is fastened with a string to the pole. If he is spent and tired by being long pursued, he tamely submits, when struck, to be taken into the boat or hauled ashore. There are men who by diving will get on their backs, and by pressing down their hind parts, and raising the fore part of their force, bring them to the top of the water, while another slips a noose about their necks.

Though the green turtle is a native of the West Indian seas, yet it is sometimes driven by storms on shore, and residence, and instances have occurred in which it has been taken on the coasts of Europe. An occurrence of this kind is said by the count de Cepede to have happened in France, a turtle having been taken at Dieppe in the year 1732, which weighed between eight and nine hundred pounds, and was almost six feet in length, and four wide. It may, however, be doubted whether this animal was not rather a caretta or loggerhead, than a green turtle. Another, of still larger size, is also said to have been taken on the coast of France, about two years afterwards.

The sea-tortoises, or turtles in general," says Catesby, "never go on shore but to lay their eggs, which they do in April: they then crawl up on the sea above the flowing of high water, and dig a hole above two feet deep in the sand, into which they drop in one night above a hundred eggs, at which time they are called their nature's oysters; they regard none that approach them; but will drop their eggs into a hat, if held under them; but if they are disturbed before they begin to lay, they will forsake the place, and seek another. They lay their eggs at three, and sometimes at four different times; there being fourteen days between every time; so that they hatch and creep from their holes into the sea at different times. When they have laid their complement of eggs, they fill all the hole with sand, and leave them to be hatched by the heat of the sun, which is usually performed in about three weeks." It may be proper to add, that the eggs are about the size of tennis-balls round, and the shell thicker than an inch, with a smooth parchment-like skin. See Plate Nat. Hist. fig. 309.

3. Testudo imbricata, the hawks-bill turtle. The testudo imbricata is so named from the peculiar disposition of its scales or lamina, which commonly lap over each other at their extremities in the manner of tiles on the roof of a building. The outline of the shell, viewed from above, is more heart-shaped than in other sea-tortoises, and terminates more acutely: each of the middle row of scales on the back is also of a sharpened form at the tip, more especially in the young or half-grown animal, and has a ridge or caine down the middle of each, and is smaller in proportion than in other turtles; the neck longer; and the beak narrower, sharper, and more curved, so as to give no incomparable resemblance to the bill of a hawk, from which circumstance the animal derives its common or popular name of the hawks-bill turtle. The fore legs are longer than in the rest of the tribe, and it is said that when turned or laid on its back, the animal is enabled by their as- tounding strength, to bear up in a manner as to recover its former situation, which no other turtle can do. In old specimens the neatness of the shell, and the well-defined outline of the scales, are occasionally impaired, and this seems to be one principal reason of its having been sometimes confounded with the carapace of the hawk. This bill turtle is a native of the Asiatic and American seas, and is sometimes, though less frequently, found in the Mediterranean. Its general length seems to be about three feet, from the tip of the bill to the end of the shell; but it has been known to measure five feet in length, and to weigh five or six hundred pounds. In the Indian ocean in particular, specimens are said to have occurred of prodigious magnitude.

The shell of this animal was anciently used for a shield, and still serves for that purpose among barbarous nations. The flesh is in estimation as a food; the lamellae or plates of the shell, which are far stronger, thicker, and clearer than in any other kind, constitute the sole value of the animal, and affording the substance particularly known by the name of tortoise-shell: they are semitransparent, and most elegantly variegated with whitish, yellowish, reddish, and dark-brown chords and undulations, so as to constitute, when properly prepared and polished, one of the most elegant articles for ornamental purposes.

See TECTUS: SHELL.

The natural or general number of the dorsal pieces is thirteen; the marginal row consisting of twenty-five smaller pieces. This external coating is raised or separated from the bone on which it covers, by placing fire beneath the shell; the heat causes the plates to start, so as to be easily detached from the bone. These plates vary in thickness, according to the age and size of the animal, and measure from one eighth to one quarter of an inch in thickness. A large turtle is said to afford about eight pounds of tortoise-shell.

In order to bring tortoise-shell into the particular form required on the part of the artist, it is steeped in boiling water, till it has acquired a proper degree of softness, and immediately afterwards committed to the pressure of a strong metallic mould of the figure required; and where it is necessary that the pieces should be joined and imbedded in a surface of considerable extent, the edges of the respective pieces are first scraped or thinned, and being laid over each other during their heated state, are committed to a strong press, by which means they are effectually joined or agglutinated. These are the methods also by which the various ornaments of gold, silver, &c. are occasionally affixed to the tortoise-shell.

The Greeks and Romans appear to have been peculiarly partial to this elegant ornamental article, with which it was customary to decorate the doors and pillars of their houses, their beds, &c. &c. In the reign of Augustus this species of luxury seems to have been at its height in Rome.

"The Egyptians," says Mr. Bruce, in the supplement to his Travels, "dealt very largely with the Romans in this elegant article of commerce. Pliny tells us the cutting them for fingering or inlaying was first practised by Carvilius Pollio, from which we should presume, that the Romans were ignorant of the art of separating the lamina by fire placed in the shell, which, as he says, they did not know out: for these scales, though they appear perfectly distinct and separate, do yet adhere, and often break than split, where the mark of separation may be seen distinctly. Mar-
TETRAEDRON, or TETRAEDRON, in geometry, is one of the five finite or regular bodies or solids, comprised under four equilateral and equal triangles. Or it is a triangular pyramid of four equal and equilateral faces.

In the description of the tetrahedron it is determined that the side of a tetrahedron is to the diameter of its circumscribing sphere, as $\sqrt{2}/2$ to $\sqrt{3}$; consequently they are incommensurable.

If a denotes the linear edge or side of a tetrahedron, $b$ its whole superficies, $c$ its solidity, $r$ the radius of its inscribed sphere, and $R$ the radius of its circumscribing sphere; then there is a general relation among all these is expressed by the following equations.

\[
a = 2\sqrt{2}/3 \approx 1.15; \quad b = 2\sqrt{3}/3 \approx 1.23; \quad c = 3\sqrt{3}/2 \approx 2.69; \quad R = \frac{2}{3}; \quad r = \frac{2\sqrt{3}}{3}.
\]

TETRAMORNIA (toward four, and power), four powers; the name of the 15th class in Limnæus's sexual system. See Botany.

TETRAO, of this genus the following species are found in Britain: 1. The uncorus, or lack of the wood, inhabits woody and mountainous countries; in particular, forests of pines, birch-trees, and junipers; feeding on the fruits of the former, and berries of the latter; the first often infests the flesh with such a taste as to render it scarcely edible. In the spring it calls the females to its haunts with a loud and shrill voice; and is at that time so very inoffensive to its safety, as to be very easily shot. It stands perched on a tree, and descends to the females on their first appearance. They lay from eight to sixteen eggs; eight at the first, and more as they advance in age.

This bird is common to Scandinavia, Germany, France, and several parts of the Alps. It is found in no other part of Great Britain than the Highlands of Scotland, north of Inverness; and is very rare even in those parts.

The length of the male is two feet nine inches; its weight sometimes fourteen pounds.

The female is much less, the length being only two feet six inches. The sexes differ also greatly in colours. The head of the female is of a pale yellow; the head, neck, and back, are elegantly marked, slender lines of grey and black running transversely. The upper part of the breast is of a rich glossy green; the rest of the breast and belly black, mixed with some white feathers; the sides are marked like the neck; the coverts of the wings crossed with undulated lines of black and reddish brown; the exterior webs of the greater quill-feathers are black; the tail consists of eighteen feathers, the middle of which is the longest; these are black, marked on each side with a few white spots. The legs are strong and covered with brown feathers; the edges of the toes are black. Of the female, the bill is dusky; the throat red; the head, neck, and back, are masked with transverse bars of red and black; the breast has some white spots on it, and the lower part is of a plain orange-colour; the head and neck is larded with pale-orange and black; the tips of the feathers are white. The tail is of a deep rust-colour, barred with black, tipped with white, and consists of sixteen feathers.

2. The tetric, black grouse, or black-cock, like the former species, is fond of woody and mountainous situations; feeding on the Vaccinium, and other mountain-fruits, and in the winter on the tops of the heather. In the summer they frequently descend from the hills to feed on corn. They never pair; but in the spring the male gets upon some eminence, crows and claps his wings; on which signal all the females within hearing resort to him. The hen lays seldom more than five or seven eggs. When the female is obliged, during the time of incubation, to leave her eggs in quest of food, she covers them up so artfully with only twenty-four hours above; but it is very difficult to discover them. On the occasion she is extremely tame and tranquil, however wild and timorous at other times. She often keeps

In the antient music, all the primitive or chief divisions were confined to four chords; so that the great scale consisted of repetitions, and all the upper tetrachords were considered only as repetitions of the first or lowest.

TETRADIAPASON, the Greek appellation of the quadruple octave, which we also call the 29th; in systems of the antients not extending to this interval, they only knew it in imagination, or by name.

TETRADYNAHIA (towards four, and power), four powers; the name of the 15th class in Limnæus's sexual system. See Botany.
her next though strangers attempt to drag away. As soon as the young ones are chased, they are seen running with extreme fertility after the mother, though sometimes they are not entirely disgorged from the egg. The hen leads them forwards for the first time into heath, and when they see them alight and alight on the wild mountain-berries, which, while young, are their own food. As they lower their appetites grow stronger, and they feed upon the tops of heath and heath cones of about a month old; at the end of which the young males fly for her, and keep in great harmony together till the beginning of spring. At season they begin to consider each other's possible game-cocks, that time is so intimate to their own dignity, that it often happens that two or three are killed at a shot.

An old black cock is in length twenty-two inches, and weighs near four pounds. The bill is dusky; and the plumage of the whole body black, crossed over the neck and rump with a shining blue. The coverts of the wings are of a dusky brown; the inner coverts white; the thighs and legs are covered with dark-brown feathers; the toes resemble those of the former species. The female coverts only two pounds, and its length is one of six inches. The head and neck are marked with alternate bars of dull red and black; the breast with dusky black and white; and the last pre-coccyx. The back, coverts of the wings, and tail, are of the same colours as the neck, but the red is deeper. It is slightly forked. The feathers under the tail are white, marked with a few bars of black and white. This bird is the largest in the same late in the summer. It lays from six to eight eggs, of a dull yellowish-white colour, marked with numbers of very small ferruginous specks; and towards the smaller end with some blotches of the same hue. See Nat. Hist. fig. 400.

3. The scoticus, red game, or moor-fowl, peculiar to the British islands. The male has about nineteen inches; and is in body 134 inches. The plumage on the head is of a light tawny red; each feather is marked with dusky bars of the middle and black. The back and scapular feathers are a deep red; and on the middle of each other is a large black spot; the breast and belly are of a dull purplish brown, crossed in its numerous narrow dusky lines; the legs and feet are clothed to the claws with sick white feathers. The claws are sharp, very broad and strong. The female has only fifteen inches. The colours in general are duller than those of the male. These birds pair in the spring, and lay from six to ten eggs. The young brood follow the adult in the whole summer; in the winter they are in flocks of forty or fifty, and become remarkably shy and wild; they always keep on the tops of the hills, are scarcely ever found on the sides, and never descends into the valleys. Their food is the mountain-berries and tops of the heath.

4. The lagopus, white game, or ptarmigan, is fifteen inches in length, and weighs nineteen ounces. Its plumage is of a pale brown or ash-colour, elegantly crossed or mottled with small dusky spots and minute bars; the head and neck with broad bars of black, rust-colour, and white: the belly and wings are white, but the shafts of the greater quill feather black; in the middle, the rear feathers are grey, blue, and white, and the neck, where there is a mixture of red, with a white bar. The females and young birds have a great deal of rust-colour in them. The tail consists of sixteen feathers; the two middle of which are ash-coloured, marked with black, and tipped with white; the two next black, slightly marked with white at their ends, the rest wholly black: the feathers beneath the tail are white, and almost entirely cover it.

Ptarmigans are found in this kingdom only on the summit of the highest hills of the Highlands of Scotland, of the Hebrides and Orkneys; and a few still inhabit the lofty hills of Kreswick in Cornwall, as well as the mountains of Wales. They live amid the rocks, perching on the grey stones, the general colour of the strata in these exposed situations. They are very likely birds; so tame as to bear driving like poultry; and, if provoked to rise, take very short flights, making a great circuit like pigeons. Like the grouse, they keep in small packs; but never, like those birds, take shelter in the heath, but beneath loose stones. To the taste they scarcely differ from a grouse.

II. Perdix, comprehends both the partridge and quail.

In England, the partridge is a favourite delicacy at the tables of the rich; and the desire of keeping it to themselves has induced them to make laws for its preservation, no way harmonising with the general spirit of English legislation. The partridge seems to be a bird well known over all the old continent. Their feathers resemble those of the game-cocks in general; but their cunning and instinct seem superior to those of the larger kinds. Perhaps, as they live in the more neighbourly of their enemies, they have more frequent occasions to put their ingenuity in practice, and learn by habit the means of evasion or safety. Whenever therefore a dog or other formidable animal approaches their nest, the female very well knows how to be incapable of flying, just hops up, and then falls down before him, but never goes off so far as to discourage her pursuer. At length, when she has drawn him entirely away from her secret treasure, she at once takes wing, and fairly leaves him to gaze after her despair. After the danger is over, and the dog withdrawn, she then calls her young, who assemble at once at her cry; and follow where she leads them. There are generally from ten to fifteen in a covey; and, if un molested, they live from fifteen to seventeen years.

2. The coturnix, or common quail, is not above half the size of the partridge. The feathers of the head are black, edged with rusty brown: the breast is of a pale yellowish red, spotted with black; the feathers on the back are marked, with lines of pale yellow, and the legs are of a pale hue. Except in the colours thus described, and the size, it ever resembles a partridge in shape, and, except that it is a bird of passage, it is like all others of the poultry kind in its habits and nature.

The quail seems to spread entirely throughout the old world, but does not inhabit the mountains. It is proposed to shift its quarters according to the season, coming northward in spring, and departing south in autumn, and in vast flocks, like other migrating birds. I twice in a year it comes in such vast quantities as to capri, that the bishop of the island draws the cries of its revenue from them; hence he is called the quail-bishop. But this does not stand alone; almost all the islands in the Archipelago, on the opposite coasts, are at times covered with these birds, and some of them occurring in this circumstance. Onto the west coast of the kingdom of Naples, within the space of four or five miles, a hundred thousand have been reported to be seen in a day, which have been sold for eight livres per hundred to the dealer for sale them to Rome. Great quantities also sometimes alight in spring on the coasts of Provence, especially in the diocese of the bishop of Frejus, which is near the sea, and appear at their first landing, as if they were afraid that they are often taken by the hand.

With us they may be said not to be plenty at any time. They breed with us, and the major part migrate south in autumn; the rest only shift their quarters, as they have been met with on the coasts of Essex, and in Hampshire, in the winter season, retiring thence in October.

It feeds like the partridge, and, like that bird, makes no nest, except a few dry leaves or sticks scraped together may be called so; and sometimes a hollow on the bare earth suffices. In this the female lays her eggs to the number of six or seven, of a whitish colour, marked with irregular rust-coloured spots. Its song is very original. It is never long as is hatched, like young partridges. They have but one brood in a year.

Quail-fighting was a favourite amusement among the Athenians. They abstained from the flesh of this bird, deeming it unholy; some, as supposing that it fed upon the white hellebore; but they reared great numbers of them for the pleasure of seeing them fight; and staked sums of money, as we do with cock, upon the success of the combat. Fashion, however, has at present changed with regard to this bird: we take no pleasure in its coigne, but its flesh is considered as a very great delicacy. Quails are easily caught by a call: the Fowler early in the morning having spread his net, and go out of it among the corn; he then imitates the voice of the female with his quail-pipe, which the cock hearing, approaches with the utmost assiduity; when he has got under the net, the Fowler then discovers himself, and terrifies the quail, who attempting to get away, entangles himself in the more in the net, and is taken.

TETRODON, a genus of fishes of the order Nines. The generic character is, jaws bony, divided at the tip; body roughened beneath; ventral has teeth.
1. Tetradon lapidaceus, bare tetradon. The fishes of this genus, of which there are
14 species, like all the others, have the power of inflating their body at pleasure, by means of
an internal membrane for that purpose, and during the time of inflation the small
spines disappear over their sides and abdomen are erected in such a manner as to operate as
a defence against their enemies: they are chiefly natives of the tropical seas, though
sometimes seen in the higher northern and southern latitudes, and are supposed to live
principally on the crustaceous and testaceous animals.

The present species grows to the length of
about twelve inches, and is of a thick form in
front, the hinder parts tapering suddenly
toward the base, the colour being a fresh
pink above, and whitish with a slight silvery
cast beneath. The present species has branches
of the Northern seas, sometimes seen
presented with numerous small spines. To the
abdomen, with numerous, longitudinal,
ventral, deep-brown streaks; fins and tail as in
the preceding species. The native of the Medi-
terranean and American seas, sometimes
found in the river Nile, where Hassequist
was assured by the fishermen that on being
taken the hands were stung in the same manner
as with nettles.

2. Tetradon testudinus, tortoise-shell te-
tradon. Length two feet; shape lengthen-
ed; colour rufous-brown above, marked by
circular round, pale-blue spots; beneath
shiny or ash-coloured, beautifully varied by
longitudinal and transverse black streaks; fins and tail
bright yellow; the whole abdomen is
dressed with numerous small spines, which,
when the animal is in a quiet state, are im-
bedded in so many corresponding cavities in the
abdomen; but when elevated when the slightest
alarm, distends its body. Native of the
Indian seas. The Linnaean name of this fish
is supposed to have been given from its
tortoise-like bulk, but perhaps, with more propriety,
from its variegated skin.

3. Tetradon ocellatus, ocellated tetradon.
Length six or eight inches; shape thick,
wide, contracting suddenly towards the tail:
mouth slightly produced: colour deep-green
above, a yellow tint on sides; eyes raised,
position on the sides, and abdomen, which are white.
Native of the Indian seas, and sometimes of the
adjacent rivers, particularly those of China
and Japan. It is of an extremely poisonous
nature, it eaten without the greatest care it
properly cleaning it before dressing, and is
said sometimes to have proved fatal in the
short space of two hours. The symptoms,
according to Rumphius, may be curable by the
treatment of the administration of a vegetable which
he calls rex amaronis. The emperor of Ja-
pan prohibits his soldiers, under very severe
penalties, from eating this fish: the rest of his
subjects may, as Mr. Pennant observes, run
the risk of being poisoned with impunity.

TEUCRUM, germander, a genus of
plants of the class dianemum, and order
gynopasminata; and in the natural system ran-
ging under the 42d order, verticillata. The
corolla has the upper lip divided into two
parts beyond the base, and divericated where
the stamina issue out. There are 69 species,
of which the scorodonia, scormium, and cha-
maidrys, are species of common occurrence. 1. The
scordonia, wood sage, or germander, is dis-
tinguished by leaves which are heart-shaped,
 serrated, and petiolated; by racemi, which are erect
and expanded in one row; and by an erect stem.
The flowers are straw-coloured, and the filaments red. 'The plant has a bit-
ter taste, and smells like hops, with a little mixture of garlic. It is used in brewing in
the isle of Jersey instead of hops. 2. The scor- domium, or common water-germander, has
creeping perennial roots, sending up many square,
procumbent, or trailing stalks, branch-
ing diffusely, and small reddish flowers. This
plant was formerly considered as medicinal,
but has now fallen into disuse. It grows na-
aturally in marshy places, in the isle of Ely
and other parts of England, and most parts of
Europe; and is sometimes admitted into gar-
dens, in many countries, for variety, and as
an ornamental plant. S. The chamaedrys, or small-
ner creeping germander, has reddish flowers,
growing almost in a verticillus, or whorls,
round the stalk, three on each peduncle: ap-
pearing in June and July. There are also some
species, ornamental as greenhouse
plants.

THALIA, a genus of plants of the class monandria, and order
polygynia; and in the natural system ranging under the 8th or
decasminata. The corolla is petunia-like
and undulated; and the drupe has a
smooth kernel. There are two species;
the genculata and canaxifrons.

H Alyrtrum, meadows rue, a genus of plants
of the class polyandria, and order
polygynia; and in the natural system ranging under the 29th order.
There is now no calyx; the petals are four or five in num-
ber, and the seeds are naked and without a
tail. There are 22 species; three of which are indigenous, the flavum, minus, and alpin-
um. The flavum or meadow, rue, has a leafy furrowed stalk, and a man-
fold erect panicule. It has commonly 24 sta-
mina, and from ten to sixteen pistils. The
root and leaves of the plant dye a yellow col-
our, and cattle are fond of it. It grows on
the banks of some rivers. 2. The minus, or
small meadow-rue, has sepals and leaves,
and a branching flowers. This plant is frequent
in sandy soils and mountainous pastures.

The alpinum, or alpine meadow-rue, has
evry simple stalk, and almost naked; and
racemus simple and terminal. It is frequent on
the sides of rivulets.

THALIFITE, a stone found in the
isles of mountains in Denmark, and
Chamouni, in the Alps. It is sometimes
amorphous, and sometimes crystallized. The
primitive form of its crystals is a rectangular
prism, whose bases are rhombi with angles of
96.5 degrees. The most usual variety is an
elongated four-sided prism (often flattened),
terminated by four-sided inco-
plete pyramids; sometimes it occurs in regular
six-sided prisms. The crystals are often very
shaped.

Its texture appears fibrous. Lustr 2.
Glassy. Causes single refraction. Britti
Specific gravity 3.42 to 3.46. Colour dark
green. Powder white or yellowish green and
feels dry. It does not become electric by
rubbing, but by the blowpipe, frotts, and
melts into a black slag. With borax melts
into a green bead.

A specimen of thalifite, analysed by Mr.
Descôteil, contained

<table>
<thead>
<tr>
<th>Substance</th>
<th>Amount</th>
</tr>
</thead>
<tbody>
<tr>
<td>37 silica</td>
<td></td>
</tr>
<tr>
<td>17 alumina</td>
<td></td>
</tr>
<tr>
<td>17 mica of iron</td>
<td></td>
</tr>
<tr>
<td>14 lime</td>
<td></td>
</tr>
<tr>
<td>1.5 oxide of manganes</td>
<td></td>
</tr>
</tbody>
</table>

96.5

THASPIA, the deadly carrot, a genus of
plants of the class pentandria, and order di-
and in the natural system ranging under the 42d order, umbelliferae. The plant is of noble growth, and the fruits are very beautiful. There are six species; the villous, sativa, asclepium, giganica, trifolita, and polygami. The roots of the latter were formerly ordered in medicine, but are now entirely disused. It is cultivated along with extreme violence in both uplands and downwarlds.

**THEA.** The tea-tree, in botany, a genus of the class and order polygonaceae, monogynia. The corolla is six or nine-petalled; the calyx five or six-leaved; the capsule triloculcus. There are three species, which are the most principal varieties. The viridis or green, and the bohea, which again admit of various subdivisions or varieties. There is, however, much uncertainty on this point. The country of which the tea plant is a native is hidden from the exploring eye of the philosopher; it is jealous of Europeans, and seldom gives them an opportunity of studying its productions. The tea plant is a native of Japan, China, and Tartary, and has not, as far as we can learn, been introduced growing spontaneously in any other part of the world. Sir Charles Thunberg, one of the most distinguished pupils of Linnaeus, who resided sixteen months in Batavia and Japan, has given a full description of the tea plant, and having classified it in the same manner as his master, says expressly that it has only one style. Several of the British botanists, on the other hand, refer it to the order of trigniae; declaring their authority from a plant in the duke of Northumberland's garden at Sion-house, which had three styles.

Linnaeus says that there are two species of the tea plant; the bohea, the corolla of which has six petals; and the viridis, or green tea, which has nine petals. Thunberg makes only one species, the bohea, consisting of two varieties: the one with broad and the other with narrow leaves. This botanist's authority is decisive respecting the Japanese tea plants; but as this subject has not yet been explored, we cannot determine what number of species there are in that country. The tea-tree, however, is now common in the botanical gardens in this country, and part of their prize plants, and there are several varieties, or, at least, permanent varieties of it: one with a much longer leaf than the other, which our gardeners call the green tea; and the other with shorter leaves, which they call the bohea. The greatest is by much the hardest plant, and with very little protection will bear the rigours of our winters. Messrs. Loddridges, of Hackney, have now several large plants of it in the open ground, which they only cover with mats in hard frost. They are chiefly propagated in this country by layers. See Plate Nat. Hist. fig. 400.

This plant delights in valleys, and is frequent on the sloping sides of mountains and the banks of rivers. In its native country it enjoys a southern exposure. It flourishes in the northern latitudes of Pekin as well as round Canton; but attains the greatest perfection in the mild temperate regions of Naskit. It is said only to be found between the 45th and 44th degree of north latitude. In Japan it is planted round the borders of fields, without regard to the soil; but as it is an important article of commerce with the Chinese, whole fields are sown with it, and it is by them cultivated with care. Thenob Rochen says, it grows equally well in a poor as in a rich soil; but that there are certain places where it is of a better quality. The tea which grows in rocky ground is superior to that which grows in a light soil; and the worst kind is that which is produced in the plains. It is propagated by seeds; from six to twelve are put into a hole about five inches deep, at certain distances from each other. The reason why so many seeds are sown in the same hole is said to be, that only one plant will vegetate. Sometimes this plant, being thus sown, grows with no other care. Some, however, manure the land, and remove the weeds; for the Chinese are as fond of good tea, and take as much pains to procure it of an excellent quality, as the Europeans do to procure excellent wine. The leaves are not fit for being plucked till the shrub is of three years' growth. In seven years it rises to a man's height; but as it then bears but few leaves, it is cut down to the stem, in this production a new crop of fresh leaves about the following summer, every one of which bears nearly as many leaves as a whole shrub. Sometimes the plants are not cut down till they are ten years old. We are informed by Kämpfer, that some seasons in which the leaves are collected in the islands of Japan, from which the tea derives different degrees of perfection.

The first gathering commences at the end of February or beginning of March. The leaves are then small, tender, and unfolded, and not above three or four days old: these are called fitch-tsiaa, or "tea in powder," because it is pulverised; it is also called imperial tea, being generally reserved for the court and people of rank; and sometimes also it is named bloom tea. It is sold in China for 20d. or 2s. per pound. The labourers employed in collecting it do not pull the leaves by handfuls, but pick them up one by one, and take every precaution that they may not break them. However long and tedious this labour may appear, they gather from four to ten or fifteen pounds a day.

The second crop is gathered about the end of March or beginning of April, just after this season's leaves have attained their full growth, and the rest are not above half their size. This difference does not, however, prevent them from being all gathered indiscriminately. They are afterwards picked and assorted into different parcels, according to their age and size. The youngest, which are carefully separated from the rest, are often sold for leaves of the first crops, or for imperial tea. Tea gathered at this season is called tea-tsinia, or "Chinese tea," because the people of Japan infuse it, and drink it after the Chinese manner.

The third crop is gathered in the end of May, or in the month of June. The leaves are then very numerous and thick, and have the appearance of a young shoot. This kind of tea, which is called ben-tsiaa, is the coarsest of all, and is reserved for the common people. Some of the Japanese collect their tea only at two seasons of the year; and the second, as has already mentioned: others confine themselves to one general gathering of their crop, towards the month of June; however, they always form afterwards different assortments of their leaves.

An infusion of tea is the common drink of the Chinese; and indeed, when we consider one circumstance in their situation, we must acknowledge that Providence has displayed much goodness in scattering this plant with so much profusion in the empire of China. The water is said to be unwholesome, and would therefore, perhaps, without some corrective, be unfit for the purposes of life. The Chinese pour boiling water over their tea, and leave it to infuse, as we do in Europe, but they use it in mixture and even without sugar. The people of Japan reduce theirs to a fine powder, which, they dilute with warm water until it has acquired the consistence of thin soup. Their manner of serving tea is as follows: They place before the company the tea-equipage, and the box in which this powder is contained; they fill the cups with warm water, and taking from the box as much powder as the point of a knife can contain, throw it into each of the cups, and stir it with a tooth-pick until the liquor begins to foam; it is then presented to the company, who sip it while it is warm. According to Du Halde, this mode has been peculiar to China, and is also used in some of the provinces of China.

The first European writer who mentions tea is Giovanni Botero, an eminent Italian author, who published a treatise about the year 1590, on the causes of the magnificence and greatness of cities. He does not indeed mention its name, but describes it in such a manner that it is impossible to mistake it. "The Chinese (says he) have a herb out of which they press a delicate juice, which serves them for drink instead of wine; it also preserves their health, and frees them from all those evils which the immoderate use of wine produces among us."

Tea was introduced into Europe in the year 1610 by the Dutch East India company. It is generally said, that it was first imported from Holland into England, in 1666, by the lords Arlington and Ossory, who brought it into fashion among people of quality. But it was used in coffee-houses before this period, as appears from an act of parliament in 1660, in which a duty of 8d. was laid on every gallon of the infusion sold in these places. In 1666 it was sold in London for 6s. per pound, though it did not cost more than 2s. or 3s. 4d. at Batavia. It continued at this price till 1707. In 1715 green tea began to be used; and as great quantities were then imported, the price was lessened, and the practice of drinking tea descended to the lower ranks. In 1720 the French began to send it to us by a clandestine cominerce. Since that period the demand has been increasing yearly, and it has become almost a necessary of life in several parts of Europe, and among the lowest as well as the highest ranks.

The following table will give an idea of the quantity of tea imported annually into Great Britain and Ireland since 1717:

<table>
<thead>
<tr>
<th>Year</th>
<th>Quantity (l)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1717-1726</td>
<td>700,000</td>
</tr>
<tr>
<td>1727-1728</td>
<td>120,000</td>
</tr>
<tr>
<td>1729-1730</td>
<td>4,000,000</td>
</tr>
<tr>
<td>1731</td>
<td>6,000,000</td>
</tr>
<tr>
<td>1735</td>
<td>12,000,000</td>
</tr>
<tr>
<td>1734 from 1730 to 1750</td>
<td>20,000,000</td>
</tr>
</tbody>
</table>

Besides those quantities imported into Britain and Ireland, much has been brought to Europe by other nations.
THE whole tea imported into Europe from China amounted to 17 million pounds; in 1785 it was computed to be about 19 million pounds.

In this country teas are generally divided into three kinds of green, and five of bohea: the former are 1. Imperial or bloom tea, with a large loose leaf, light-green colour, and a faint delicate smell. 2. Hyson, so called from the name of the merchant who first imported it: the leaves of which are closely curled and small, of a green colour, verging to a blue: 3. Single tea, from the name of the place where it is cultivated. 4. Congou, which imparts a yellow-green colour by infusion. 2. Canmo, so called from the place where it is made; a fragrant tea, with a violet smell; its infusion pale. 3. Congo, which has a larger leaf than the preceding, and its infusion somewhat deeper, resembling common bohea in the colour of the leaf. 4. Pekoe tea; this is known by the appearance of small white down mixed with it. 5. Common bohea, whose leaf is darker and one colour. There are other varieties, particularly a kind of green tea, done up in roundish balls, called gunpowder tea.

THEATINES, a religious order in the Roman church, so called from their principal founder John Picon, bishop of Theate or Chieti, in the kingdom of Naples, and afterwards pope, under the name of Paul IV.

THEFT, in law, an unlawful felonious taking away another man's moveable and personal goods, against the owner's will, with intent to steal them. It is divided into theft or larceny, properly so called, and petty theft, or petty larceny; the former wherein is of goods above the value of 12d. and is deemed felony; the other, which is of goods under that value, is not felony. See the articles Felony and Larceny.

THEFTBOTE, the receiving a man's goods again from a thief, or other amends, by way of composition, and to prevent prosecution, that the felon may escape unpunished; the punishment whereof is fine and imprisonment.

THELIGONUM, a genus of plants of the class monoeccia, and order polyanthria; and in the natural system ranging under the 33d order, scabridae. The male calyx is bith; there is no corolla; the stamens are generally 12. The female calyx is also bith; there is no corolla; only one pistil; the capsule is coriaceous unilocular, and monospermous. There is only one species, the cynoaranea, which is indigenous in the south of Europe.

THEOBROMA, a genus of plants of the class polypodiophyta, and order decandria; and in the natural system ranging under the 37th order, columnifera. The calyx is triphyllous, and there are five in number, are vaulted and two-horned; the nectarium is pentaphyllous and regular; the stamina grow from the nectarium, each having five anthers, see Plate Nat. Hist. fig. 492. There is one species:

The cacao, or chocolate-tree, which we shall describe in the words of Dr. Wright: "In all the French and Spanish islands and settlements in the warmer parts of America, the chocolate-tree is carefully cultivated. This was formerly the case also in Jamaica but at present we have only a few straggling trees left as monuments of our indolence and bad policy. There are delightful walks in shady places and deep valleys. It is seldom above 20 feet high. The leaves are oblong, large, and pointed. The flowers spring from the trunk and large branches; they are small, and pale red. The pods are oval and pointed. The seeds or nuts are numerous, and are curiously stowed in a white pithy substance. The cocoa-nuts being gently parched in an iron pot over the fire, the external covering separates easily, and is levigated on a smooth stone; a little anacto is added, and with a few drops of water is reduced to a mass, and formed into rolls of one pound each. This simple preparation of chocolate is the most natural, and the best. It is in daily use in most families in Jamaica, and seems well adapted for rearing of children."

THEODOLITE, a mathematical instrument much used in surveying, for the taking of angles, distances, &c.

THEOREM, a proposition which terminates in tautology, and which considers the properties of things already made or done. Or a theorem is a speculative proposition, deduced from several definitions compared together. Thus in triangle is compared with a parallelogram standing on the same base, and of the same altitude; and party from their immediate definitions, and partly from other of their properties already determined, it is inferred that the parallelogram is double the triangle; that proposition is a theorem.

Theorem stands contrasting from problem, which denotes something to be done or constructed, as a theorem proposes something to be proved or demonstrated.

There are two things to be chiefly regarded in every theorem, viz., the proposition and the demonstration. In the first is expressed what is to be demonstrated, in certain ideas, and what is to be demonstrated. In the latter, the reasons are laid down by which the understanding comes to conceive that it does or does not agree to it.

Theorems are various kinds: an Universal theorem, is that which extends to any quantity without restriction, universally, as this, that the rectangle or product of the sum and difference of any two quantities is equal to the difference of their squares.

Particular theorem, is that which extends only to a particular quantity, as this, in an equalilateral rectilinear triangle, each angle is equal to 60 degrees.

Negative theorem, is that which expresses the impossibility of any assertion, as that the sum of two biquadratic numbers cannot make a square number.

Local theorem, is that which relates to a surface that is either rectilinear, or bounded by the circumference of a circle; as that all the angles in the same segment of a circle are equal.

Solid theorem, is that which considers a space terminated by a solid line; that is, by any of the three cenic sections; as this; that if a right line cuts two asymptotic parabolas, its two parts terminated by them shall be equal.

Reciprocal theorem, is one whose converse is true; as that if a triangle has two sides equal, it has also two angles equal; the converse of which is likewise true, viz., that if the triangle has two angles equal, it has also two sides equal.

THERMOMETER. A glass vessel filled to a certain degree with a liquid, for the purpose of shewing the expansions of that liquid in different temperatures, or for the purpose of shewing the temperature by the corresponding expansion of that liquid, is called a thermometer; i.e., a measure of the temperature.

The fluids most used for thermometers are either mercury or spirit of wine; the latter of which is generally tinged red, by means of cochineal, or Brazil wood, &c. for the pur-
THERMOMETER.

One of rendering it more visible; hence they are denominated the mercurial thermometer, and the spirit thermometer. Other fluids, on account of their clamminess, or of their great irregularity of expansion, are not useful for thermometers.

The most proper and the most useful shape for thermometers, is that of a long tube with a narrow bore, and with a globular cavity at one extremity (see Plate Miscel. fig. 237). The cavity of the bulb C, and part of the tube, as far, for instance, as A, are filled with the fluid; the rest of the tube is either partly, or quite, exhausted of air; and the end B of the tube is hermetically sealed; viz. perfectly closed by melting the extremity of the tube at the flame of a candle or lamp, burned by means of a blowpipe.

When the bulb C is heated, the mercury, or the spirit of wine, is expanded; and not being able to extend itself any other way, all the increment of bulk is manifested in the increase of the diameter of the tube, viz. the whole of the surface A of the fluid will rise considerably into the tube. On the other hand, when the bulb C is cooled, the fluid contracts, and its surface A descends. It is evident, that, certain peribns, the larger is the proportion to the diameter of the cavity of the tube, or the narrower the latter is in proportion to the former, the greater will the motion of the surface A be in the tube. But it must be observed, that when the bulb is very large, the thermometer will not easily arrive at the precise temperature of any place, wherein it may be situated. Some persons, in order to give the bulb a greater surface, and to render it more capable of readily attaining a given temperature, have made it not globular, but cylindrical (which shape was adopted by Fahrenheit), or flat, or bell-like, &c.; but those shapes are improper, because they are liable to be altered by the varying gravity of the atmosphere, consequently those thermometers cannot be accurate.

If a thermometer is heated suddenly, as when the bulb C is immersed in hot water, the surface A of the fluid in it will be seen to descend a little, and instantly after will be seen to rise; the reason of which is, that the heat of the water enlarges the glass first, and is then communicated to the fluid. But, if the contrary, if a bulb of a thermometer is cooled suddenly, the surface A of the fluid will first rise a little, and then will descend; because the cold contracts the glass alone at first, and afterwards contracts the fluid.

Ice is melted by a certain invariable degree of temperature; and water freezes at about the same temperature; therefore, if the bulb C of a mercurial thermometer is placed in melting ice, or in melting snow, and a mark is made on the outside of the tube, even with the surface of the fluid, as at D; that mark is called the freezing-point, though in fact it is the melting-point of ice; the freezing-point of water being not so constant. If the bulb of the thermometer is placed in boiling water, and a mark is made on the glass tube, even with the surface of the fluid within, at E, that mark is called the boiling-point; for in an open vessel, and under the same atmospheric pressure, which is indicated by the barometer, water constantly boils at the same temperature, and an increased fire will force it to evaporate faster, but will not raise its temperature.

Those points being

Fahrenheit's, which is generally used in Great Britain. It is also used throughout this work, unless some other is mentioned. Reaumur's, which is generally used in France, and other parts of the Continent. Celsius's, which has been used in the French elements, under the name of centigrade thermometer.

The Florentine thermometers, which were made and used by the members of the famous academy at Paris, and are some of the first instruments of the sort, were vaguely graduated, some having a great many more degrees than others. But two of their most common graduations seem to be useful, viz. the annuated (or mercurial thermometer, viz. the annual thermometer of the Academy of Sciences, seems to have been graduated already thus,

<table>
<thead>
<tr>
<th>Fahrenheit</th>
<th>Reaumur</th>
<th>Celsius</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>100</td>
<td>80</td>
<td>50</td>
</tr>
<tr>
<td>212</td>
<td>90</td>
<td>100</td>
</tr>
</tbody>
</table>

These are the chief thermometers that have been used in Europe; and the temperatures indicated by the principal of them may be reduced into the corresponding degrees on any of those scales, by means of the following simple theorems; in which R signifies the degrees on the scale of Reamur, F those of Fahrenheit, and S those of the Swedish thermometer.

1. To convert the degrees of Reamur into those of Fahrenheit; $\frac{x}{4} + 32 = F$.

2. To convert the degrees of Fahrenheit into those of Reamur; $(x - 32) \times \frac{5}{9} = R$.

3. To convert the Swedish degrees into those of Fahrenheit; $\frac{5}{9} x + \frac{32}{5} = F$.

4. To convert Fahrenheit's into Swedish; $(x - 32) \times \frac{5}{9} = S$.

5. To convert Swedish degrees into those of Reamur; $\frac{x}{5} + \frac{32}{9} = R$.

6. To convert Reamur's degrees into Swedish; $x \times \frac{4}{5} = S$.

To such readers as are unacquainted with the algebraic expression of arithmetical formule, it will be sufficient to express one or two of these in words, to explain their use: 1. Multiply the degree of Reamur by 9, divide the product by 4, and to the quotient add 32, the sum expresses the degree on the scale of Fahrenheit. 2. From the degree of Fahrenheit subtract 32, multiply the remainder by 4, and divide the product by 9, the quotient is the degree according to the scale of Reamur, &c.

Thermometers have been made of a great variety of shapes and sizes, suitable to the different purposes for which they were intended.

Thermometers for shewing the temperature of the atmosphere, need not have their scales much extended; it is more than sufficient if they go as high as 120°. The lower degrees may be carried down as low as may be necessary for the cold of any particular climate. The mercurial thermometer needs not to be graduated lower than 40° below 0, because at about that degree mercury ceases to be a fluid.
The spirit thermometer may be graduated lower if necessary. We shall therefore mention, that a number which will be noticed hereafter, if a mercurial thermometer and a spirit thermometer are both graduated according to the above-mentioned directions, the two thermometers will not, in their usual indications of the same temperatures, point to the same degrees.

The degrees of thermometers may be delineated on metal, or wood, or paper, or ivory, &c., but such substances should be preferred for the scales of thermometers, as are not apt to be bent or shortened, or otherwise altered by the weather, especially when the instruments are not defended by a glass case, or by a box with a glass face.

The bulb of the thermometer must be clean and colourless; since coloured surfaces are apt to be partially heated by a strong light. The ball of the thermometer ought not to be in contact with the substance of the scale, lest it should be affected by the temperature of that substance.

Thermometers which are to be situated in the open air out of the house, must be at some distance (at least a foot) from the wall, and which shall not possibly be in any way not directly upon them. Fig. 238 represents a thermometer of the most usual shape independent of the case.

For chemical purposes, the bulb and part of the tube of the thermometer, must project some way below the scales, in order that they may be placed in liquids, mixtures, &c.

For other purposes, as for botanical observations, hot-houses, brewing-manufactories, baths, &c., the thermometers must be made longer, or shorter, or narrower, or particular directions must be added to the scales, &c.; but we shall not take any further notice of those fluctuating variations.

It is necessary, however, to describe a sort of thermometers which have been constructed for a particular purpose; namely, for shewing the highest degree of heat or cold, of objects which may be placed in the immediate presence of the observer; as for instance, in the course of the night, or in the hottest part of the day, or even during a whole season.

Thermometers for this purpose have been constructed, peculiarly intended for persons, as by Bernoulli, Kröf, lord Charles Cavendish, &c. but the best of them, which however is not without faults, and of course is in need of improvements, was contrived by Mr. James Siv, and is described in the 72nd vol. of the Philosophical Transactions. Fig. 239 exhibits this instrument, but divested of the scale and frame; ab is a tube of thin glass, about 16 inches long, and \( \frac{7}{8} \) of an inch in diameter; cd is a smaller tube with the inner diameter, about \( \frac{3}{8} \) joined to the larger at the upper end b, and bent down, first on the left side, and then, after descending two inches below ab, upwards again on the right, in the several directions daebg, parallel to, and one inch distant from it. On the end of the same tube at k, the inner diameter is enlarged to half an inch from h to i, which is two inches in length. This glass is filled with highly rectified spirit of wine, to within half an inch of the end ; excepting that of the small tube from d to g, which is filled with mercury. From a view of the instrument in this state, it will readily be conceived, that when the spirit in the large tube, which is the bulb of the thermometer, is expanded by heat, the mercury in the small tube on the left side will be pressed down, and consequently cause that on the right side to rise; on the contrary, when the spirit is condensed by cold, the reverse will happen, the mercury on the left side will rise as that on the right side descends. Further, therefore, which is Fahrenheit's, beginning with 0, at the top of the left side, has the degrees numbered downwards, while that at the right side, beginning with 0 at the bottom, ascends.

The divisions are arranged, by placing this thermometer with a good standard mercurial one in water, gradually heating or cooling, and marking the divisions of the new scale at every 5°. The method of shewing how high a degree of heat or cold is, is, to place the thermometer at the second degree; let it then be in the air, or immersed in a similar substance, and the liquid will always rise or fall, according as the temperature increases or decreases; and therefore it may be depended on, that the scale is correctly adjusted.

The common contrivance for a self-registering thermometer, now sold in most of the London shops, is, one mercurial and the other of alcohol (fig. 243), having their stems horizontal, the former has for its index a small bit of magnetic steel wire, and the latter a minute thermometer, in a tube inserted into small knobs by means of the flame of a candle.

The magnetic bit of wire lies in the vacant space of the mercurial thermometer, and is pushed forward by the mercury whenever the temperature rises, and pushes that fluid against it; but when the temperature falls and the fluid retires, this index is left behind, and consequently shews the maximum. The other index, or bit of glass, lies in the tube of the spirit thermometer immersed in the alcohol; and when the spirit retires by depression of temperature, the index is carried along with it in apparent contact with its interior surface; but on increase of temperature it moves forward and leaves the index, which therefore shews the minimum of temperature since it was set. As these indexes merely lie in the tube, the operation of motion is altogether incon siderable. The fluid is brought to the mercury by applying a magnet on the outside of the tube, and the other is duly placed at the end of the column of alcohol by inclining the whole instrument.

The operation of this instrument has been thus explained: When the surface of the column of spirit is viewed by a magnet, it is seen to have the form of a concave hemisphere, which shews that the liquid is attracted by the glass. The glass in that place is consequently attracted in the opposite direction, by a force equal to that which is employed in maintaining that concave figure; and if it was at liberty to move, it would be drawn back till the flat surface was restored. Let a small stick or piece of glass be to lose within the tube and to protrude into the vacant space beyond the surface of the alcohol. The fluid will be attracted also by the glass, and form a concave between its surface and the bore of the tube. But the small interior piece, being quite at liberty to move, will be drawn towards the spirit so long as the attractive force possesses any activity; that is, so long as any additional fluid hangs round the glass, or, in other words, until the end of the stick of glass is even with the surface. Whence it is seen that the small piece of glass will be resisted, in any action that may tend to protrude it beyond the surface of the fluid; and if this resistance is greater than the force required to slide it along in the tube (as in fact it is), the piece must be slide along as the alcohol contracts; so as always to keep the piece within the tube, this fact is accordingly observed to take place.

It might at first sight be imagined that equal increments of heat would cause fluids to expand equally; viz. that if the heat is increased gradually by one degree, two degrees, &c., the fluid that heated fluid thus heated would expand its bulk by a certain quantity, then by twice that quantity, three times that quantity, and so on. But this is not the case, and every fluid seems to follow a particular law of expansion.
Mercury seems to expand more equally than any other fluid. Yet its increments of bulk are not quite proportional to the increments of heat, with other fluids the irregularity of expansion is very considerable.

One cubic inch of mercury, or one measure whatever of it, at 32° of temperature, when heated to the temperature of boiling water, viz. at 212°, will be found increased in bulk by the quantity 0.01386. This fluid metal boils and becomes a vapour at 600° of Fahrenheit's thermometer, and it becomes a solid at 40°; viz. 72° below melting ice. Below that point, viz. —40°, it contracts irregularly.

Spirit of wine boils at about 180° and the promise probably never freezes. When brassy, or a mixture of water and spirit, freezes, it is the water that is solid, but the spirit will be found collected together in one or more bubbles, in some part of the ice.

From all that has been said with respect to the expansion of fluids, it appears that, on account of the variability of the rate of expansion, mercury and spirit of wine are the only two fluids which can be used for thermometers; observing that some compensation must be made by the spirit thermometer, in order to make it correspond with the scale of the mercurial thermometer. But the mercurial thermometer cannot indicate a temperature higher than 600°. Hence various ingenious inventors have endeavored to devise instruments capable of indicating the higher degrees of heat, which would be of great use in philosophy, chemistry, and various arts; but the only useful contrivance that has been made is that of the late Mr. Wedgewood. This ingenious gentleman applied to the measuring of high degrees of heat, a singular property of argilaceous bodies, a property which obtains more or less in all such kind of them, as far as an argilaceous substance, when exposed to fire, is diminished in bulk by it, or does the bulk increase again after cooling; and this diminution of bulk is proportional to the degree of heat to which the substance has been exposed.

This property may seem to be a deviation from the general rule, viz. that heat expands all sorts of bodies; but it is to be observed that any heat enables them to contract their dimensions; but in this case it must be considered that the clay pieces contract and remain contracted, because some substance, viz. water and an aeiform fluid, is separated from them by the action of the fire.

Mr. Wedgewood's thermometer, or apparatus for measuring the high degrees of heat, consists of small pieces of clay of a determined length, which are to be placed in the furnace. Each of these pieces, after they have been exposed to the fire, Fig. 241 represents the gauge, which is either of brass or of porcelain. Fig. 242 represents a section of the same; and the letters refer to the like parts in both figures. EFGH is a smooth flat plate; AC, BD, are two rulers of equal pieces, a quarter of an inch thick, and fixed fast upon the plate, so as to form a converging canal ABCD, whose width at CD is three-fourths of the width at AB. The whole length of the canal from AB to CD, is divided into 240 equal parts, and the divisions are numbered from the wider end. The liquid to be expanded as to its exact degree, is put into the canal, and is afterwards diminished in bulk by the action of fire (as the thermometrical pieces which will be described in the next paragraph), it may then be passed further in the canal, and more so according as the diminution is greater.

The thermometrical pieces are small cylinders of clay, a little flattened on one side. They are nearly as much in diameter as they are in length. When one of these pieces is to be used, it is proper to measure it first by placing it in the gauge at AB; for sometimes the pieces are a few degrees larger or smaller than the distance AB, which excess or defect being ascertained, must afterwards be allowed for. P represents one of these pieces set in the gauge for measurement.

The piece is then placed in the furnace, or between the ends of Fahrenheit's thermometer, at the end of the operation, or at any period, and, when grown cold, is measured by sliding it as far as it will go, into the canal of the gauge, the number of divisions against the scale of the gauge will shew the contracted dimensions of the piece, and of course the degree of heat to which it has been exposed.

It will be found that these pieces will go very little beyond 0 in the canal, if they have been exposed to a low degree of heat; or go to 27 or 28, if they have been exposed to the heat in which copper melts; to about 90° if exposed to the welding-heat of iron; or about 160° if exposed to the greatest heat that can be produced with charred pine or a well constructed air-furnace, &c.

The same thermometrical piece which has been used before, may be used again for higher degrees of heat, but not for lower degrees.

It is now necessary to shew the correspondence between the scale of this, and the scale of Fahrenheit's mercurial thermometer.

As the mercurial thermometer cannot show a temperature higher than 600°, and Wedgewood's thermometer cannot shew a temperature lower than 60°, it shows degrees between these limits, but it is necessary to shew the intermediate degrees, and which might reach some degrees below 600°, and some degrees above the temperature of a red heat. Mr. Wedgewood chose a piece of silver, the expansion of which measured in a gauge made for the purpose, similar to the gauge figured 241, might indicate the degrees of temperature between the two thermometers; with this instrument he first found the correspondence between the scale of Fahrenheit's and the last-mentioned gauge, by placing them alternately in water of the temperature of 50°, and in boiling water. Then he found the correspondence between the degrees of the gauge of the silver piece, and that of the earthen thermometrical pieces, by placing them both at the same time in different and higher degrees of heat; lastly, by computation from those results, he determined the correspondence between the degrees of Fahrenheit's scale and those of his own thermometrical gauge.

It was found that one degree of Wedgewood's thermometer is equal to 150° of Fahrenheit's; and that the 0 of Wedgewood's coincides with the 177.5° of Fahrenheit's; from which a comparison of the two thermometers may be made, or rather of the imaginary extensions of their two scales; for, in fact, Fahrenheit's thermometer cannot show a figure higher than 320°, and Wedgewood's cannot show a figure below 50°; so that it may be observed that the degrees of Wedgewood's scale are supposed to show equal increments of heat, whereas in truth we do not know whether the clay thermometrical pieces contract in proportion to the increments of heat; which shows that, though this is the best known thermometer for measuring the higher degrees of heat, yet an improvement of the same, or some other manageable and more accurate contrivance, is highly desirable.

Upon the whole it appears, that the spirit thermometer enables us to measure the degrees of heat as low as has ever been experienced, either naturally, or by artificial cooling; that the mercurial thermometer enables us to measure from a red heat up to the farthest extent of that scale, viz. to its 240th degree, which is reckoned as equivalent to 327°27' of Fahrenheit's scale.

THESIUM, Base flueinum, a genus of plants of the class pistacia, and order nooxynagia. The calyx is monophyllous, with the stamens inserted in the axil of each leaf, and one seed, which is inferior. There are nineteen species; one of which is a British plant, the linophyllum or bastard-tobacco. It has a foliaceous panicule with linear leaves, and flows in June and July.

TILLAPI, Bastard-cress, or Mithridate mustard, a genus of plants of the class tetradyum, and order silicoua; and in the natural system ranging under the 39th order, silicoua. The pod is enamour, obcordate, and polyspermous; the valves are boat-shaped, and marginated and carinate. There are 14 species; of which six only are natives of Britain. 1. The arvense, treacle-mustard, or pennycress, which is a weed, like garlic, and has a white flower. 2. The hirtum, or perennial mithridate mustard. 3. The campstire, or mithridate mustard. 4. The montanum, or mountain mithridate mustard. 5. The perennis, or treacle-mustard. 6. The burras pastoris, or shepherd's purse. The seeds of some of these species have an acrid biting taste, approaching to that of the common mustard; with which they agree nearly in their pharmacutic properties.

THIRD, in music, an interval so called because it contains three diatonic sounds. The Greeks not admitting the third as a consonance, it obtained no general name amongst them; but took that of the lesser or greater interval from which it was formed.

There are four species of thirds; two consonant, and two dissonant. The consonants are: first, the major third, called by the ancient dition, composed of two tones; secondly, the minor third, called hemitonic, consisting of a tone and a half. The dissonant thirds are, first, the diminished third, composed of two major semitones; secondly, the superius third, composed of two tones and a half. This last interval, not having place in the same mode, or key, is never used either in harmony, or in melody. The Italians sometimes introduce the
diminished third in airs, but it is never used in harmony.

The dominant thirds are the spirit of harmony, particularly the major third, which is sonorous and brilliant; the minor third is more tender, and even pathetic; a difference of character from which skilful composers derive some of the best and most poignant effects.

The old French theorists had almost as severe laws respecting the thirds as we now observe in regard to fiftis and eightis. It was the best forbidden to have two in immediate succession, even of different kinds, particularly in the same direction.

THIRTEENTH, in music, an interval forming the octave of the sixth, or the sixth of the octave. It contains twelve diatomic degrees, i.e. thirteen sounds.

THOA, a genus of the monocotyledon poyantria class and order of plants. There is no calyx or corolla; the male stamens are numerous; two; seed three or four-cleft; seed is grown in a brittle shell, covered with a bristly nect. There is one species.

THORACIC, a term applied to an order of fishes in the Linncean system; the character of this order of fishes is, that they have but two lateral fins placed directly under the thorax. Of this order there are 21 genera, viz. the


THORACIC DUCT. See ANATOMY.

THORAX. See ANATOMY.

The theory of insects is the back part of the breast. See ENTOMOLOGY.

THORNBACK. See RAI.

THOINUING, a genus of plants of the class diandria, and order monogynia. The corolla is quadrilateral, the calyx quadri- partite, and the anther sessile. There is only one species, a tree of Madagascar.

THRESHING, or Threshing, in agriculture, the art of beating the corn out of the ear.

THRESHING-MACHINES. The threshing of corn by means of machinery, has been long in use in the northern districts of the kingdom, and mills of this sort are now becoming general in most parts of the country; and upon arable farms of considerable extent, they cannot but be highly advantageous, as they save much labour and expense. In the making of those machines, attention should always be had to the size of the farms, or rather the quantity of grain that may be grown on them, and the mill proportioned accordingly. They are mostly constructed on the principles of the flax-mill, and are moved either by water or horses, the first by far the best method where it can be had; the grain by these machines being, in a manner, swung out of the ears by means of beaters which are attached to a cylinder that moves with very great velocity. Since the introduction of these machines, many improvements have been made on them; a screen has been added for the grain to pass through into a winnowing-machine, and a circular rake to remove the straw from it; as

before this addition the straw was forced out from the beater upon the upper barn-floor, and raised and laboriously and putting into order, which by this contrivance is saved. In working these mills, four persons are commonly necessary; one takes the sheaf from the stack, another places it ready for the third who is to feed the mill, and the fourth removes the straw to prevent its collecting in too large a quantity. It has been objected to these machines, that they do not thrash some sorts of grain clean; this has been particularly the case with barley. It is, however, observed by an intelligent writer, that the circumstance on which the good threshing of this kind of grain depends, is the iron covering under which the beating-wheel, having six beaters, moves; in some machines this is fixed, while the beating-wheel is capable of being raised or depressed at pleasure; but a recent improvement is, to render the iron roof movable, and the wheel fixed; and the iron is placed so near to the beaters that the grain is rubbed, as well as stricken out of the ear. In some machines of this sort, the beaters are a little rounded; but it is probably a better practice to have them of a rectangular form.

In some large mills of this kind the rollers take in about three hundred inches of grain in a minute. The medium length of the straw being estimated at about thirty inches, and supposed there would be ten feet deep to引进 the machine at a time, the whole sheaf will be equal to sixty inches, and the machine, when supplied with a middling quantity of water, will thrash five sheaves in a minute. But in respect to the performance of these mills much must depend on the attention with which they are fed, as a small neglect in this point will make a very considerable difference in the quantity of work done.

An excellent description of a mill of this nature is given in a late publication, in which it is remarked, that in such mills five people are commonly necessary to keep the work going on without interruption; yet this depends greatly on the construction of the machines, some of them being so contrived, that the work can be performed with much fewer hands. The manner in which one person operates is this: One person is employed in the constant work in carrying the sheaves to the man who feeds or puts the unthreshed corn into the machine, and in loosing the bands; another is required to feed the machine; a third to carry off the straw; the fourth to attend the samers, and lay aside the cleaned grain; and a fifth, where horses are made use of, to take care that they go regularly; and thus by means of five men and four horses they will through at the rate of five quarters in the hour on a medium, and when the crop is rich, and easily threshed, considerably more: consequently if a threshing-mill was to be employed for a whole day, or nine hours, it would thresh forty-five quarters; but in that case it would be necessary to employ two sets of horses. The expense is calculated in this manner:

Hire of eight horses, at 22. 6d. each per day. 1 0 0
Five men's wages, at 1s. 6d. each, 0 7 6
Total. 1 7 6

In this account the hire of the men and horses is, it is conceived, charged at the lowest rate, and that the expense of thrashing one quarter would cost about 1l. 7s. 6d. or about 7d. each quarter. But that taking the average expense of thrashing forty-five quarters of grain with horses, throughout the whole kingdom, including an equal proportion of all kinds, it cannot be, it is supposed, estimated at less than 3l. 7s. 6d. or 1s. 6d. each quarter, which makes a difference of about 1s. 6d. each. It must be observed, that since the introduction of these mills, the grain is thrashed by the ordinary servants on the farm, and without in any material degree obstructing the operations in the field; farmers are in general employing their men and horses in this business in bad weather, where other operations cannot be carried on.

The whole expense of constructing a threshing-mill, including the building of the shed for covering the great wheel, does not, in almost any case, exceed 100l. The annual repayment of the money, on another, amount to 5l., which added to the interest of the prime cost, makes the yearly expense 10l. 5s.; a sum for which any quantity of grain, however great, that may be supposed to be saved on the threshing-mill, and that to in a manner so much superior to what can be done by manual labour. The expense either of erecting these machines, or of keeping them afterwards in repair, must be considered by every intelligent occupier of a corn farm as a secondary object, when compared with the advantages that are derived from them; such as the performing of the operation at less than half the ordinary price, and affording the farmer the means of securing his grain from being embezzeled; besides, the saving, in regard to superior clean threshing, as has been now well ascertained, is not only more than the annual expense of repairs, but so great as, on a farm of considerable extent, to reimburse the farmer for the whole of his expenditure in the course of a few years. Considering, therefore the increasing scarcity of labourers, and the recent increase in the price of the better cultivated parts of the kingdom, the introduction of threshing-mills into common use cannot but be highly beneficial.

There is, however, one difficulty in the introduction of threshing-mills into the southern parts of the kingdom, which arises from the manner of harvesting all kinds of grain, except wheat, which cannot probably be easily removed; as the corn, in order to be clean threshed, should be put into the machine as straight and regular as possible. For while the sheaves, after being loosened and spread on the board, so as to be easily taken in by the feeding rollers, are passing between them, they keep the straw steadily, by which means the strokes of the beaters or scutters operate with more force and effect in separating the grain from the ears; whereas, if the unthreshed corn goes in sideways or irregularly, the threshers can have but little power upon it. This would no doubt frequently happen, threshing corn which has been mown with the scythe, and which is harvested in every respect like hay; so that unless the unthreshed grain is put into the mill in small quantities, it is almost impossible.
that it can be completely separated from the straw.

But though, when the size of the machine is considered, the expense of erecting it may be from sixty to one hundred pounds, according to situation and materials, smaller ones may be erected at much less, as from thirty to fifty pounds.

Some of the early mills have rollers or small mill-stones added to them, for the purpose of crushing and grinding grain for horses, swine, and other animals; and also instruments for cutting straw into chaff.

On the whole, this line of employing machines of this kind, it is remarked by an able writer, that it is the only method left for having the corn cleanly and properly threshed. They are so quick in the work, that the whole may be done under the eye of the master, and the corn secured in the granary without the least pilfering. The saving, by this means of threshing, in the extra quantity of corn procured, and the security against having the corn stolen, or injured in any way, especially in wet seasons, and with smutty wheat, which is threshed by it without any mischief being done to the sound grain, the smut not being crushed comes out whole, and is blown away with the chaff.

The principal objections that have been made to these machines, are the great expense of erecting and using them, their tendency to diminish the labour of the poor, and their allowing too great a supply of straw at a time. These objections are, however, of little consequence, when the general utility and advantages of such machines are considered; besides the latter are either such as have natural and deep root from them, or as may be readily obviated. The difficulty in regard to the straw may be easily removed, by having it properly stacked up or cut into chaff.

THRAVE, or THREAVE of corn, twenty-four sheaves, or four shocks of six sheaves to the shock, though, in some counties, they only reckon twelve shocks to the thrave.

THREAD, a small line made up of a number of fine fibres of any vegetable or animal substance, such as flax, cotton, or silk; from which it takes its name of linen, cotton, or silk thread.

Linen and cotton thread may be dyed of a durable and deep black by a solution of iron in sour beer, in which the linen is to be steeped for some time, and afterwards boiled in madder. See the article DYEING. Thread may be easily bleached by the oxymuriatic acid discovered by Mr. Scheele. This acid whitens cloth remarkably well, but it is still more advantageous for bleaching thread.

THREATENING LETTER. If any person shall send any letter threatening to accuse, defame, or threaten, punishable with death, transportation, pillory, or other infamous punishment, with a view to extort money from him, he shall be punished at the discretion of the court, with fine, imprisonment, pillory, whipping, or transportation. 80 C. 11. c. 24. But if the writer of a threatening letter delivers it himself, and does not send it to any other person under this act, Lösch's Corl. Law, 351.

THRINAX, small Jamaica junc-palm; a genus of plants of the natural class of palm and order of flaccid-sedges. The calyx is sepalate, there is no corolla; there are six stamens; the stigma is emarginate, and the berry monosperous. This plant was brought from Jamaica to Kew gardens by Dr. Threlfall.

THRIPS, a genus of the order hirudiptera; the generic character is, many insecutores; antennae the length of thorax; body linear, abdomen reflexed upwards; wings four, straight, long, narrow, incumbent on the back in length. The larva is a great consisting of very small insects, which are principally found on flowers. The antennae are submoniform, and of the length of the thorax; the wing is secure or incomparable, long and parallel between the neck or head; the body of a lengthened or sublinear shape, and the abdomen is at pleasure bent upwards or backwards; the wings are four in number, narrow, long, incumbent, and very slightly, or scarcely, crenulate.

The most familiar example of the genus is the thrips physapus of Linnaeus, which is a very small slender insect, of a black colour, very frequently seen during the spring and summer on various flowers. It consists especially on what are termed the compound flowers, as dandelion, &c. It wanders about the petals of the flower, descending to the bottom of the flowers, occassionally creeping at intervals, and often slipping from place to place, in performing which action it is observed suddenly to turn back its abdomen, so as nearly to touch the thorax with its tip. The wings are of a transparent quality, white, very narrow, and when properly magnified, are observed to be edged and tipped with hairs growing gradually longer as they approach the tips, where they are of considerable length. They are much shorter than the upper, beneath which they are, in general, almost concealed; the antennae consist of six joints, and the feet are tipped with an expanse and apparently vascular process, enabling the little animal to adhere at pleasure with the greater security to any particular substance. All these particulars require a microscope for their investigation, the whole insect not exceeding the tenth of an inch in length. This small species resembles the complete insect, but is destitute of wings; when very young it is white, and afterwards of a yellowish or reddish colour, and like the complete insect, is seen wandering about the petals of flowers.

The thrips physapus has been supposed to do much injury to wheat, rye, &c. by causing the young flowers to decay, thus preventing the growth of the embryo grain. This opinion, however, has been somewhat corrected by erroneous; who have contended that the thrips does not attach itself to such of the cereals as are in a perfect healthy state, but rather to such as are diseased by having the embryo grain covered with the growth of a very minute fungus, often growing on wheat; &c. and belonging to the genus acidioma or lyco-

THRU, the eoror viza, a genus of plants of the class monoclad, and order monoclad; and in the natural system ranging under the 35th order, conifera. There are four species of this genus, which are mostly known, the brahimiens, a shrub of Brazil.

THUYA, the orbor viza, a genus of plants of the class monadacl, and order monadacl; and in the natural system ranging under the 35th order, conifera. There are four species of this genus, which are mostly known, the brahimiens, a shrub of Brazil.

THYME, or Thymus vulgaris; a genus of the plant kingdom, and order monadacl; and in the natural system ranging under the 35th order, conifera. There are four species of this genus, which are mostly known, the brahimiens, a shrub of Brazil.
into a hard black enamel. With borax it exhibits the same phenomena, or even when the stone is simply heated at the end of a fire.

A specimen of thummerstone, analysed by Klaproth, contained

52.7 silica
23.6 alumina
9.4 lime
9.6 oxides of iron, with a trace
of manganese.

97.3

A specimen, analysed by Vauquelin, contained

44 silica
14 lime
10 oxide of iron
4 oxide of manganese

99.

THUNDER. See Electricity.

THUNBERGIA, a genus of plants belonging to the class dicotyledon angiosperma. The calyx is double; the corolla bell-shaped; capsules beaked. There are 5 species.

TIJUS. See RESTIES.

TIYMBRA, a genus of the class dicotyledon angiosperma. The calyx is two-lipped; seeds semiblind. There are 3 species.

TIYMYUS, THYME, a genus of plants of the class dicotyledon, and order gynnopteridae; and in the natural system ranging under the 42d order, verticillata. The calyx is bilabiata, and its throat closed with soft hairs. There are 22 species; of which only two are natives of Britain, the serpyllum and acinos.

1. The serpyllum, or mother of thyme, has pale red flowers growing on round heads, terminal; the stalks are procumbent, and the leaves plane, obtuse, and dilated at the base.

2. The acinos, or wild basil, has flowers growing in whorls on single footstalks; the stalks are erect and branched; the leaves acute and serrated. The thymus vulgarus, or garden thyme, is a native of France, Spain, and Italy. The attachment of birds to this and other aromatic plants is well known. In the experiments made at Upsal, sheep and goats were observed to eat it, and swine to refuse it.

Thymus, in anatomy, a gland, which in infants is very remarkable; it is situated in the upper part of the thorax, immediately under the sternum, and lies upon the pericardium, and on the trunk of the aorta and of the vena cava. See ANATOMY.

TIYNNUS, a genus of the hymenoptera order of insects. The generic character is, mouth hairy, with an incised mandible; the jaw short and straight; lip longer than the jaw, membraneous at the tip, and trifid, the middle division emarginate; tongue very short, involute; feelers four, equal, filiform; antennae cylindrical, the first joint thicker.

There are four species, three inhabiting New Holland, and the fourth is found in Africa.

THYROID GLAND. See ANATOMY.

THYRUS, in botany, a mode of flowering resembling the cone of a pine.

TIARELLA, a genus of plants of the class dicotyledon, and order gynnopteridae, and in the natural system ranging under the 13th order, sylvestrense. The calyx is quinquepartite; the corolla pentapetalous, and inserted into the calyx; the petals are entire; the capsule is unilocular and bivalve, one valve being less than the other. There are two species, the cordifolia and trifoliata, natives of North America.

TIBIA. See ANATOMY.

TIDALIS, or THIBRUS. See ANATOMY.

TIDES. See Astronomy.

Tide-waiters, or tide-men, are inferior officers belonging to the custom-house, whose employment it is to watch or attend upon ships, until the customs are paid; they get this name from going on board ships on their arrival in the mouth of the Thames or other part, and in the tide of the holders, or those of the measure, or those of the tide; a measure of liquid things, as wine, oil, &c., containing the third part of a pipe, or forty-two gallons. See MEASUREMENT.

TIGER. See FELIS.

Tiger-shell, a beautiful species of webula, of a dusky-red colour, spotted all over with large irregular blotches of white: it is brought from the East Indies, and is about two inches in length, and about an inch in diameter.

TILE, in building, a sort of thin brick, used on the roofs of houses; or more properly a kind of clayey earth, kneaded and mixed with water, dried and salted, and then allowing it to stay in the air a kiln, like a brick, and used in the covering and paving of different kinds of military and other buildings. The best brick-earth only should be made into tiles.

The thinness for all sorts of uses may now be comprised under seven heads, viz. 1. The plain tile for covering of houses, which is flat and thin. 2. The plain tile for paving, which is also flat, but thicker, and which is 9, 10, or 12 inches. 3. The pantile, which is also used for covering of buildings, and is hollow, and crooked, or bent, somewhat in the manner of an S. 4. The Dutch glazed pantile. 5. The English glazed pantile. 6. The gutter-tile, which is made with a kind of wings. And 7. The hip or corner-tile.

Tiles, plain, are best when they are firmest, soundest, and strongest. Some are dusky-coloured, and others rich in colour. The dusky-coloured are generally the strongest. These tiles are not laid in mortar, but pointed only in the inside.

Tiles, paving, are made of a more sandy earth than ordinary or common, or plant tiles for covering large spaces; the materials for these last must be absolute clay, but for the others a kind of loam is used. These are made thicker and larger than the common roof-tiles; and when care has been taken in the choice of the earth, and the management of the fire, they are very regular and beautiful.

Tiles, pan, when of the best kind, are made of an earth not much unlike that of the paving-tiles, and clay of the same; but the best sort of all is a pale-coloured loam that is less sandy; they have about the same degree of fire given them in the baking, and they come out nearly of the same colour. These tiles are laid in mortar, because the roof being very flat, and many of them warped in the baking, they will not cover the building so well that no water can pass between them.

Tiles, pan, Dutch glazed, get the addition of glazing in the fire. Many kinds of earthy matter running into a glassy substance in great heat, is a great advantage to them; preserving them much longer than the common pan-tiles, so that they are very well worth the additional charge that attends the using them.

Tiles, pan, English glazed, are in general not so good as the Dutch ones under that denomination, but the process is nearly the same.

Tiles, Dutch, for chimneys, are of a kind very different from all the rest. They are made of a whitish earth, glazed and painted with various figures, such as birds, flowers, or landscapes, in blue or purple colour, and sometimes quite white; they are about 0.5 inches thick, and which are made by the Dutch in each way, and three quarters of an inch thick. They are seldom used at present.

Tiles, gutter, are made of the same earth as the common pan-tiles, and only differ from them in shape; but it is advisable that particular care be taken in tempering and working the earth for these, for none are more liable to accidents. The edges of these tiles are turned up at the larger ends for covering the tiles; they are seldom used where lead is to be had.

Tiles, hip or corner, are at first made flat, like pan-tiles of a quadrangular figure, whose two sides are right lines, and the ends arches of circles; the upper end concave, and the lower convex the latter being about seven times as broad as the other; they are about 10.5 inches long; but before they are burnt, are bent upon a mould in the form of a ridge tile, having a hole at the narrow end, to nail them on the hip-corner for covering the roof.

Tiles, ridge, are made to cover the ridges of houses, and are made in the form of a semi-cylindrical surface, about 13 inches in length, and of the same thickness as plain tiles; their breadth at the outside measures about sixteen inches.

TILLA, lime, or Linden-tree, a genus of plants of the class polyantha, and order morgynia, and in the natural system ranging under the columnae. The calyx is quinquepartite; the corolla pentapetalous; the capsule semibifid; the juice crimson, quinquvalve, and opening at the base. There are four species; the europaea, americana, pubescens, and alba. The europaea, or common lime-tree, is generally supposed to be a native of Britain; but we are informed by Mr. Coxe, that Mr. Pennant told him (on what authority is not mentioned) that it was imported into England before the year 1652.

The wood is light, smooth, and of a spongy texture, used for making laths and tables for shoemakers, &c. Ropes and bandages are made of the bark, and mats and rustic garnments of the inner rind, in Carniola and some other countries. The lime-tree contains a gummy juice, which being repeatedly boiled and clarified, produces a substance like sugar.

TILLANDSIA, a genus of the hemiphylia monogynia class of plants, with a tubulated monopetalous flower, trifol at the limb; the fruit is a long, oblong, acuminate capsule, formed of three valves, and containing only one cell, with numerous seeds affixed to a long capillary plume. There are 16 species.

TILLER of a ship, a strong piece of wood fastened in the head of the rudder, and in small ships and boats called the helm.

In ships of war, and other large vessels,
the timber is to be felled, the statute requires it to be done then, for the advantage of tanning.

After timber has been felled and secured, it is hauled by hand; for which purpose some of the men advise it to be laid up in a very dry airy place, yet out of the wind and sun, or at least free from the extremities of either; and that it may not decay, but dry evenly, they recommend it to be laid up with wings, and covered with carting. It must not stand upright, but lie all along, one piece over another, only kept apart by short blocks interposed, to prevent a certain mouldiness which they otherwise apt to contract in sweeping one another; from which arises frequently a kind of fungus, especially if there are any sappy parts remaining. Others advise the planks of timber to be laid for a few days in some cool or dark place, to work off the sap, and extract the sap, and afterwards dry them in the sun or air. By this means, it is said, they will be prevented from either chopping, casting, or cleaving, but against shrinking there is no remedy. Some argue that placing them in the earth, others in a hot; and some for scourching and seasoning them in fire, especially piles, posts, &c., which are to stand in water or earth. The Venetians have not found the method of preserving wood, which is done after this manner: they put the piece to be seasoned into a strong and violet flame, in which they continually turn it round by means of an engine, and take it out when it is every way covered with a black coaly crust; when the internal part of the wood is so hardened, that neither earth nor water can damage it for a long time afterwards.

After timber has been well seasoned and fixed in their places, care is to be taken to defend or preserve them; to which the smearing with lime-wood oil, tar, or other oleaginous matter, contributes much. (being the principal danger which they are exposed to is shrinking.) The mean circumference be found in feet and decimals of a foot; square it, multiply this square by the decimal 0.77577, and the product by the length. Ex. Let the mean circumference of a circle be 24 feet. Then $0.77577 \times 24 = 202.615$, the number of cubical feet in the tree. The foundation of this rule is, that when the circumference of a circle is 1, the area is $0.775774715$, and that when the mean circumference be found in feet and decimals of a foot; square it, multiply this square by the decimal 0.77577, and the product by the length. According to the planck's method, the tree of the last example would be computed at 159.13 cubic feet only.

But the common way used by artificers for measuring round timber, differs much from this rule. They call one-fourth part of the circumference the girth, which is by them reckoned the side of a square whose area is equal to the area of the section of the tree; therefore square the girth, and then multiply by the length of the tree. According to the planck's method, the tree of the last example would be computed at 159.13 cubic feet only.

For measuring hewn or square timber, the custom is to find the middle of the length of the tree, and there to measure its breadth, by clapping two rules to the sides of the tree, and measuring the distance betwixt them; in like manner they measure the breadth the other way. If the two are found unequal, they are added together, and half their sum is taken for the true side of the square.

Timber, strength of. "After spending much time," says Mr. Smart, "in making various experiments, and comparing the results with those of Buffon, Belidor, &c., the differences were so great, that it would be wasting time to enumerate them; I shall therefore only mention the means of observations necessary to be known by all those mechanics who use timber; and point out some evident errors in a table of Belidor's, supposed to be the result of the best set of experiments ever produced in transverse strain.

He tells us, that a bar of wood, thirty-six inches long, and one inch square, supported at the ends by two props, will break with a weight of 187 pounds, and that the stress of the load is loose at the ends; but if the ends are firmly fixed, it will require 283 pounds to break it.

"This appeared to me so great an error, that I was induced to put little or no confidence in many of his experiments; and, in consequence, I made two fathoms of fir, of the same dimensions, one with a strong shoulder at each end, to prevent its bending, which having firmly fixed in a frame, I carried a weight more than ten times greater than that which was loose."

The fibres of timber requiring so great a force to tear them asunder in a vertical direction, and being easily broken by a transverse strain, which cannot be resisted by the parts lying nearly an equal weight in all directions, opens a wide field for useful experiments.

All timber-trees have their annual circles, or growths, which vary greatly according to the soil and exposure of the sun. The northeast side of the trees (being much smaller in the grain than the other parts, which are more exposed to the sun) is strongest for any column that has a weight to support in a vertical direction; because those circles, being nearer each other, and the area contains a greater quantity of them; nor are they so liable to be compressed by the weight, or to slide past each other, as when they are at a greater distance. On the other hand, this part of the tree is not fit for a transverse strain; because the nearer the hard circles are to each other, the easier the beam will break, there being so little space between them, and the hard circle forms a thin, smooth wire, which cannot slide past the other upon: but that part of a tree, the tubes of which are of a greater distance, or of larger grain, is more elastic, and requires a greater force to break it; because the outside fibre on the convex side; cannot slide past the next, nor is the one pressed upon it, which forms the full-crum to break it on. It is generally observed in large timbers, such as masts, that the fracture is seldom on the convex, but usually on the concave side; which is owing to the fibres on the concave side being more readily forced past each other, and those on the convex being so difficult to be torn asunder, that they cannot snap, in consequence of the largeness of the segment of the circles, they describe when on the strain. The curve described by the inner layers of the wood being so large, and indeed little less than a straight line, cannot form a fulcrum to break the outer ones upon; and as the convex side, or that on which the fibres are extended, ought to be always free from any mortise or incision on the outside, the strength decreases as it approaches the centre.

Fig. 7, 8, 9, and 10, Plate Ship-build, describe the simple method invented by Mr. George Smart, of converting all timber that is straight, and intended for square beams, to great advantage in general.
is generally called the major time, and that of the reversed \( \gamma \) the minor time.

The moderns have added to the old music a combination of times; but still we may say that we have now no more than two times common and triple: since the time of nine crotches, or nine quavers in a bar, is but a species of triple time; and that of six crotchets, or six quavers in a bar, though called a compound time, is only measured by two beats, one down and one up, as absolutely common time as that of four crotchets in a bar.

With respect to the velocities of the different species of time, they are as various as the measures and modifications of music, and are generally expressed by some Italian word or phrase at the beginning of each movement, as largo (rather slow), presto (quick), &c. But when once the time of the improvements has been once, it cannot be perfectly equal, that is, every bar is to take up the same quantity of time, and the corresponding divisions of the bars are to be perfectly symmetrical with respect to each other.

**TIMEKEEPERS, in a general sense, denote instruments adapted for measuring time. See CHRONOMETER.**

In a more peculiar and definite sense, time-keeper is a term first applied by Mr. John Harrison to his watches constructed for determining the longitude at sea, and for which he received, at different times, the parliamentary reward of twenty thousand pounds. Several other artists have since received also considerable sums for their improvements of time-keepers, as Arnold, Mudge, &c. See LONGITUDE.

This appellation is now become common among artists, to distinguish such watches as are made with extraordinary care and accuracy for nautical or astronomical observations.

The principles of Mr. Harrison's time-keeper, as they were communicated by himself to the commissioners appointed to receive and publish the same in the year 1765, and after, are as follows:

In this time-keeper there is the greatest care taken to avoid friction, as much as can be, by the wheels moving on small pivots, and in roller-holes, and high numbers in the wheels and pinions.

The part which measures time goes but the eighth part of a minute without winding up; so that part is very simple, as this winding-up is performed at the wheel next to the balance-wheel, by which means there is always an equal force acting at that wheel, and all the rest of the work has no more to do in the measuring of time than the person that winds it once a day.

There is a spring in the inside of the fusee, which I will call a secondary main spring. This spring is always kept stretched to a certain tension by the main spring; and during the time of winding up the time-keeper, at which time the main spring is not subjected to act, this secondary spring supplies its place.

In common watches in general, the wheels have about one-third the dominion over the balance, but in this balance-spring bar that is, if the power which the balance-spring has over the balance is called three, that from
...and that the balance, when at rest, the force of the error, acting on the pendulum, balances the spring, and makes the balance, when at rest, to a greater degree in proportion to the vibration that is a) pitch, than the force of the weight of the pendulum a b) common spring can move the pendulum on the perpendicular, when it is at rest.

"My timekeeper's balance is more than three times the weight of a large-sized common watch balance, and three times its diameter, and a common balance goes through about six inches of space in a second, but mine goes through about twenty-four inches in that time; so that my timekeeper only these advantages over a common spring; it is a good example of the advantage of an exceedingly strong spring, and at the same time, I may be allowed to say, an artificial cycloid, which acts at the spring; so that if these contrivances, let the balance vibrate more or less, all its vibrations are performed in the same time, and therefore if it goes at all, it must go true. So that it is plain from this, that such a timekeeper goes entirely from principle, and not on chance.

We must refer those who may desire to see a minute account of the construction of Mr. Harrison's timekeeper, to the publication of the Commissioners of longitude.

We shall here subjoin a short view of the improvements in the Harrison's watch, which will be presented to the Board of longitude by Mr. Ludlam, one of the gentlemen by whom, by order of the Commissioners, Mr. Harrison discovered and explained the principle upon which his timekeeper is constructed. The defects in common watches which Mr. Harrison proposes to remedy, are these: 1. That the main spring acts constantly with the same force upon the wheels, and through them upon the balance. 2. That the balance, together with an equal force, or meeting with a different distance from the air, or the oil, or the friction, vibrates through a greater or less arch. 3. That these unequal vibrations are not performed in equal times. And, 4. That the balance-spring is altered by a change of heat.

To remedy the first defect, Mr. Harrison has contrived that his watch shall be moved by a very tender spring, which never unrolls itself more than one-eighth part of a turn, and acts upon the balance through one wheel only. But such a spring cannot keep the watch in motion. He has then joined another, whose force is to wind up the first spring eight times in every minute, and which is itself wound up but once a Vol. II.

day. To remedy the second defect, he uses a much stronger balance-spring than in a common watch. For if the force of this spring upon the balance remains the same, whilst the force of the other varies, the error arising from that variation will be less, as the fixed force is the greater. But a stronger spring will require either a heavier or a larger balance, and must have a greater friction. Mr. Harrison, therefore, increases the diameter of it. In a common watch it is under an inch, but in Mr. Harrison's, two inches and ten tenths. However, the method already used little lessened the errors, and not removing them, Mr. Harrison uses two ways to make the times of the vibrations equal, though the arches may be unequal: one is to place a pin so that the balance-spring pressing against it, has its force increased, but increased less when the vibrations are larger: the other, to give the pallets such a shape, that the wheel may press them with less advantage when the vibrations are less but great advantage when the vibrations are greater. The method by which he achieves this, is to make the balance a different part of the spring in different degrees of heat, and lengthen or shorten it as the regulator does in a common watch.

The principles on which Mr. Arnold's timekeeper is constructed are these: The balance is unconnected with the wheel-work, except at the time it receives the impulse to make it continue its motion, which is only whilst it vibrates 10° out of 360°, which is the whole vibration; and during this small interval it has little or no friction, which is on the pivots, which work in ruby holes on diamonds. It has but one pallet, which is a planet surface formed out of a ruby, and has no oil on it. Watches of this construction, in the hands of Mr. Pelletier, of Lyons, go with great accuracy, and do not require any oiling; they keep the same rate of going in every position, and are not affected by the different forces of the spring; and the compensation for heat and cold is absolutely adjustable.

TIN, a metal known to the ancients: the physicians procured it from Spain and Britain, with which nations they carried on a very extensive and lucrative commerce. This metal has a fine white colour, like silver; a slight disagreeable taste, and emits a peculiar smell when rubbed. Its specific gravity is 7.29. It is very malleable. Tin-laf or foil is about 3/10th part of an inch thick, and it might be reduced to half this thickness. It is very flexible, and produces a remarkable cracking noise when bent, and the white heat. When exposed to the air it very soon loses its lustre, and assumes a greyish-white colour, but undergoes no further change. Neither is it sensibly altered by being kept under water, but when it is made to pass over red-hot tin, it is decomposed, the tin is oxidized, and hydrogen gas is evolved.

When tin is melted in an open vessel, its surface becomes very soon covered with a grey powder, which is an oxide of the metal. If the heat be continued, the colour of the powder gradually changes, and at least it becomes yellowish. In this state it is known by the name of putty, and employed in polishing glass and other hard bodies. When tin is heated very violently in an open vessel, it takes fire, and is converted into a fine white oxide, which may be obtained in crystals.

Tin is capable of combining with two different proportions of oxygen, and of forming two oxides; usually distinguished, on account of their colour, by the names of the yellow and the white oxide. The protoxide may be obtained by exposing tin to a strong heat under a bell-jar, constantly stirring it with a rod. It may be procured also by dissolving tin in dilute sulphuric acid without the assistance of heat, and then precipitating the oxide by pure potash; but in that case it retains a little acid, and has a white colour. It is composed of about 20 parts of oxygen and 80 of tin.

Tin oxide may be obtained by heating tin in concentrated nitric acid. A violent effervescence ensues, and the whole of the tin is converted into a white powder, which is deposited at the bottom of the vessel. It is composed of about 22 parts of oxygen and 72 of tin.

Tin combines with sulphur and phosphorus; but it has never been combined with carbon or hydrogen.

Sulphuric oxide of tin may be formed by throwing on the surface of the metal melted in a crucible, or by fusing the two ingredients together. It is brittle, heavier than tin, and not so fusible. It is of a bluish and lamellated structure, and is capable of crystallizing. According to Bergman, it is composed of 80 parts of tin and 20 of sulphur; according to Pelletier, of 85 parts of tin and 15 of sulphur.

When equal parts of white oxide of tin and phosphorus are mixed together and heated gradually in a retort, some sulphur and phosphorus are disengaged; and there remains a substance composed of tin, 60 of oxygen and 60 of white oxide of tin, formerly called aurum mithrum, musicum, or mosaicum, and now sulphurized oxide of tin. It consists of beautiful gold-coloured flakes, exceedingly light, which adhere to the sides of the vessel in which the substance was formerly very complicated. Pelletier first demonstrated its real composition, and was hence enabled to make many important improvements in the manner of manufacturing it.

Phosphorus of tin may be formed by melting in a crucible equal parts of filings of tin and phosphoric glass. Tin has a greater affinity for oxygen than phosphorus has. Part of the metal therefore combines with the oxygen of the glass during the fusion, and leaves off in the state of an oxide, and the rest of the tin combines with the phosphorus. The phosphorus of tin may be cut with a knife; it extends under the hammer, but separates in laminae. When newly cut, it has the colour of silver; its filings re-semble those of lead. When these filings are thrown on burning coals, the phosphorus in takes fire. This phosphorus may likewise be formed by dropping phosphorus gradually into melted tin. According to Pelletier, whose experiments we are indebted for the knowledge of all the phosphorus, it is composed of about
85 parts of tin and 15 of phosphorus. Marggraf also formed this phospshur, but he was ignorant of its composition.

Tin does not combine with azote or mur-"mous; though the last substance converts it into an oxide.

Tin is capable of combining with most of the metals, and some of its alloys are much employed. The greater number of them and divided. The older metallurgists considered it as a property of tin to render other metals brittle. Hence they called it diabolous metallorum.

1. It mixes readily with gold by fusion; but the proportions in which these metals combine chemically are still unknown. When one part of tin and twelve of gold are melted together, the alloy is brittle, hard, and hard-colored. Twenty-four parts of gold and one of tin produce a pale-colored alloy, harder than gold, but possessed of considerable ductility. Gold alloyed with no more than \( \frac{1}{4} \) of tin is scarcely altered in its properties, according to Mr. Alchome; but Mr. Tillet, who more later examined this alloy, found that whenever it was heated it broke into a number of pieces. It is very difficult to separate these metals from each other. The method is to fuse the alloy with sulphuret of antimony.

2. Before alloy of platinum and tin is very fusible and brittle, at least when these metals are mixed in equal proportions. Twelve parts of tin and one of platinum form an alloy, possessed considerable ductility, which becomes yellow when exposed to the air.

3. The alloy of silver and tin is very brittle, hard, and durable. The two metals can scarcely be separated again by the usual processes. This alloy has been applied to no use.

4. Mercury dissolves tin very readily cold; and these metals may be combined in any proportion by pouring mercury into melted tin. The amalgam of tin, when composed of three parts of mercury and one of tin, crystallizes in the form of cubes, according to Daubenton; but, according to Sage, in gray brilliant square plates, thin towards the edges, and thick towards the center. Each of the cavities between them are polygonal. It is used to silver the backs of glass mirrors. See FOLIATION of looking-glasses.

5. Tin unites very readily with copper, and forms an alloy exceedingly useful for a great variety of purposes. Of this alloy canons are made; bell-metal; bronze; and the mirrors of telescopes, are formed of different proportions of the same metals. The addition of tin diminishes the ductility of copper, and increases its hardness, tenacity, fusibility, and sonorosity. The specific gravity of the alloy is greater than the mean density of the two metals. It appears, from the experiments of Mr. Bricke, that this augmentation of density increases with the tin; and that the specific gravity, when the alloy contains 100 parts of copper and 16 of tin, is a maximum: it is 8.87. The specific gravity of equal parts of tin and copper is 8.76, but it ought only to be 8; consequently the density is increased 0.79. In order to mix the two metals exactly, they ought to be kept a long time in fusion, and constantly stirred, otherwise the greater part of the copper will sink to the bottom, and the greater part of the tin rise to the surface; and there will be formed two different alloys; one composed of a great proportion of copper combined with a small quantity of tin, the other of a great proportion of tin alloyed with a small quantity of copper.

Bronze and the metal of canons are composed of from 6 to 12 parts of tin combined with 100 parts of copper. This alloy is brittle, yellow, heavier than copper, and has much more tenacity; it is much more fusible and less altered by exposure to the air. It was this alloy which the ancients used for sharp-edged instruments before the method of working iron was brought to perfection. The spekloos of the Greeks, and perecho, were tin. Even their copper coins contain a mixture of tin.

Bell-metal is usually composed of three parts of copper and one part of tin. Its color is greyish-white; it is very hard, sonorous, and clastic. The greater part of the tin may be separated by melting the alloy, and then pouring a little water on it. The tin decomposes the water, is oxidized, and thrown upon the surface.

The mirrors of telescopes are formed by melting together the parts of tin and one part of copper. This alloy is very hard, of the color of steel, and admits of a fine polish. But besides this there are many other compounds used for the same purpose.

Vessels of copper, especially when used as kitchen-utensils, are usually covered with a thin coat of tin, to prevent the copper from oxidizing, and to preserve the food which is prepared in them from being mixed with any of that poisonous metal. These vessels are then said to be tinned. Their interior surface is scraped very clean with an iron instrument, and rubbed over with sal ammoniac. The vessel is then heated, and a little pitch thrown into it, and allowed to spread on the surface. Then a bit of tin is applied all over the hot copper, which instantly assumes a silvery whiteness. The intention of the previous steps of the process is, to have the surface of the copper perfectly bare and mealy, enter which cannot combine with the oxide of copper. The coat of tin thus applied is exceedingly thin. Bayen ascerlentiate, that a pan nine inches in diameter, and three inches three lines in depth, when tinned, only acquires an additional weight of 21 grains. Nor is there any method of making the coat thicker. More tin indeed may be applied; but a moderate heat melts it, and causes it to run off.

6. Tin does not combine readily with iron. An alloy, however, may be formed, by fusing them in a close crucible, completely covered from the external air. We are indebted to Bergman for the most precise experiments on this alloy. When the two metals were fused together, he always obtained two distinct alloys; the first composed of 21 parts of tin and one part of iron; the second of two parts of iron and one of tin. The first was very malleable, harder than tin, and not so brilliant; the second but moderately malleable, and too hard to yield to the knife.

The formation of tin-plate is a sufficient proof of the affinity between these two metals. This very useful alloy is formed by dipping into melted tin thin plates of iron, thoroughly cleaned by rubbing them with sand, and then sleeping them 24 hours in water scalded by bran or sulphuric acid. The tin not only covers the surface of the iron, but penetrates it completely, and gives the whole a white colour. See TINNIN.

The affinities of tin, and its oxides, are, according to Bergman, as follows:

- Tin.
- Oxide of tin.
- Zinc.
- Tartaric acid.
- Mercury.
- Muratic.
- Copper.
- Sulphure.
- Antimony.
- Oxalic.
- Gold.
- Arsenic.
- Silver.
- Phosphoric.
- Lead.
- Nitric.
- Iron.
- Succinic.
- Manganese.
- Fluoric.
- Nickel.
- Sulfur.
- Arsenic.
- Citric.
- Platinum.
- Lacetic.
- Bismuth.
- Acetic.
- Cobalt.
- Boracic.
- Sulphur.
- Prussian.

Tin-plate, an ore of tin which occurs in masses and is usually covered with a metallic crystallized. These crystals are very irregular. Colour dark brown; sometimes yellowish grey, and some times nearly white. Sometimes transparent when crystallized. Specific gravity 0.9 to 0.97. Before the bloom is removed, and on charcoal is partly reduced. Tinges borax white. According to Klaproth it is composed of

- 77.50 tin
- 21.50 oxygen
- .75 iron
- .75 silica

100.00

TINCTURE. See PHARMACY.

TINCTURE, in heraldry, the hue or colour of any thing in coat-armour. See HERALD.

TINEA. See MEDICINE.

TINNIN. Tinning is the art of covering any metal with a thin coating of tin. Copper and iron are the metals most commonly tinned. The use of tinning these metals is, to prevent them from being corroded by rust; as tin is not so easily acted upon by the air or water, as iron and copper are.

What are commonly called tin-plates, sheets, so much used for utensils of various kinds, are in fact iron plates coated with tin.

The principal circumstance in the art of tinning is, to have the surfaces of the metal to be tinned perfectly clean and free from rust, and also that the melted tin may be perfectly metallic, and not covered with any ashes or cals of tin.

TINNIN. Tinning. When iron plates are to be tinned, they are first scoured, and then put into what is called a pickle, which is sulphuric acid diluted with water; this dissolves the rust of oxide that was left after scouring, and renders the surface perfectly clean. They are then again washed and scoured. They are now dipped into a vessel full of melted tin, the surface of which is covered with round pieces, and renders the action of the air. By this means, the iron coming in contact with the melted tin in a perfectly metallic state, it comes out completely coated.
When a small quantity of iron only is to be used, it is heated, and the tin rubbed on to a piece of it; or more conveniently, the scale or spangles which are sprinkled the iron with some powdered tin, the use of which is to reduce the tin at may be oxidized. Any inflammable substance, as off for instance, will have in some degree the same effect, which is owing to its attraction for oxygen.

Tinning of copper. Sheets of copper may be tinned in the same manner as iron, copper boilers, saucepans, and other kitchen utensils, are tinned after they are made. They are first scoured, then made hot, and the tin rubbed on as before with resin, nothing ought to be used for this purpose but pure grain tin; but lead is frequently fixed with the tin, both to ablate its impurity, and to make it lie on more easily; but it is a very pernicious practice, and ought to be severely prohited.

To whiten brass or copper by boiling. Put a brass or copper into a pipkin with some lime tartar, alum, and grain tin, and boil them together. The vessels will soon be covered with a coating of tin, which, when well polished, will look like silver. It is in this manner that pins, and many sorts of tins, are whitened.

TINNITUS ALÆRUM, a noise or buzzing in the ear, when it seems to receive sounds which do not exist, or at least which are not produced by the motion of the external air; but the ear being filled with a certain species of sound, cannot admit other sounds, unless they are very violent. The tinnitus is of two kinds, the one proceeding from a distemper of the organ of hearing, the other from a disorder of the brain.

TIPHIA, a genus of insects of the order Mecoptera. The generic character is, mouth clefted over by the upper jaw extended from the head; palpi two, recurved, longer than the head; pterous, very thin. The larger kinds of tipulæ are, in general, stigniæ by their lengthened bodies, horizontally expanded wings, and the unusual length and slenderness of their legs, which are also remarkably difficult to catch, and so to enable the insect without breaking some of its limbs. The smaller kind have incumbent wings, and in habit or general appearance are much alluded to gnats, and some are so very small as scarcely covered the tenth of an inch in length. The larvæ of this genus differ in habit, according to their different modes of life, some being terrestrial, and others aquatic. They feed on the softer kinds of vegetable substances, as the fine fibres of roots, &c.

The larvæ of the European tipulæ, is the pulica or Lucanus, often measuring more than an inch and a half in body; and is distinguished by the short legs, which are transparent, with large dusky indentations intermixed with white towards the rib or upper edge. This insect proceeds from a dusky or greyish larva of a lengthened form, and des-

TITANUM, a metal found in black sand, resembling guncpowder, in Cornwall, and upon examination, is found to possess the following properties: Its colour is orange-red, and it has a good deal of lustre. As it has been only obtained in very small agglomerated grains, neither its hardness, specific gravity, nor malleability, has been ascertained. It is one of the most infusible of metals, requiring a greater heat to melt it than can be produced by any method at present known.

When heated, in the open air, it combines readily with oxygen, and seems capable of existing in three different oxides; namely, the blue or purple, the red, and the white.

The protoxide, which is of a blue or purple colour, is formed, when titanium is exposed hot to the open air, evidently in consequence of the absorption of oxygen.

The deutoxide or red oxide is found native. It is often crystallized in four-sided prisms. Its specific gravity is about 4.2; and it is hard enough to scratch glass. When heated it becomes brown, and when burned by a very violent fire some of it is volatilized. When heated sufficiently along with charcoal, it is reduced to the metallic state.

The peroxy or white oxide may be obtained by fusing the red oxide in a crucible with four times its weight of potash, and dissolving the whole in water. A white powder is precipitated, which is decomposed by the acid of titanium. Vauquelin and Hecht have shown that it is composed of 89 parts of red oxide and 11 parts of water.

Titanium does not seem to be capable of combining with sulphur.

Phosphates of titanium have been formed by Mr. Chenex by the following process: He put a mixture of charcoal, phosphat of titanium (phosphoric acid combined with oxide of titanium), and a little borax, into a durable crucible, well tuted, and exposed it to the heat of a forge. A gentle heat was first applied, which was gradually raised for three quarters of an hour, and maintained for half an hour as high as possible. The phosphat of titanium was found in the crucible in the form of a metallic button. It is of a white colour, brittle, and granular, and does not melt before the blowpipe.

Vauquelin and Hecht attempted to combine it with silver, copper, and zinc, without success. But they combined it with iron, and formed an alloy of a grey colour, interpersed with yellow-coloured brilliant particles. This alloy they were not able to fuse.

The affinity of the oxides of titanium are,
according to professor Lampadius, as fol-
los. 64. Gallic acid, Sulphuric, Phosphoric, Muratic, Arsenic, Nitric, Oxalic, Acetic.

TITLES, are the tenth part of the increase yearly arising and reposing from the profits of lands, the stock upon lands, and the per-
sonal industry of the inhabitants. And hence they are usually divided into three kinds: pradial, mixed, and personal.

Pradial titles are such as arise merely and immediately from the ground, as grain of all sorts, hay, wood, fruits, herbs; for a piece of land or ground, being called in Latin praedium, whether it is arable, meadow, or pasture, the fruit or produce thereof is called pradial, and consequently the title payable for such annual produce is called a pradial title.

Mixed titles are those which arise not im-
mediately from the ground, but from things immediately nourished from the ground: as by means of cattle depastured thereof, or otherwise nourished with the fruits; as colts, calves, lambs, chickens, milk, cheese, eggs.

Personal titles are such as arise from the labour and industry of man, employing himself in some personal work, artifice, or negotiation; being the tenth part of the clear gain, after charges deducted. Watts, c. 59. But while the tithe is paid in England, except by especial custom.

Tithes with respect to value, are divided into great and small. Great tithes are, corn, hay, milk. Small tithes are the pradial tithes of all other kinds, together with those that are mixed, and personal.

Tithes of common right belong to that church, within the precincts of whose parish they arise. But one person may prescribe to have tithes within the parish of another; and this is what is called a portion of tithes.

No title is due to the mere produce of a mine, or of a quarry, because this is not a fruit of the earth, renewing annually; but is the substance of the earth, and has been perhaps so for a great number of years. 1 Rol. Abr. 637.

But in some places tithes are due by cus-
tion of the produce of mines. 2 Vern. 36.

No title is due of lime: the chalk of which this is made being part of the soil. 1 Rol. Abr. 637.

Tithes is not due of bricks which are made from the earth itself. 2 Mod. 77.

Nor is tithe due of turf, or of gravel; be-
cause both these are part of the soil. 1 Mod. 35.

It has been held, that no title is due of salt, because this does not renew annually. 1 Rol. Abr. 642.

But every one of these, and all things of the kind, may by custom become tithe.

1 Rol. Abr. 642.

Barren land converted into tillage: no tithe shall be paid for the first seven years; but if it is not barren in its own nature, as if it is fertile, garnished and made fit for tillage, tithes shall be paid presently; for woodland is fertile, not barren. 1 Rol. Abr.

Glebe lands, in the hands of the parson, shall not pay tithe to the vicar, nor being in the hands of the vicar, shall they pay tithe to the parson, because the church shall not pay tithes to the church. But if the parson lets his recarty, reserving the glebe lands, he shall pay the tithes thereof to the lessee. Gisb. 651.

No tithes are due for houses; for tithes are only due of such things as are renewed from year to year. 11 Rol. Rep. 16. But houses in London and in the next year, no tithe for such land; because by this lying fresh, the title of the next crop of corn is increased. 1 Rol. Rep. 642. But if suffered to lie fallow longer than by the course of husbandry is usual, an agriment title is due for the heads depa-
tured upon such land. Sheep. Abr. 1098.

Sheep, after paying tithe of wool, had been fed upon tumps not severed, by which they were bettered to the value of five shilling each, and were then sold; it also appeared, that before the next shearing time, as many as had been bought in as were sold, and that some of this wool of wool had been paid. It was held, that if an agriment was to be paid for the sheep sold, it would be a double tithe; and the court held, that this was a new increase, and decreed the defendant to account for an agriment title. Gibs. Rep. in E. 231. But in a later case the court held, that no agriment title should be paid on any sheep if the sheep were animalis fructuosa. Busby 278.

Corn. It is held that no tithe is due of the raking of corn involuntarily scattered. Cro. Eliz. 173. But if more of any sort of corn be. scattered, then there would have been scattered if proper care had been taken, tithe is due of the raking of such corn. Cro. Eliz. 473. No tithes are due of the stubbles left in corn-fields, after mowing or reaping of corn. 2 Rol. Abr. 641.

Tithe of hay is to be paid, though beasts of the plough or pail, or sheep, are to be foddered with such hay. 12 Mod. 197. But no tithe is due of hay upon the heads or ploughed grounds, provided that such heat lands are not wider than is sufficient to turn the plough and horses upon. 1 Rol. Abr. 646. It is laid down in an old case, that if a man cuts down grass, and while it is in the swaths carry it away, and gives it to his plough-cow, that not having sufficient for their support, otherwise, no tithe is due thereof. 1 Rol. Abr. 645. And in a modern case, the cause of exchequer was of opinion, that no tithe is due of vetches, or of clover, cut green and given to cattle in husbandry. Rainh. 279.

Wood. Tithes of wood is not due in com-
mon right, because wood does not renew itself annually; but it was in antient times paid in many places by custom. 2 Inst. 645. Fag-
got wood, however, pays tithe.

Exemptions from tithe are of two kinds either to be wholly exempted from paying any tithes, or from paying tithe in kind. The forser is called de non decadendo; the latter de modo decadendo.

Privy tithe of non decadendo, is to be free from the payment of tithes, without an recompence for the same. Concerning which the general rule is, that no layman can pro-
scribe in non decadendo; that is, to be de-
charged absolutely, from the payment of tithes and to pay nothing in lieu thereof; unless he begins his prescription in a religious or ecclesi-
astical person. But all spiritual persons, in bishops, deans, prebendaries, parsons, and vicars, may prescribe generally in non deca-
dando. 1 Rol. Abr. 653.
A modus decimandus, usually called by the name of modus only, is where there is by custom a particular manner of tithing, different from the general laws of taking tithes in kind. This is sometimes a pecuniary or money payment, as in the case of the tithe of land; sometimes a compensation in work and labour; as that the parson shall have only the twelfth cock of hay, and not the tenth, in consideration of the owner's making for him; sometimes in lieu of a large quantity, when arrived to great maturity; as a couple of fowls in lieu of tithes, &c. Any means in short, whereby the general law of tithing is altered, and a new method of taking them is introduced, is called modus decimandus, or special method of tithing. 2 Black. 29.

In order to make a modus or prescription good, several qualifications are requisite. It must be supposed to have had a reasonable commencement; as that at the time of the prescription, the thing titheable was the real value of money, though now become much less. It must be something for the parson's benefit; therefore the finding straw for the body of the church, the finding a rope for a bell, or pulling a cart, have been adjudged not to be good. But it is a good modus to be discharged, that one has time out of mind been used to employ the profits for the repair of the church, for the parson has a benefit by that.

A modus must be certain; so a prescription to pay a penny or thereabouts, for every acre of land, is void for the uncertainty. And it has been held, that if a precise day of payment is not certain, the modus will not. And now it is held, that where an amensal modus has been paid, and no certain day for the payment thereof is limited, the same shall be due and payable on the last day of the year.

A modus must be antient; and therefore if it is any thing near the value of the tithe, it will be supposed to be of late commencement, and for that reason will be set aside.

A modus must be durable: for the tithe in kind, being an inheritance certain, the prescription for it should be as durable; therefore a certain sum, to be paid by the inhabitants of such a house, has been set aside, because the house may go down and none inhabit it.

And it must be constant and uninterrupted; for if there have been frequent interruptions, no custom or prescription can be obtained. But after it has been once duly obtained, a disturbance for ten or twenty years shall not destroy it.

When a common is divided and inclosed, a modus shall only extend to such tithes as the common yielded before inclosure, and not to the tithes of hay and corn, which the common, whilst it was common, did never produce. 1635.

The parson cannot come himself and set out his tithe without the consent of the owner, as may attend and see it set out; yet the owner is not obliged to give him notice when he intends to set it out, unless by special custom. 1 Ed. 1891. After it is set out, the care thereof as to waste or spoliating rests on the parson, and not upon the owner of the land; but the parson may spread, dry, and prepare his corn, hay, or the like, in any convenient place upon the ground, till it is sufficiently weathered, and fit to be carried into the barn. And he may carry his tithe from the ground, either by the common way, or such other way as the owner of the land uses to carry away his nine parts. If the parson suffers his tithe to stay too long upon the land, the other may detain the same as doing damage, or he may have an action on the tithe, and he cannot put in his cattle and destroy the corn or other title, for that would be to make himself judge what shall be deemed a convenient time for taking it away. Lord Baym. 180.

Payment of tithes. By 1 Geo. I. c. 6, all customary payments due to clergyman, the payment of tithes, &c. are enforced; and the prosecution in this case may be for any tithes or church-rates, or any customary or other rights, dues, or payments, belonging to any church or chapel, which, of right, by law and custom ought to be paid for the stipend or maintenance of any minister or curate, officiating in any church or chapel, provided that the same does not exceed 20l. But the time is not limited, within which the same shall become enforceable.

And if any quaker shall refuse to pay or compound for the same, any parson, vicar, curate, farmer, or proprietor of such tithes, or any churchwarden, chapelwarden, or other person who has or is supposed to have, receive, or collect any such tithes, rates, dues, or payments, may make complaint to any two justices, other than such as is patron of the church or chapel, or interested in the tithes. And by of certain days not limited between the time of refusal and the complaint; nor is it hereby required that such complaint shall be in writing. But it will be more conformable to the usual practice in like cases, if it is in writing. Upon which complaint, the said justices are required to summon in writing, under their hands and seals, by reasonable warning, such quaker, against whom such complaint shall be made. And after appearance, or otherwise, as the justice shall direct, the said justice or the clerk, or any other person, administrator of the estate, or executor of the will of the person who had the tithes, or the executor of the vendor or purchaser of the estate, may direct and appoint the payment thereof, so that the sum, ordered as aforesaid, does not exceed 10l.; and also such costs and charges, that upon the merits of the case shall appear, not exceeding 10s.; and on refusal to pay, any one of the two next justices, by warrant under his hand and seal, may levy the same by distress and sale, rendering the overplus, the necessary charges of distressing being first deducted and allowed by the said justice, unless it is in the case of appeal, and then no warrant of distress shall be granted till the appeal shall be determined. Tithes under the value of 40l. may also be recovered by the same process from persons who are not quakers. As no time is limited for obtaining the distress, nor charges allowed for keeping it, it may be sold immediately.

Any person who shall think himself aggrieved by the judgment shall have an appeal to the next session; where if the judgment shall be affirmed, they shall decree the same by order of session, and give costs against the appellant, to be levied by distress and sale, as to them shall seem reasonable; and no proceeding herein shall be removed by certiorari, or otherwise, unless the title of such tithes shall be in question.

The withholding of tithes from the parson or vicar, whether the former is a clergyman or lay-appropriator, is among the primary causes cognizable in the ecclesiastical court; but herein a distinction must be taken: for the ecclesiastical courts have no jurisdiction to try the right of tithes, unless between spiritual persons, between spiritual and temporal, and are only required to settle the payment of them when the right is not disputed. 2 Inst. 364.

Tithes, however, if of any considerable value, are generally sued for in the exchequer by English bill, except where the title is not in the church with the stipulated grace of the tithe, or, if others, unless the title of such tithes shall be in question.

TITHINGMEN. In the Saxon times, for the better conservation of peace, and the more easy administration of justice, every hundred was divided into ten tithings, called tenchings or ten tithings. Each tithing consisted of ten triforbs, or triforbs of ten families; in which tithingmen, or civil deans, were to examine and determine all smaller differences between villages and neighbours, but to refer all greater matters to the superiors, which had a jurisdiction over the whole hundred.

TITLE, in law, denotes any right which a person as to the possession of a thing; or an authentic instrument, whereby he can prove his right. See RIGHT, &c.

As to the titles of the clergy, they denote certain places wherein they may exercise their functions. There are several reasons why a church is called titular; but that which seems to be the best, is because antiently the name of the same was in the church, and thereto the clergyman was an engraver on the porch, as a sign that the saint had a title to that church, and thence the church itself was afterwards called titular. In this sense a title signifies the church to which a bishop was presented, and where he is constantly to reside; and by the canons, none shall be ordained without a title. This is in order to keep out from such the ministry who, for want of maintenance, might bring a disturbance into the church. Can. 31.

In short, according to some writers, such a title is an assurance of being preferred to an ecclesiastical benefice; that is to say, a certificate that the clerk is provided of some church or vicarage, or where the bishop that ordains him, intends shortly to admit him to a benefice or curacy then void.

TITMOUSE. See PARUS.

TMESIS, in grammar, a figure whereby a compound word is separated into two parts, and one or more words placed between them; thus, for quiresque, Virgil says, quae mihi venit ex tantum terras, &c.

TOAD. See RANA.

TOBACCO. See NICOTIANA.

TODUS, the tody, in ornithology, a genus belonging to the order of passerines. The beak is slender, depressed, broad, and the base beset with bristles; the nostrils are small and oval; the toes are placed three before and one behind; the middle are connected to the outer. There are 15 species according to

Dr. Latham. * Birds of this genus (says
that eminent ornithologist) inhabit the warmer parts of America. They vary considerably in their bills, length of beak, and all of them have a certain flattening or depressions, which is peculiar. They have a great affinity to the flycatchers; and, indeed, to speak the truth, the two genera run much into one another. However, in one thing they differ materially; for in the tody, the outer and middle toes are much connected, whereas in the flycatcher genus they are divided to their origin."

BOUNDARY, the balsam of tallow-tree, a genus of plants, and the class deciduous, and order monogynia. The calyx is five-toothed, bell-shaped; petals five, obovate; style none. There is only one species, the balsamum. This tree grows to a considerable height; it sends off numerous large branches, and is covered with a large bark; the leaves are elliptical or ovate, entire, pointed, alternate, of a light-green colour, and stand upon short strong stalks; the flowers are numerous, and produced in lateral racemes.

It grows in Spanish America, in the province of Tolou, behind Carthagena, where we are supplied with the balsam. This balsam is obtained by making incisions in the bark of the tree, and the exudation is collected into spoons, which are made of black wax, from which it is poured into proper vessels.

This balsam is of a reddish-yellow colour, transparent, in consistence thick and tenacious. By age it grows hard and thick, and finally, that it may be rubbed into a powder between the finger and thumb. Its smell is extremely fragrant, somewhat resembling that of lemon. It is taste, in warm and sweetish, and on being chewed, it adheres to the teeth. See PARAS.

This balsam possesses the same general virtues with the balsam of Gilead, and that of Peru. It is, however, less heating and stimulating, and may therefore be employed with more safety. It has been chiefly used as a pectoral, and is said to be an efficacious corroboration in glects and seminal weakness. It is a perfect medicine, as Pharmacopoeia in the syrups totulanum, tintura totulanum, and syrupus balsamicus.

TOMATORE, a metal composed of copper and arsenic. See ARSEN.

TOMATE, a genus of the class and order dodecandria monogynia. The involute is four or five-leaved; calyx none; corolla five-petalled; nect. scales five; berry one-seeded. There are three species, of which the saffire or tallow-tree of China is the most remarkable. The leaves and twigs of this tree abound in a viscous juice, and being bruised and macerated in water, render it glutinous, and it is used by the natives to work up their plaster. A small quantity of thick white oil is extracted from the berries, of which candles are made resembling wax or spermaceti.

TONIC weight, 20 hundred. See WEIGHT.

TONE, or TUNE, in music, a property of sound whereby it comes under the relation of grave and acute; or it is the degree of elevation any sound has, from the degree of swiftness of the vibrations of the parts of sonorous bodies. See SOUND.

TONGUE. See ANATOMY.

TONNAGE, a custom or impost due for merchandise brought or carried in tows from or to other nations after a certain rate in every ton.

The usual method of finding the tonnage of any ship is by the following rule:—Multiply the length of the keel by the breadth of the beam; and that product by half the breadth of the boat; and divide the last product by 94, and the quotient will be the tonnage.

Ship's keel 72 feet; breadth of beam 24 feet.

\[ 72 \times 24 \times 12 \div 94 = 120.6 \text{ tonnage.} \]

The tonnage of goods and store is taken sometimes by weight, and sometimes by measurement; and that is allowed to the vessel which yields the most tonnage. In tonnage by weight, 20 cwt. make 1 ton. In tonnage by measurement, 46 cubic feet are equal to the weight of one hundredweight; all other stores to be measured by tonnage, are taken to pieces, and packed in the manner which will occupy the least room on board ship. All ordinance, whether brass or iron, is taken in tonnage by its actual weight. Musket-cartridges are reckoned in rounds or boxes, all ammunition in boxes, and other articles of great weight, are taken in tonnage according to their actual weight.

The following is the tonnage allowed to the military officers of the ordnance embarked for foreign service, for their camp-equipment and baggage:—

For a field officer = 5 tons. For a captain = 3 tons. For a subaltern = 1.5 tons.

TONSELLA, a genus of the class and order triandria monogynia. The calyx is five-parted; petals five; nect. pitcher-shaped; berry one-celled, four-seeded. There are two species, trees of the West Indies.

TONTINE. See ANATOMY.

TONTINE, in ecclesiastical history, a particular manner of administering a fund; the stock, the amount of which is fixed; while the interest arising from the stock, the amount of which is fixed; the interest arising from the stock, or the interest of the survivor, will be no more than 11. 17s. 6d. But it is to be observed, that these lives will be continually dying from the time of the first subscription to the conclusion of the tontine; and the scheme of this weekly contributions will reduce the share of each survivor to 11. 12s. nearly. When the expenses of management are also deducted, and allowance is made for the loss which may be sustained by investing the money in the public funds, it is more than probable that the shares will fall greatly below the sum just stated, and that the surviving members will, at the end of seven years, be left at and to the end of seven years, to the share of each survivor; the interest of the money they have paid, after having endangered the loss of the greatest part of it by dying in the mean time. In several of these schemes, which have lately been called by mineralogists accidental rubies, topaz, and sapphire; which, agreeing in their crystallization and most of their properties, were ar-
ranged under one species by Mr. Ronan de Lisle. The word topaz, derived from an island in the Red Sea, where the ancients used to find topazes, was applied by them to a mineral very different from ours. Our variety of our topaz they denominated chrysolite.

The topaz is found in Saxony, Bohemia, Siberia, and Brazil, mixed with other minerals in granitic rocks.

It is commonly crystallized. The primitive form of its crystals is a prism whose sides are rectangles, and bases rhombs, having their greatest angles 154° 22′, and the internal molecule has the same form; and the height of the prism is to a side of the rhomboidal bases as 3 to 2. The different varieties of topaz crystals hitherto observed, amount to 6. Five of these are eight-sided prisms, terminate by four-sided pyramids, or wedge-shaped summits, or by irregular figures of 7, 13, or 15 sides: the last variety is a twelve-sided prism, terminated by six-sided pyramids wanting the apex. For an accurate description and illustration of the varieties, the reader is referred to Mr. Hany.

The texture of the topaz is foliated. It causes a double refraction. Specific gravity from 3.45 to 3.56. The Siberian and Brazil topazes, however, become positively electrified on one side, and negatively on the other. It is insusceptible of the blowpipe. The yellow topaz of Brazil becomes red when exposed to a strong heat in a crucible; that of Saxony becomes white by the same process. This shows us that the colouring matter of these two stones is different.

The colour of the topaz is various, which has induced mineralogists to divide it into the following varieties:

1. Red topaz, of a red colour, inclining to yellow; called Brazilian or occidental ruby.
2. Yellow topaz, of a golden-yellow colour, and sometimes also nearly white; called occidental or Brazil topaz. The powder of this and the following variety, causes syrup of violets to assume a green colour.
3. Saxony topaz. It is of a pale wine yellow colour, glossy greyish white.
4. Augite marini, of a bluish or pale-green colour.
5. Occidental sapphire, of a blue colour, and sometimes white.
6. A specimen of white Saxony topaz, analyzed by Vauquelin, consisted

| 68 aluminia | 31 silica |

99.

TOPOGRAPHY, a description or draught of some particular place, or small tract of land, as that of a city or town, minor or mountain, field, garden, house, castle, &c. such as surveyors set out in their plots, or make draughts of, for the information and satisfaction of the proprietors.

TORDYLIUM, hart-wort in botany, a genus of plants of the family Compositae, and order Dignyana, and in the natural system, arranged under the 45th order, Umbellata.

The corollas are radiated, and all hermaphrodite; the fruit is roundish, and crested on the margin; the involucr long and un

There are seven species; of which two are British, the maximum and officinale.

1. The maximum, or knotted parsley, has simple sessile umbels, the exterior seeds being rough. It grows in the borders of the coasts, and in damp places.

TORMENTILLA, T. tormentil, a genus of the class Polyandria, family Polygynia, and in the natural system ranging under the 35th order, Santenum. The calyx is obovate; the petals are four; the seeds round, naked, and affixed to a juiceless receptacle. There are two species, the erecta and repens, both indigenous. The erecta, common tormentil, or sepool, has a stalk somewhat erect, and sessile leaves. The roots consist of thick tubercles, an inch or more in diameter, requiring of an assenting quality. They are used in most of the Western Islands.

TORNADO, or Tornado, a sudden and vehement gust of wind from all points of the compass, frequent on the coast of Guiana.

A tornado seems to partake much of the nature of a whirlwind or water-spout, but is more violent in its effects. It commences very suddenly, several clouds being previously drawn together, when a spot of wind, proceeding from them, strikes the ground, in a round spot of a few rods or perches diameter, in the course of the wind of the day, and proceeds thus half a mile or a mile. The prominence of its descent makes it rebound from the earth, throwing such things as are movable before it, but some sideways or in a lateral direction from it. A vapour, mist, or rain descends with it, by which the path of it is marked with vet.

The gentleman who furnishes the above general description, gives an account of one which happened a few years since at Leicester, about forty miles from Boston, in New England. "It happened in July, on a hot day; about four o'clock in the afternoon. A few clouds having gathered westward, and congealed, as is usual, in the running together in a point being observed, immediately a spot of wind struck the ground at the west end of a house, and instantly carried it away with a negro man in it, who was afterwards found dead in the path of it. Two men and a woman, by the breach of the floor, fell into the cellar; and one man was driven forcibly up into the chimney-corner. These were preserved, though much bruised; they were wet with a vapour or mist, as were the remains of the floor, and the whole path of the spot. This wind raised boards, timbers, &c. A joist was found on one end, driven near three feet into the ground. The spot probably took it in its elevated state, and drove it forcibly down. The tornado moved with the celerity of a madding wind, and constantly declined in strength till it entirely ceased."  

TORPEDO. See RAY, and ELECTRICITY.

TORRICELLIAN experiment, a famous experiment made by Torricelli, a disciple of the great Galileo, which has been already explained.

TORRID ZONE, among geographers, denotes that tract of the earth lying upon the equator, and on each side as far as the two tropics, or 23° 30′ of north and south latitude.

TORTOISE-shell, the shell of the testaceous animal called a tortoise; used in inlaying, and in various other works, as for small boxes, combs, &c. 

Mr. Catesby observes, that the hard strong covering which includes all sorts of tortoises, is very improperly called a shell; being of a perfect bony contexture, but covered on the outside with scales, or rather plates of a horny substance; which are what workmen call tortoise-shell. See HELIX.

There are two general kinds of tortoises, viz. the land and sea tortoise, testudo terrestris and marina. The sea-tortoise, again, is of several kinds; but it is the testudo imbricata of Linnaeus, alone which furnishes that beautiful shell so much admired in Europe. See Testudo.

The whole spoils of the tortoise consist in thirteen leaves or scales, eight of them flat, and five a little bent. Of the flat ones; there are four large ones, sometimes a foot long, and seven or eight inches broad. The upper shell is thick, clear, transparent, of the colour of antimony, sprinkled with brown and white. When used in marquetry, &c. the workmen give it what colour they please by means of coloured leaves, which they put underneath it.

Working and joining of tortoise-shell.—Tortoise-shell and horn become soft in a moderate heat, as that of boiling water, so as to be pressed, in a mould, into any form, the shell or horn being previously cut into plates of a proper size. Plummer informs us, in his Art de Tourner, that two plates are likewise united into one by heating and pressing them; the edges being thoroughly cleaned, and made to fit close to one another. The tortoise-shell is conveniently heated for this purpose by applying a hot iron above and beneath the juncture, with the interposition of a wet cloth to prevent the shell from being scorched by the iron. These iron should be pretty thick, that they may not lose their heat before the union is effected. Both tortoise-shell and horns may be stained of a variety of colours, by means of the colouring drugs commonly used in dyeing, and by certain metallic solutions.

TOUCAN. See RAMPHASTOS.

TOUCAN, in astronomy, a constellation of the southern hemisphere, consisting of eight small stars, and otherwise called asser americus. See ASTRONOMY.

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TOUCAN, in anatomy, a constellation of the southern hemisphere, consisting of eight small stars, and otherwise called asser americus. See ASTRONOMY.
fourth part of their breadth in thickness, and an inch and a half long; these being thus prepared are pasted on the under surface of each mark so as to give its particle, or the thinnest quirety of the admixture in it. The black rough marbles, the basaltites, or other softer kinds of black pebbles, are the most proper for touchstones.

The method of using the needles and stone is this: the piece of metal to be tried, ought first to be wiped well with a clean towel, or piece of soft leather, that you may the better see its true colour; for from this alone an expert person will, in some degree, judge beforehand what the price of metal is, and how and with what debate. Then choose a convenient, not overlarge, part of the surface of the metal, and rub it several times very hard and strongly against the touchstone; that in case a decortical coat or crust should have been laid upon it, it may be worn off by that friction: this, however, is more readily done by a grindstone, or small file, if you have them at hand. Then wipe a flat and very clean part of the touchstone, and rub against it, over and over the surface of the piece of metal, till you have, on the flat surface of the stone, a thin layer, about an inch long, and about an eighth of an inch broad; this done, look out the needle that seems most like the metal under trial, wipe the lower part of this needle very clean, and then rub it against the touchstone as you did the metal, by the side of the other line, and in a direction parallel to it. When this is done, if you find no difference between the colours of the two marks made by your needle and the metal under trial, you may, with great probability, pronounce that metal and your needle to be of the same alloy, which is immediately known by the mark engraven on your needle. But if you find a difference between the colour of the mark given by the metal, and that by the needle you have tried, choose out another needle, either of a darker or lighter colour than the former, as the difference of the tinge on the touchstone directs; and by where the marks of this kind are rubbed you would be able to determine which of your needles the metal answers, and whence it is of, by the mark of the needle; or else you will find that the alloy is extraordinary, and cannot be determined by the comparison of your needles.

TOURMALINE, in mineralogy, a species of siliceous earth. It has been found only in Ceylon, Brazil, and Tyrol. That of Ceylon is of a dark-brown of yellowish colour; its specific gravity 3.065, or 3.093; that of Brazil is green, blue, red, or yellow, and its specific gravity 3.075 or 3.180; that of Tyrol by reflected light is of a blackish brown, but by refracted light yellowish, or in thin pieces green; its specific gravity 3.050; it is readily crystallised in polygonal prisms, but sometimes amorphous. The thinnest parts are opaque: the thin more or less transparent. See Shor.

TOURNEFORTIA, a genus of the pentandra monogynia class of plants, the flowers of which consist of a single petal in form of an oval tube, longer than the calyx, divided into five slight segments somewhat broad and pointed, and spread open; the fruit is a glosso-beerry, containing two cells; and the seeds are of an oval figure, two in number, and separated by the pulp. There are eleven species, shrubs of South America. There are three species, herbs of the Levant.

TRACHICHTHYS, a genus of fishes of the order tetraclis. The generic character is, head rounded in front; eyes large; mouth wide, toothless; deciduous; gill-membrane with eight rays, the four innermost of which are rough on the edges; scales rough; abdomen crenellated with large crenate scales. There is only a single species, viz. 

TRACHINUS, a genus of fishes of the order jugulares: the generic character is, hided slightly roughened, compressed; gill-membrane six-rayed; gill-covers covered with the body compressed, vent situated near the hinder end. 1. Trachinus draco, dragon weever. This fish is of a lengthened shape, much compressed on the sides, and covered with small and hard scales, the head is wide, and opens vertically, like that of the star-gazer; both jaws are armed with sharp teeth; the tongue is straight, smooth, and pointed; the eyes are seated on the upper part of the head, but do not quite reach the gills. The gill-covers are armed at their tips with a strong spine. The general colour of the weever is silvery, with a yellowish or dusky cast on the upper parts, while the sides are commonly varied by numerous obliquely transverse streaks of a similar colour; the scales are small and rounded; the first dorsal fin is of a deep black. The usual length of the fish is about ten or twelve inches.

This fish is an inhabitant of the Mediterranean and Northern seas, commonly frequenting the coasts, and frequently infesting the sand; in which situation, if accidentally trodden on, it strikes backwards with its tail, and inflicts a violent wound on the aggressor with the spines of its first dorsal fin. So troublesome are the consequences arising from the punctures inflicted by this part, that a law is said to exist in France, obliging the fisherman to cut off the fish before the fish is exposed for sale. The usual symptoms attending the wound are, violent heat, pain, and inflammation; and it not unfrequently happens that when the hand is thus wounded, a sudden redness extends throughout the whole length of the arm, as far as the shoulder. The usual remedy among the English fishermen is, according to Mr. Pennant, sea-sand, well rubbed on the part; an application which one might at first suppose would rather aggravate than alleviate the complaint. Many other popular remedies are used in different countries. Notwithstanding the suspicious aspect of the above-mentioned black fin, it does not seem to have any thing in its constitution which can justify the idea of any poisonous fluid conveyed from it into the wound; the spines when microscopically examined shewing no apparent trace of a tubular passage.
TRADE.

In 1794 £16,729,403

1795 13,335,213

1796 19,102,290

1797 16,093,103

1798 16,672,503

1799 24,984,213

1800 25,308,000

1801 25,993,129

1802 26,093,129

1803 22,352,027

1804 23,955,793

1805 23,903,308

The real value of British produce and manufactures exported, however, considerably exceeds the above official statement, and as far as it can be ascertained, under the ad valorem duties, or computed at the average current prices of the goods, it amounted in the year 1804 to 40,349,642l. and in 1805 to 41,008,942l. The commodities included under the term British produce, such as alum, bark, coals, cattle, fish, hemp, metals, salt, and a few other articles, being united in these accounts with manufactured goods, the actual value of the latter cannot be derived from them; but in a comparative view they furnish a sufficiently accurate idea of the proportions exported at different periods.

The annual produce of the different manufactures of this country, and the employment by them, has in several instances been greatly over-rated. It is very difficult to say what the number of persons which the various branches have at different times been represented to employ, were added together, they would form a very considerable population of the country far exceed its known amount, with full allowance whatever for other occupations.

The woollen-manufacture, which is the most antient and important, has increased during the last twenty years, and appears to be still increasing, notwithstanding the high price of the material, and the precarious state of the foreign markets. On a late examination of the principal woolen-manufacturers, Mr. W. Hargiver estimated the quantity of wool grown in this country at 600,000 packs, of 240 pounds each, which at 11s. per pack makes the value of the whole 8,600,000l. He justly observed that it is difficult to ascertain how much wool is imported, and how much being manufactured; some sorts are increased rather more than double, some nine times or even more; but if the average is taken at only three times, which will be the truth, the total value of the wool manufactured in the country will amount to 19,800,000l.

It must be remarked, that this calculation is founded on a supposition that, in 1791, the number of sheep in the kingdom was 28,800,000, which, as far as any idea can be formed from the proportion of the consumption of the metropolis to that of the whole island, and the stock requisite for the supply, greatly exceeded the truth at that time; and it is the general opinion, particularly of persons in the wool-trade, that of late the number of sheep kept has been considerably reduced. The calculation is likewise made at an unusually high price of wool; for though during the year 1800, the average price of 12 to 14s. about eleven guineas, the average of the three or four preceding years was certainly not more than from ten pounds to ten guineas; upon the whole, the estimate, therefore, will be

30K
The average value of woolen goods exported from Great Britain in six years was as follows:

In 1794 £4,300,920
1795 £3,172,884
1796 £6,011,133
1797 £4,936,355
1798 £4,490,339
1799 £6,876,939

The average is £5,647,924. Most of the custom-house values of goods exported are greatly below their present value, but not so much, so in this article as in some others; they are found, however, to be about thirty-eight per cent. below the actual value, and this addition being made to the average amount, the value of woolen goods exported will appear to be £7,744,140. The value re- mained for home consumption may be nearly equal to the value exported, although in quantity the former may greatly exceed the latter; a very considerable proportion of which consists of superfine and second cloths, whereas the consumption of fine woollens in great Britain has much diminished of late years, from the general use of Manchester manufactures of cotton in clothing, particularly for workmen and hand work, and the whole value of the manufacture thus appears to be about 15,588,000l. and, as a medium between this sum and the amount before stated, it may be taken at 16,400,000l. Deducing from this amount the rate of 10 per cent. on the cost of the goods for the profits of the manufacturer, including the interest of his capital, there remains 14,909,000l. consisting of the cost of the material, and the wages of labour; the value of all the wool used, as we have seen, is about 5,750,000l. and including the cost of some other necessary articles, the materials cannot be valued at less than this sum; the remainder therefore, or 9,159,000l. will be the wages of the whole persons employed in the manufacture. It is scarcely possible to assume with precision an average rate of wages, with respect to any manufacturer, as they vary in different parts of the country, and the proportion of the different classes of persons employed is in no instance known with certainty. In the West, where the woollen-manufacture has been for some time past in a state of depression, few workmen get above 14s. per week, and many much less from being only employed; in Yorkshire good workmen earn from 16s. to 18s. per week, children 3s. older children and women from 5s. to 9s. and older men from 9s. to 12s. If, on taking all classes together, 8s. per week is not thought too high, it will appear that the whole number of persons employed does not exceed 440,340.

The value of the feather-manufacture was, some years ago, stated at 10,500,000l. and from the state of the trade of late, particularly those branches of it which supply military accoutrements, harness, saddlery, carriages, &c. combined with the high price of skins of most kinds, it cannot be supposed less than that sum at present. Deducing 934,545l. for the profits of capital employed, and 3,500,000l. for the cost of the raw article, there remains 6,045,354l. for the wages of the persons employed, at 25s. per annum for each person, makes the number employed 241,818.

The cotton-manufacture was formerly of little importance in this country, in comparison with its present state. The total quantity of cotton-wool imported into England, on an average of five years, ending with 1795, was 1,170,881 pounds, and even so late as the year 1791, it amounted to only 5,101,920 pounds. About that time, however, the British calicoes, which had been introduced some years before, had arrived at some degree of perfection, and the branch of muslins being added, in which great improvements were soon after made, the whole manufac- ture experienced a rapid and great increase, that previous to the commencement of the war with France, the consumption of cotton-wool amounted to upwards of 35,000,000l. For the price below the ten per cent. is laid on, it is proba- bly not less than this rate on the whole of this and in most other manufactures. The number of persons employed in the silk-manufac- ture has been about 100,000 and upwards, but there appears no reason to believe that it exceeds 65,000 of all descriptions.

The linen-manufacture of great Britain is chiefly carried on in Ireland, though some branches of it are carried on in Manchester and other parts of England. The exportation of British-made linen duty-free, was allowed in 1717, but the bounties on exportation were not limited till 1743, in which year the export was 52,772 yards. On an average of seven years of peace from 1740 to 155, the export of British-manufactory had increased to 270,733 yards; and it continued to increase greatly during the succeeding years, till the average of seven years, ending with 1792, was 1,336,640 yards.

The average of the next seven years was 2,423,378 yards; but in consequence of the commercial embarrassments of the year 1794, the quantity fell very much, and in the beginning of 1774, it is said there were not so much as half the weavers employed throughout Scotland and the north of England. In the course of a few years revived again, and in the year 1783 the export amounted to no less than 14,298,000 yards. The total quantity of British linen exported during three years ending with 1779, was as follows:

1776 14,533,000 yards
1778 20,744,000
1779 21,204,000

The value, estimated at the current price of linen exported, on an average of three years preceding 5th January 1798, was 1,278,734l.; therefore, if the quantity retained for home consumption is not greater than the export, the value of the whole must be upwards of 2,590,000l. and it probably will not be less. The whole value of this branch of the manufacture in Great Britain with the thread, and other branches of the flax trade, is stated at 3,000,000l. That is not of less extent, may be presumed from the following account of the quantities of
high flax and linen-yarn imported on an average of five years, ending the 3rd of January in the years stated, viz.

<table>
<thead>
<tr>
<th>Year</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>1798</td>
<td>£21,297,059</td>
</tr>
<tr>
<td>1799</td>
<td>£24,506,007</td>
</tr>
<tr>
<td>1800</td>
<td>£24,235,633</td>
</tr>
</tbody>
</table>

The returns of the quantity and value of linen-cloth stamped for sale in Scotland, furnish much information respecting the state of this manufacture; and were in three years ending with 1800, as follows:

<table>
<thead>
<tr>
<th>Year</th>
<th>Linen and flax</th>
<th>Hemp</th>
<th>Paper</th>
<th>Glass</th>
<th>Pottery</th>
<th>Iron, tin, and lead</th>
<th>Copper and brass</th>
<th>Steel, plating</th>
<th>&amp;c.</th>
</tr>
</thead>
<tbody>
<tr>
<td>1797</td>
<td>£3,141,411</td>
<td>£8,747,157</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1798</td>
<td>£3,214,900</td>
<td>£8,873,905</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1799</td>
<td>£3,232,254</td>
<td>£7,581,275</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

The annual value of the iron-manufacture was estimated at 8,700,000/.; which sum appears rather too high at present; but including tin and lead, the value of the whole will probably not be taken too high at 10,000,000/. The number of persons employed at 200,000.

The copper and brass manufactures are now established in this country in all their branches. Till about the years 1720 or 1730, most of the copper and brass utensils for culinary and other purposes, used in this country, were imported from Hamburgh and Holland, being procured from the manufactories of Germany; even so late as the year 1773, copper pots, kettles, saucepans, and pots of all sizes, were imported here in large quantities; but through the persevering industry, capital, and enterprising spirit of our miners and manufacturers, these imports have become totally unnecessary, the articles being now all made here, and far better than any other country can produce.

The discovery of new copper-mines in Cornwall, Derbyshire, and Wales, about the year 1773, has greatly added to the manufacture of this country; and it appears to be still increasing, notwithstanding the very great advantage in the price of copper, which must certainly be attended with some disadvantage in the foreign markets. The value of wrought copper and brass exported during the year 1799 was 1,222,187.; and there is reason to believe, that the whole value of these manufactures at present is at least 3,000,000/. and the number of persons employed about 60,000.

The steel, plating, and hardware manufactures, including the toy trade, have been carried to a great extent of late years, and much in value to 4,000,000/. and the persons employed to about 70,000.

It must be confessed, that many of these estimates are unavoidably defective from the want of public documents respecting many important branches of trade; they may, however, be sufficiently accurate to shew, in a general view, the relative extent of the principal manufactures of Great Britain, viz.

<table>
<thead>
<tr>
<th>Material</th>
<th>Quantity</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Woolen</td>
<td>16,400,000</td>
<td>£5,440,000</td>
</tr>
<tr>
<td>Leather</td>
<td>10,500,000</td>
<td>£241,818</td>
</tr>
<tr>
<td>Cotton</td>
<td>11,000,000</td>
<td>£347,271</td>
</tr>
<tr>
<td>Silk</td>
<td>2,700,000</td>
<td>£65,000</td>
</tr>
</tbody>
</table>

There are many other manufactures, such as those of hats, horn, straw, &c., which, though of themselves of less importance than most of those above enumerated, are together of very considerable amount, and employ a great number of hands. There are likewise some, which, though not generally included among the manufactures, are certainly such in a great degree, and might, with much propriety, be classed with them.

It may be proper to observe, that those who have rated the number of persons employed in the different branches very considerably higher than is here stated, have generally included a variety of employments, as mariners, carriers, miners, &c., whereas the numbers here given are meant to include only the persons directly employed in the various transactions and operations necessary for bringing the raw materials into their finished consumable state.

**TRADE-WINDS.** See WIND.

**TRADESCANTIA.** A genus of the hexaandrous monotypic class of plants, the flower of which consists of three orbiculate, plane, and very pellucid petals; and its fruit is an oval trilocular capsule, containing a few angular seeds; 10 species.

**TRAGACANTH.** See ASTRAGALUS.

Tragacanth, gum, or, as some call it, gundragon, or gum dragons, is the produce of the above and some other shrubs. The gum is brought to us in long and slender pieces, of rather a flat figure, more or less, and they are usually heavy, of a firm consistence, and properly esteemed, very tough rather than hard: and is extremely difficult to powder, and is first carefully dried, and the mortar and pestle kept dry. Its natural colour is a pale yellow, and in the clearest pieces it is something transparent. It is often, however, met with tinged brownish, and of other colours, and more opaque. It has no smell, and very little taste, but what it has is disagreeable. Taken into the mouth, it does not grow clammy, and stick to the teeth, as the gun arabic does, but melts into a kind of very soft mucilage. It dissolves in water but slowly, and communicates its mucilaginous affinity to a great quantity of that fluid. It is by no means soluble in oily or spirituous liquids, nor is it inflammable. It is brought to us from the island of Crete, and from several parts of Asia. It is to be chosen in long twisted pieces, of a whitish colour, very clear, and free from all other colours; the brown, and particularly the black, are to be rejected.

Tragacanth has the same virtues with gum.
arabic, but in a greater degree. It greatly
insipiates and obtunds the acrimony of the
humours, and is therefore found of service in
inverteous cathers, and other disorders of the
breast, arising from an acid phlegm, and in
stomach, in the cases of ulcer, and other com-
plaints of that kind. It is usually given in
the compound powder, called the species dis-
tragacanthi frigida, rarely alone. It is also.
by some, esteemed a very great external con-
trary for wounds, and in this sense made an
ingredient in some sympathetic powders, with
vitriol and other things. It is by some re-
commended alone, in form of a powder or
strong mucilage, for cracks and chaps in the
nipples of women: but it is found, by ex-
perience, to be a very troublesome application
in those cases, and to do more harm than good,
as it dries by the heat of the part, and draws
the lips of the wound further asunder than be-
fore.

TRAGIDAD. See Poetry.

TRAGIA, a genus of the monocoe trian-
dria class of plants, without any flowers—petales;
it's fruit is a very large tricocc double-cap of a
roundish figure, containing single and round-
ish, or compound. There are 8 species.

TRAGOPOGON, goat's-beard, a genus of
plants of the class syngeasia, and the or-
der polygona equals; and in the natural
system ranging under the 49th order, com-
parative. The root, and its leaves, are
purplish, the calyx simple, and the pappus plumeous.
There are 14 species; of which two are British, the
pratensis and portuloid. 1. The pratensis,
or yellow goat's-beard, has its calyxes equal
with the root and its leaves all entire, long,
marrow, sessile, and grassy. In fair weather
this plant opens at sunrise, and shuts be-
tween nine and ten in the morning. The roots
are comical and excetant, and are sometimes
boiled and served up at table as asparagus.
It grows on meadows. 2. The portuloid,
or purple goat's-beard, has the calyx longer
than the radius of the floret; the flowers are
large, purple, single, and terminal; and the
leaves are long, broad, and oblong.

TRAJECTORY, a term often used, gen-
ernally for the path of any body moving
either in a void, or in a medium that resists
its motion; or even for any curve passing
through a given number of points. Thus
Newton, Princip. lib. 1, prob. 23, purposes to
describe a trajectory that shall pass through
two given points.

Trajectory of a conic, is its path or
orbit, or the line it describes in its motion. This
path, Hevelius, in his Cometographia, will
leave to the naked and a right line; but Dr.
Hailey concludes it to be, as really is, a
very eccentric ellipse; though its place may
often be well computed on the supposi-
tion of its being a parabola. Newton, in
Prop. 41 of his 3d book, shows how to de-
termine the trajectory of a comet from three ob-
servations; and in his last prop. how to cor-
rect a trajectory graphically described.

TRAMEL, in mechanics, an instru-
mant used to regulate the length of a
bow, &c. One part of it consists of a cross
with two grooves at right angles; the other
is a beam carrying two pins which slide in these
grooves, and also the describing pencil. All
of the engines for turning achs are constructed
on the same principles with the trammeL:
the only difference is, that in the trammeL
the board is at rest, and the pencil moves
upon it; in the turning engine, the tool, which
supplies the place of the pencil, is at rest, and
the board is moved. See a demonstra-
tion of the chief properties of these instru-
ments by Mr. Ludlam, in the Philos. Trans.
vol. 70, p. 378, &c.

TRAMEL-NET, is a long net, where-
with to take fish by night in champain coun-
tries, much like the net used for the low
bell, both in shape, bigness, and meshes. To
use it, they spread it on the ground, so that
the method or further end, fitted with small
plumets, may be loose thereon; then the
other part being borne up by men placed at
the fore ends, it is thus trailed along the ground.
At each side are carried great blazing lights,
by which the birds are raised, and as they rise
under the net they are taken.

TRANSCENDENTAL, or TRANSCEN-
dant, something elevated or raised above
other things, which passes and transcends
the nature of other inferior things.

Transcendents, among geom-
eters, are indeterminate ones, or such as
cannot be fixed, or expressed by any constant
equation; such are all transcendental curves
which cannot be defined by any algebraic
equation, or which when expressed by an
equation, one of the terms thereof is a vari-
able quantity. Now whereas algebraists use
to assume some general letters or numbers, for
the quantity sought in these transcendental
problems. Leibniz assumes general or
undeinate equations for the lines sought;
c. e. putting x and y for the absciss and or-
dinate, the equation he uses for a line sought
is ax + by + cx + dy + ex - f = 0, &c. = 0,
by the help of which indefinite equation, he seeks
the tangent: and by comparing the result
with the given property of tangents, he finds
the value of the assumed letters, a, b, c, d, &c.
and thus deduces the equation of the line
sought.

If the comparison above-mentioned does not
proceed, he pronounces the line sought not
to be an algebraical, but a transcendental one.
This supposed, he goes on to find the species
of transcendent, which depend on the general
division or section of a ratio, or upon the logaritiam; others, upon
the arcs of a circle; and others, on
more indefinite and compound equations. He there-
fore, besides the symbols x and y, assumes a
third, as v, which denotes the transcendental
quantity; and of these three forms, a general
equation for the line sought, from which he
finds the tangent, according to the dif-
ferent methods, which succeeds even in
transcendental quantities. The result he
compares with the given properties of the
tangent, and so discovers, not only the value of
a, b, c, d, &c. but also the particular nature
of the transcendental quantity. And though
it may sometimes happen, that the several
transcendents are so to be made use of, and
of those of different natures too, one from
another; also though there are transcen-
dents of transcendentals, and a progression of
these, you may be satisfied with the
most easy and useful one; and for the most
part, may have recourse to some peculiar ar-
tifices for shortening the calculus, and re-
ducing the problem to as simple terms as may
be.

This method being applied to the business of
quadratures, or to the invention of quadratics,
in which the property of the tangent is always
given, it is minutely, not only how it may be
discovered, but how the same quadrature
may be algebraically impossible; but also,
how, when this impossibility is discovered,
a transcendental quadratrix may be found,
which is a thing not before shown. So that
the most general case, by this method, is
carried infinitely beyond the bounds to which
Vita and Des Cartes brought it; since, by
this means, a certain and general analysis is
established, which extends to all problems of
a certain degree, and consequently not
comprehended within algebraical equations.
Again, in order to manage transcendental
problems, wherever the business of tangents
or quadratures occurs, by a calculus, there is
hardly any that can be imagined shorter,
more advantageous, or more universal, than
the differential calculus, or analysis of indi-
visible and infinites.

By this method, we may explain the nature
of transcendental lines, by an equation:
y = ax + by + cx + dy + ex - f = 0,
then will y = \sqrt{x - x_0} + \sqrt{y - y_0},
and, if the ordinate of the
cycloid is y, then will y = \sqrt{x - x_0} + \sqrt{y - y_0},
which equation perfectly
expresses the relation between the ordinates x and from it all the proper-
ties of the cycloid may be demonstrated.

The analysis has been extended to
to those lines, which have hitherto been excluded;
for no other reason, but that they were thought
capable of it.

TRANSFORMATION of Equations, in alge-
bra, is the changing equations into others of
a different form, but of equal value. This opera-
tion is often necessary, to prepare equations for
an easy solution, some of the principal cases
of which are as follow: 1. The signs of the roots
of an equation are changed, viz. the positive
roots into negative, and the negative roots
into positive ones, by only changing the signs of
the odd, 4th, and all the other even terms of
the equation. Thus the roots of the equation
x^3 - 2x^2 + 4x - 3 = 0,
whereas the roots of the same equation having
only the signs of the 4th and 7 terms changed,
 zig. of x^3 - 2x^2 + 4x - 3 = 0,
are

2. To transform an equation into another
that shall have its roots greater or less than the
roots of the proposed equation by some given differ-
ence, proceed as follows: Let the proposed
equation be the cubic x^3 - ax^2 + bx - c = 0,
and let it be required to transform it into an-
other, whose roots shall be less than the roots
of this equation by some given difference d; if the
new equation must be the less, take
y = x - d, and hence x = y + d; then, in-
stead of x and its powers, substitute y + d and
its powers, and there will arise the new equa-
tion
differed by a cubic
(A) y^3 + ad^3 + 3ad^2 y + 3ady^2 + b + 3ad^2 y + 3ady^2 - c = 0;
whose roots are less than the roots of the former
equation by the difference d. If the roots of the
new equation had been required to be greater
than those of the old one, we must then have
substituted x = y - d, or x = x - d, &c.
TRANSMUTATION, in geometry, denotes the reduction or change of one figure or body into another of the same area or solidity, but of a different form; as a triangle into a square, a pyramid into a parallelepiped, &c. In the higher geometry, transmutation is used for the converting a figure into another of the same kind and order, whose respective parts rise to the same dimensions in an equation, admit of the same tangents, &c. If a rectilinear figure is to be changed into another, it is sufficient that the intersections of the lines which compose it are transferred, and the lines drawn through the same in the new figure. If the figure to be transmuted is curvilinear, the points, tangents, and other right lines by means whereof the curve line is to be defined, must be transferred.

TRANSMUTATION, among builders, denotes the piece that is framed across a double-light window.

TRANSMUTATION, among mathematicians, signifies the conversion of a continent, or a broken number fixed across, with a square whereon it slides, &c.

TRANSPORTATION, the act of conveying or carrying a thing from one place to another.

TRANSPORTATION of plants. In sending plants from one country to another, great cautions are necessary. The plants sent from a hotter country to a colder, should be always put on board during the spring of the year, that the heat of the season may be advancing as they approach the colder climates; and, on the contrary, those which are sent from a colder country to a hotter, should be sent in the beginning of winter, and packed up for a voyage, if they are such as will not bear keeping out of the earth, to have boxes with handles, filling them with earth, and planting the roots as close together as may be; the plants should be set in these boxes three weeks before they are to be put on board; and in good weather they should be set upon the decks, and in bad removed or covered with a tarpaulin. If they are going from a hotter country to a colder one, they will generally have very little moisture, so, on the contrary, they are going from a colder to a warmer, they may be allowed water more largely, and being shaded from the heat of the sun, they will come safe.

A great many plants, however, will live out of the earth a considerable while; as the sedums, euphorbias, meconopsis, thistles, &c., and other succulent ones. These need no other care than the packing them up with moss in a close box; and there should be a little hay put between, to prevent them from wounding or bruising one another, and locks bored in the boxes to keep them from heating and putrefying. In this manner they will come safe from a voyage of two or three, or even four or five months. Several trees also will come in the same manner; taking them up in the autumn when they have done growing, not packing them up with moss. Of this sort are oranges, olives, capers, jasmines, and pomegranate trees. These, and many others, are annually brought to us from the east, and, though they are three or four months in the passage, seldom miscarry. The best way of sending over seeds, is in their natural husks, in a bag, or packed up in a gourd-shell, keeping them dry, and out of the way of vermin.

TRANSPOSITION, in algebra, the bringing any term of an equation over to the other side.

TRANSUBSTANTIATION, in theology, the conversion or change of the substance of the bread and wine into the body and blood of Jesus Christ, which the Romish church hold is wrought by the consecration of the priest. This is a main point in the Romish religion, and is rejected by the protestants, the former maintaining the transubstantiation to be real, the latter only figurative; interpreting the text hoc est corpus meum, " this signifies my body?" but the council of Trent stood up strenuously for the literal sense of the verb eat, and say expressly, that in transubstantiation the body and blood of our Lord Jesus Christ are truly, really, and substantially, under the species of bread and wine. The controversy about this point has been considerable.

TRANSVERSE MUSCLES, in anatomy, are certain muscles arising from the transverse processes of the vertebrae of the loins. See Anatomy.

TRAPA, a genus of the *Tetragonia* monogynia class of plants, the corolla is hermaphrodite, consisting of four petals, two linearly placed, and larger than the cup; the fruit is a hard osseous capsule, of an oblong oval figure, containing only one cell, and armed with four sharp thick spines, placed oppositely in the middle of the sides, and pointed; these before were the leaves of the caixs: the seed is a covered single nucleus, of an oval figure. There are two species, aquatic.

TRAPEZIUM, in geometry, a plane figure containing four unequal right sides. 1. Any three sides of a trapezium taken together, are greater than the third. 2. The two diagonals of any trapezium, divide it into two proportional triangles. 3. If two sides of a trapezium are parallel, the rectangle under the aggregate of the parallel sides and one-half
their distance, is equal to that trapezium. 4. If a parallelogram circumscribes a trapezium, so that one of the sides of the parallelogram is parallel to a diagonal of the trapezium, that parallelogram will be the double of the trapezium. 5. If any trapezium has two of its opposite angles, each a right angle, and a diagonal is drawn joining those angles; and if from the other two angles are drawn two perpendiculars to that diagonal, the distance from the feet of these perpendiculars to those right angles, respectively taken, will be equal. 6. If the sides of a trapezium are each bisected, and the points of bisection are joined by four right lines, these lines will form a parallelogram, which will be one-half of the trapezium. 7. If the diagonals of a trapezium are bisected, and a right line joins these points, the aggregate of the squares of the sides is equal to the aggregate of the squares of the diagonals, together with the square of the right line joining the point of bisection. 8. In any trapezium, the aggregate of the diagonals is less than the aggregate of four right lines drawn from any point (except the intersection of the diagonals) within the figure.

TRAPS. See Rocks, primitive.

TRAVERE, or Transverse, in general, denotes something that goes athwart another; that is, crosses and cuts it obliquely.

Hence, to traverse a piece of ordnance, meaning gunners, signifies to turn or point it which way one pleases, upon the platform.

In fortification, traverse denotes a trench with a little parapet, or bank of earth, thrown perpendicularly across the mast, or other work, to prevent the enemy's cannon from raking it. These traverses may be from twelve to eighteen feet, in order to be cannon-proof; and their height about six or seven feet, or more if the place is exposed to any enemy. And to protect a communication, a passage of about five or six feet wide must be left at one end of the traverse. If any part of a work, thus shut in by one or more traverses, is likely to be defended by the musketry, it will be provided with foot-holes within the defence, for the troops to mount on when they want to fire over the traverse.

Traverse. See Navigation.

Traverse, in law, signifies sometimes to deny, sometimes to overthrow or undo a thing, or to put one to proseose matter; much used in answers to bills in chancery: or it is that which the defendant pleads or says in bar to avoid the plaintiff's bill, either as confessing and avoiding, or by denying and traversing the material parts thereof.

Traverse an Indictment, is to take issue upon the chief matter, and to contradict or deny some point of it. A traverse must be always made to the substantial part of the title. Where an act may indifferently be intended to be at one day or another, there the day is not traversable. In an action of trespass generally, the day is not material; therefore, the matter is due upon a particular day, there it is material and traversable. 2. Rolf's Rep. 37.

TRAVESTY, or Travesti, a French term, derived from the verb 'travailler', to disguise one's self, or to appear in masquerade; and hence, travesty is applied to the disfiguring of an actor, or to the translation into a different style and manner different from his own, by which means it becomes difficult to know him.

TREACLE. See Sugar, sc.

TREASON, in law, is divided into high treason and petty treason. High treason, as compared under the famous high treason act, as it is called, or the statute 25th Edw. III. is divided into seven heads.

1. When a man compasses or imagines the death of the king, queen, or the heir apparent, he is guilty of high treason. But as this compassing or imagining is an act of the mind, it cannot be proved unless demonstrated by some overt (or open) act. To conspire to imprison the king, and toassemble company for the purpose, to procure arms and ammunition with the intent to kill him, or even to take arms in order to put such designs into execution, as consulting of the best means of putting him to death, are overt or open acts.

2. To violate the queen-consort, the king's eldest daughter, or wife of the heir apparent, is high treason; and if both parties consent, they are alike guilty. This is to guard the blood royal from pollution, so that to violate a queen or princess dowager is not treason.

3. If a man levies war against the king in his realm, he is guilty of high treason. This may be done under pretence of redressing grievances, as well as to dethrone the king. An insurrection with the avowed design of destroying all inclosures, all broths, &c. is likewise treason; though a tumult to destroy any particular inclosure or brothel would only amount to a riot: but in the first instance, the universality of the design renders it high treason. A more conspiracy to level war is not treason, unless the design is particularly pointed against the king, when it falls under the first head, viz. compassing or imagining his death.

4. To be an adherent to the king's enemies in his realm, or aiding them in his realm, or otherwise, is treason. The only way by which it must be demonstrated by some overt act, as the giving them intelligence, sending provisions, surrendering up a fortress by combination with the enemy, and not by cowardice, in which case it is an offence against the laws of war, but not treason. Giving assistance to foreign pirates or robbers who invade our coasts without any open hostilities between their nation and our own, or any commission from any state at war with Great Britain; also aiding our own fellow-subjects in rebellion at home; are both treasons; but to relieve a rebel fled out of the kingdom is not. And if a person through force or fear is obliged to join the rebels, provided he leaves them at the first safe opportunity, he is not treasonable.

5. Counterfeiting the great or privy seal is likewise high treason.

6. Counterfeiting the king's money; or bringing false and counterfeit money into the realm, and knowing it to be false, uttering it, is the great crime of treason. Counterfeiting is of itself treason, without making payment with it; and if the minter alters the legal standard of gold and silver, it is treason. As to importing foreign counterfeit money, it is held that uttering it without importing it is not within the statute. The seventh and last species of treason under this statute is, if a man slays the chamberl. treasurer, or the king's justices of either of the bench, justices in eyre, or justices of assize, and all other justices assigned to hear and determine their cases during their offices. This extends only to killing them, and not to wounding and assaulting them. The barons of the exchequer are not specified as within the act, but by the 3 Edw. c. 18, and 1 W. and M. c. 21, the lord keeper or commissioners of the great seal are within it.

There are other treasons, not comprised under this act, which may be divided into three heads: 1. Such as relate to piracy. 2. Such as relate to falsifying the coin or other royal signatures. 3. Such as relate to securing the protestant succession in the house of Hanover.

For the first see Papists. For the second see Coinage.

By the statute 1 Anne, s. 2, c. 17, if any person shall endeavour to deprive or hinder any person being the next in succession to the crown, according to the limitations of the act of settlement, from succeeding to the crown, and shall commit any other overt act, such offence shall be high treason. And by statute 6 Anne, c. 7, if any person by writing or printing manifest and affirms that any person has any right or title to the crown of this kingdom, contrary to the act of settlement; or that the king of this realm, with the authority of parliament, are not able to make laws and statutes to bind the crown and the descent thereof; such person shall be guilty of high treason.

The punishment for this crime is very severe: that the criminal shall be dragged on the ground to the place of execution, though a sledge is now allowed through humanity, and be langed and cut down alive, his entrails taken out and burned before his face, his heart cut off, and his body quartered. The punishment for coining is, however, more mild.

Treason, misprision of. There is likewise a misprision of treason, which is the concealing the knowledge of treason without ascertaining to R. 1 and 2 Ph. and Mary, c. 10. The statute 13 Eliz. c. 2, enacted, that those who for foreign coins not current in Great Britain, their aids, abettors, or procurers, shall be all guilty of misprision of treason. The punishment for this crime, which is a degree lower than high treason, is loss of the profits of lands for life, forfeiture of goods, and perpetual imprisonment.

Treason, petit (which is an aggravated degree of murder), according to the statute 25th Edw. III. c. 2, may happen three ways: by a servant killing his master, a wife her husband, or an ecclesiastical person his superior to whom he owes faith and obedience: such a servant is liable to be hanged whereupon he has left upon a grave conceived while in his service; for the intention was formed while the relation subsisted: so if a wife is separated a mesne & thorowe, the vicarious matrimonii is not continued; and if her husband after the divorce, she is guilty. And a clergyman owes canonical obedience to the bishop who ordained him, to him in whose diocese...
TREESTIMATORS in found poor the men.

TREASURE, TROVE, is where any monoy or coin, gold, silver, plate, or bullion, is hidden in the earth, or other private place, the owner in which case the treasure belongs to the king, or some other who claims by the king's grant, or by prescription. Brac. Lib. 3. But if he had it known, or afterwards found out, the owner, and not the king, is entitled to it. Black. 295.

TREASURER, an officer to whom the treasure of a prince, or corporation, is committed to be disposed of.

The lord high treasurer of Great Britain, or first commissioner of the treasury when in commission, has under his charge and government all the king's revenue, which is kept in the exchequer. He holds his place during the king's pleasure, being instituted by the delivery of a white staff to him: he has the check of all the officers employed in collecting the customs and other royal revenues; and in his gift and disposition are all the officers of the customs in the several ports of the kingdom; excisors in every county are nominated by him; he also makes leases of the lands belonging to the crown. This office is now always executed by a commission, who are entitled, "the commissioners for executing the office of lord high treasurer," and the first commissioner is commonly prime minister.

There is, besides the lord treasurer, a treasurer of the king's household; who is of the privy council, and the steward of the marshalsea, has great power.

To these may be added the treasurer of the navy; as also the treasurer of the king's chamber, and of the wardrobe; and most corporations throughout the kingdom have treasurers, whose office is to receive their rents, and disburse their common expenses.

The treasurer of the county is an officer that keeps the county-stock, in which office there are two in every county; who are chosen by the major part of the justices of the peace at Easter-sessions. They ought to have the value of 150l. in land, and the income of 150l. in personal estate; and are to continue in their office only for a year, at the end whereof, or within ten days after the expiration of the year, they must account to their successors, under certain penalties. The county-stock which this officer has the keeping of, is raised by rating every parish annually; and the same is from time to time disposed of to charitable uses, towards the relief of poor offenders, prisoners in the county gaols, paying the salaries of officers of houses of correction, and relieving poor. Im-houses, &c.

TREFOIL. See Trifolium.

TREMELLA, a genus of plants of the class craspedosporosphaera, and natural order of algae. It is a gelatinous membraneous substance; the parts of the fructification scarcely visible. There are 11 species, of which five are indigenous: the nostoc, lichenoides, verrucosus, heimisphera, and purpurea. 1. The nostoc, or jelly rain tromella, is found in pastures and by the sides of gravel-walks in gardens after rains; not uncommon in spring, summer, and autumn. It is a membraneous, pellicular, and gelatinous substance, without any visible thallus; of a yellowish dull-green colour; assuming various forms, either round, angular, plated or folded together irregularly, like the intestines, or a pocket-handkerchief, an inch or two, or more, in diameter: soft to the touch when moist; but thin, membraneous, and brittle, when dry; and of a black fuscous colour. The ancient alchemists called this vegetable the flowers of heaven, and imagined that from it they should procure the universal menstruum: but all their researches ended in discovering that by distillation it yielded some phlegm, volatile salt, and empyreumatic oil. It has been extolled in wounds, ulcers, &c. but no regard is ever paid to it by judicious practitioners. Dr. Darwin says, he has been well informed that tromella is a mucilage voided by herons after they have eaten frogs. 2. The lichenoides, or transparent tromella, is erect, plane, margin curled, laminated, and brown. It grows on rocks and in woods, and is a white, membranaceous, or varie tromella, is tubercular, solid, wrinkled, roundish, and resembling a bladder; it is of a blackish yellow. It grows on stones in rivulets. 4. Hemisphera, or sea tromella, is scattered among concrevus, &c. 5. Purpurea, or purple tromella, is globular, sessile, solitary, and smooth. It grows on ditch-banks about London.

TREMOLITE. This mineral is found chiefly near St. Gothard, in Switzerland; and takes its name from mount Tremola, where it was first observed by Nannure. It occurs is massive and in crystals. The primitive form of its crystals is a rhombohedral prism, whose sides are inclined to each other at angles of 126° 59' 13" and 53° 7' 45". It usually occurs in four-sided prisms, terminated by rhombohedral summits; and not unfrequently the two acute edges, or all the four, are truncated. Texture radiated. Fragments splintery. Specific gravity from 2.9 to 3.2. Fibres easily separated, so that it appears soft, yet it scratches glass. Phosphoresces very readily when struck or rubbed in the dark. Before the blowpipe, melts into a white scoria. Werner divides this species into three sub-species.

A specimen of tremolite analysed by Klaproth, contained

- 65.0 silica
- 38.0 lime
- 0.5 magnesia
- 0.5 oxide of iron
- 6.0 water and carbonic acid

100.0

A specimen of this mineral from the castle-hill of Edinburgh, analysed by Dr. Kennedy, yielded

<table>
<thead>
<tr>
<th>Name</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>SiO₂</td>
<td>51.5</td>
</tr>
<tr>
<td>Al₂O₃</td>
<td>12.0</td>
</tr>
<tr>
<td>Fe₂O₃</td>
<td>0.3</td>
</tr>
<tr>
<td>MgO</td>
<td>3.3</td>
</tr>
<tr>
<td>CO₂</td>
<td>3.0</td>
</tr>
<tr>
<td>H₂O</td>
<td>28.8</td>
</tr>
</tbody>
</table>

98.0, with some traces of magnesia and muratic acid.

Boutron has shown that the property which the tremolite has of phosphorizing when rubbed, is owing to the presence of carbonat of lime.

TREMOR. See Medicine.

TRENCHES, in a siege, are of tches made by the besiegers, that they may approach more securely to the place attacked; on which account they are also called lines of approach. The tail of the trench is the place where it was begun, and its head is the place where it ends.

Trenches are also made to guard an encampment.

The trenches are usually opened or begun in the night-time, sometimes within musket-shot, and sometimes within half or whole cannon-shot of the place. They are about 800 fathoms. They are carried on in winding lines, nearly parallel to the works, so as not to be in view of the enemy, nor exposed to the enemy's shot.

The workmen employed in the trenches are always supported by a number of troops to defend them against the sallies of the besieged. The pioneers, and other workmen sometimes work on their knees, and are usually covered with mantlets or escabiers; and the troops who support them lie flat on their faces, in order to avoid the enemy's shot. On the angles or sides of the trench, there are lodgments, or eggements, in form of traverses, the better to hinder the sallies of the garrison, and to favour the advancement of the trenches, and to sustain the workmen.

The platforms for the batteries are made behind the trenches; the first at a good distance, to be used only against the sallies of the enemy. As the approaches advance, the batteries are brought nearer, to ruin the defences of the place, and dismount the artillery of the besieged. The breach-batteries are made when the trenches are advanced near the very walls.

If there are two attacks, it will be necessary to have lines of communication, or byways, between the two, with places of arms at convenient distances. The trenches are 6 or 7 feet high with the parapet, which is 5 feet thick, with bastings for the soldiers to mount upon.

The approaches at a siege are generally carried on upon the capitals of the works attacked; because the capitals produce roof, of all other situations in the front of a work, the least exposed to the fire of either the cannon or musketry; and are the least in the line of fire between the besieged and besiegers' batteries. But if, from particular circumstances, these or other advantages do not attend the approaches upon the capitals, they are by no means to be preferred to other positions.

The trenches of communication, or zigzags, are 3 feet deep, 10 feet wide at bottom, and 13 feet at top, having a berm of one foot, beyond which the earth is thrown to form a parapet.
The parallels or places of arms of the trenches are 3 feet deep, 12 feet wide at bottom, and 17 or 18 feet from a bank in height, having a bank of about 3 feet wide, with a slope of nearly as much.

The first night of opening the trenches, the greatest exertions are made to take advantage of the enemy's ignorance as to the side of attack. The workmen are generally carried on as far in advance as the first parallel, and even sometimes to the completion of that work. The workmen set out on this duty, each with a fascine of 6 feet, a pick-ax, and a shovel; and the fascines being laid so as to tap one foot over each other, leave 5 feet of trench for each man to dig.

The usual method of directing the trenches or zig-zags, is by observing during the day some near object in line with the salient parts of the work, and which may serve as a direction in the night; or if the night is not very dark, the angles of the works may be seen above the horizon; but as both these methods are subject to uncertainty, the following is proposed: The most extended part of the attack is first laid down the plan of attack, the exact positions of the flanked angles of the works of the front attacked, and particularly of those most extended to the right and left; mark on the plans the points of commencement for the first portions of zig-zag, the point where it crosses the capital, and the point to which it extends on the other side of the capital: this last point will be the commencement of the second branch; then mark off the point where this branch crosses the capital, and its extent on the other side; and this will give the commencement of the third branch; and so on for the others. This provided with a plan ready marked of it, will be very easy, even in the darkest night, to lay down the points where the zig-zags are to cross the capital, and the points to which they are to be produced beyond them. The first parallel is generally run about 600 yards from the place, and of such extent as to embrace the prolongation of the faces of all the works which fire upon the trenches; and each end has a return of about 30 or 40 yards.

The second parallel is constructed upon the same principles, and of the same extent, as the first, at the distance of about 300 yards from the salient angles of the covert-way. This parallel is usually formed of gabions; each workman carrying a gabion, a fascine, a shovel, and a pick-ax. After this the trenches are usually carried on by sap.

The half-parallel are about 140 or 150 yards from the covert-way, and extend sufficiently on each side to embrace the prolongation of the branches of a covert-way.

The third parallel must not be nearer than 28 yards from the covert-way, or they will be liable to be annoyed by hand-grenades.

Trench, return of a, are the elbows and turnings, which form the lines of approach, and are made, as near as can be, parallel to the place, to prevent their being enfiladed.

TRENCHES, to mount, is to mount guard in the trenches, which is generally done in the night.

TRENCHES, to relieve the, is to relieve the guard of the trenches.

TRENCHES, to secure the, is to make a vigorous sally upon the guard of the trenches, force them to give way and quit their ground, drive away the workmen, break down the parapet, fill up the trench, and nail their cannon.

TRENCHES, counter, are trenches made against the besiegers; which consequently have their parapet turned against the enemy's approaches, and are enfiladed from several parts of the place, on purpose to render them useless to the enemy, if they should chance to become masters of them; but they should not be enfiladed or commanded by any height in the enemy's possession.

TRENCHES, to open the, is to break ground for the purpose of carrying on approaches towards a besieged place.

TREPPING, See SURGERY.

TREPIDATION. See Medicine.

TRESPASS, is any transgression of the law, under trespass, felon, or misprision of either. Stautd. Pl. Cor. 36.

Trespass signifies going beyond what is lawful; hence it follows that every injurious act is, in the large sense of this word, a trespass. Some trespasses are not accompanied with any force; a trespass of this sort is called a trespass upon the case: and the proper remedy for the party injured, is by an action upon the case. Other trespasses are accompanied with force, either actual or implied. If a trespass which was accompanied with either actual or implied force, has been injurious to the public, the proper remedy in every such case, is by an indictment, or by information in the case. If a trespass was accompanied with an actual force, has been injurious only to one or more private persons, the offender is in every such case liable to an indictment, or to an information; for although the injury has in such case been only done to one or more private persons, as every trespass accompanied with actual force is a breach of the peace, it is to be considered and punished as an offence against the public. 5&c. Abr. 150.

A man is answerable for not only his own trespass, but that of his cattle also. 3 Black. 211.

And the law gives the party injured, a double remedy in this case; by permitting him to detain the cattle thus doing damage, till the owner shall make him satisfaction, or else by leaving him to the common remedy by action. And in either of these cases of trespass committed on another's land, either by a man himself or his cattle, the action that lies, is the action of trespass with force and arms; for the law always couples the idea of force with that of taking possession of the property of another. 3 Black, 210.

In some cases, trespass is justifiable; or rather entry on another's land or house shall not in these cases be accounted trespass: as if a man came there to demand or pay money there payable, or to execute in a legal manner the process of the law. 3 Black 219.

For every filing such information, and actions of trespass, it is enacted by 43 Eliz. c. 6 22, and 23 Car. II. c. 9, and 3 & 9 W. c. ii. that where a jury who try an action of trespass, give less damages than 40l., the plaintiff shall recover no damages; unless the judge shall certify on the back of the record, that the freethold or title of the land came chiefly in question. But if it shall appear that the trespass was willful and malicious, the plaintiff shall have his full costs. And every trespass is willful, where the defendant has been forsworned, and malicious where the intent of the defendant appears to be to harass or injure the plaintiff. 3 Black. 570.

TRESPASSER, denotes a person that comes, or proceeds to or into any lands, in respect of whom it is held, that though the law permits a person to enter a tavern, and a landlord to distrain on lands, &c. yet if he abuses this liberty by committing any trespass, he will be judged a trespasser.

TRET, in commerce, an allowance made for the waste, or the dirt, that may be mixed with any commodity, which is always four pounds in every hundred and four pounds weight. See TARE.

TREVIA, a genus of the polyandria monogyna class of plants, having no corolla besides the cup; the fruit is a turbinate, tricuspid, coronated, trilocular, trivalvate capsule; the seed is single, convex on one side, and angular on the other. There is one species, a tree of the East Indies.

TRIAL, in law, the examination of a cause, civil or criminal, according to the laws of the land, before a proper judge; or, it is the manner and order observed in the hearing and determining of causes. There are divers kinds of trials; as those of matters of fact, which must be tried by a jury; matters of law which are only triable by the courts; and matters of record, which are to be tried by the records themselves. The practice of trials in foreign countries, where the jury are strangers to the whole matter. Where any trial is for murder, it must be in the county wherein the fact was committed; but if the assaultis in one county, and the person assailing happens to die in another county, the indictment may be found by a jury of the county where the party died; and by special commission, when a person is indicted in one county, he may be tried in another. In all criminal cases the custom is to ask the prisoner how he will be tried, which was formerly a very significant question, though it is not so now; because antiently there were trials by combat, by ordeal, and by jury; and when the prisoner answered, By God and his country, it appeared he made choice to be tried by a jury; which is the only now used way for the trial of criminals.

The method of proceeding in a criminal case is this. First the bill of indictment, against the offender is prepared, and the prosecutor and his witnesses attend on the grand jury, and there give in their evidence; which being done, the grand inquest either and the bill of indict-
ment, or bring it in ignominy; and if the bill is found, the prisoner is brought to the bar of the court, and the clerk of the arraignment calls him by his name, desires him to hold up his hand, saying, "Thou art indicted by the name—, for such a felony, &c. (setting forth the crime laid in the indictment). How sayest thou? art thou guilty of this felony whereof thou art indicted, or not guilty?" To which the prisoner answering, "Not guilty," the clerk says, "Culprit, how wilt thou be tried?" whereupon the prisoner answers, "By God and my country;" which plea of the prisoner the clerk records, and then the panel of the petty-jury is called over.

After the jury are sworn, and the indictment is read over to them, and they are charged, the evidence on both sides, for and against the prisoner, are called, sworn, and examined in open court; after which the jury bring in their verdict; and if they find the prisoner guilty, their verdict is recorded, and the prisoner is taken from the bar; but if they bring him in not guilty, the prisoner is discharged.

On the prisoner being brought in guilty, proclamation is made for all persons to keep silence, upon which the prisoner is again brought, and the arraignment repeated; after which sentence is passed on him, and an order or warrant is made for his execution.

The methods of trial, in our civil courts, are as follows: viz. The declaration is first drawn for the plaintiff, and when the appearance of the defendant is entered, it has been usual to deliver it with an imprecation to the defendant's attorney; and the term following, rule is to be given with the secondary for the defendant to plead by such a day, or else the plaintiff is to have judgment: and the defendant having pleaded, a copy of the issue made by the plaintiff, and delivered to the defendant's attorney, at the same time giving him notice of the trial; in which the record is made up, and the parties proceed to answer and defend, and the judge gives in their verdict, &c. But in case the defendant neglects to plead, and suffers it to go by default, on entering such a judgment, a writ of inquiry of damages is awarded returnable next term, notice of the execution whereof the defendant's attorney is to have; and which being executed, and the damages inserted in a schedule annexed to the writ, a rule is given, and costs are taxed by the prothonotary.

TRIANDRIA, in the Linnean system of botany, a class of plants, the third in order; comprehending all such plants as have hermaphrodite flowers, with three stamens, or male parts, in each; whence the name. See Botany.

TRIANGLE, in geometry, a figure bounded or contained by three lines or sides, and which consequently has three angles, from whence the figure takes its name.

Triangles are either plane, or spherical, or conoid. In plane geometry the three sides of the triangle are right lines; but spherical when some or all of them are arcs of great circles on the sphere.

Plane triangles take several denominations,

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both from the relation of their angles, and of their sides, as below. See Geometry.

The chief properties of squares of triangles are as follow, viz. In any plane triangle,

1. The greatest side is opposite to the greatest angle, and the least side to the least angle, &c. Also, if two sides are equal, their opposite angles are equal; and if the triangle is equilateral, or has all its sides equal, it will also be equiangular, or have all its angles equal to one another. 2. Any side of a triangle is less than the sum, but greater than the difference, of the other two sides.

3. The sum of all the angles of a triangle, when taken together, is equal to two right angles. 4. If one side of a triangle is produced, the external angle, made by it and the adjacent side, is equal to the sum of the two opposite internal angles. 5. A line drawn parallel to one side of a triangle, cuts the other two sides proportionally, the corresponding segments being proportional, each to each, and to the whole sides; and the triangle cut off is similar to the whole triangle.

If a perpendicular is let fall from any angle of a triangle, as a vertical angle, upon the opposite side as a base; then, 6. The rectangle of the sum and difference of the sides, is equal to twice the rectangle of the base and the difference of the sides, separated from the middle of the base. Or, which is the same thing in other words, 7. The difference of the squares of the sides, is equal to the difference of the squares of the segments of the base; or, as the base is to the sum of the sides, so is the difference of the sides to the difference of the segments of the base.

8. The rectangle of the legs or sides is equal to the rectangle of the perpendicular and the diameter of the circumscribing circle.

If a line is drawn bisecting any angle, to the base or opposite side; then, 9. The segments of the base, made by the line bisecting the opposite angle, are proportional to the sides adjacent to them. 10. The square of the line bisecting the angle, is equal to half the difference of the angles at the base. Or, as the base is to the sum of the sides, so is the difference of the segments of the base to the rectangle of the segments of the base.

If a line is drawn from any angle to the middle of the opposite side, or bisecting the base, then, 11. The sum of the squares of the sides of the triangle, is equal to the square of half the base and the line bisecting the base. 12. The angle made by the perpendicular from any angle and the line drawn from the same angle to the middle of the base, is equal to half the difference of the angles at the base.

13. If through any point within a triangle three lines are drawn parallel to the three sides of the triangle, the continual products of any solids made by the alternate segments of these lines will be equal. 14. If three lines are drawn from the three angles of a triangle to bisect the opposite sides, or to the middle of the opposite sides, do all intersect one another in the same point, and that point is the centre of gravity of the triangle; and the difference of the squares of any angle is equal to the double the distance from the opposite side, or one segment of any of these lines is double the other segment: moreover the sum of the squares of the three bisecting lines is 1 of the sum of the squares of the three sides of the triangle.

15. Three perpendiculars drawn from the three sides of a triangle, all intersect in one point, and that point is the centre of the circumscribing circle. 17. Three lines bisecting the three angles of a triangle, all intersect in one point, and that point is the centre of the inscribed circle. 18. Three perpendiculars drawn from the three angles of a triangle upon the opposite sides, all intersect in one point. 19. Any triangle may have a circle circumscribed about it, or touching all its angles, and a circle inscribed within it, or touching all its sides. 20. The square of the side of an equilateral triangle is equal to three times the square of the radius of its circumscribing circle.

21. If the angles of one triangle are equal to the three angles of another triangle, each to each, then those two triangles are similar, and their like sides are proportional to one another, and the areas of the two triangles are to each other as the squares of their like sides.

22. If two triangles have any three parts of the one (except the three angles) equal to three corresponding parts of the other, each to each, those two triangles are not only similar, but also identical, or having all the corresponding parts equal, and their areas equal.

23. Triangles standing upon the same base, and between the same parallels, are equal; and triangles upon equal bases, and having equal altitudes, are equal. Triangles upon equal bases, are to one another as their altitudes, and triangles of equal altitudes are to one another as their bases; also equal triangles have their bases and altitudes reciprocally proportional.

24. Any triangle is equal to half its circumscribing parallelogram; or half the parallelogram on the same or an equal base, and of the same or equal altitude.

25. The area of any triangle is found by multiplying the base by the altitude, and taking half the product.

27. The area is also found thus: Multiply any two sides together, and multiply the product by the sine of the opposite angle, to radius 1 and divided by 2. 28. The area of an obtuse triangle is otherwise found thus, when the three sides are given: Add the three sides together, and take half their sum; then from this half sum subtract each side severally, and multiply the three remainders equal to one another, and finally together; then the square root of the last product will be the area of the triangle.

29. In a right-angled triangle, if a perpendicular is let fall from the right angle upon the hypotenuse, it will divide it into two other triangles similar to one another, and to the whole triangle.

30. In a right-angled triangle, the square of the hypotenuse is equal to the sum of the squares of the two sides; and, in general, any figure described upon the hypotenuse is equal to the sum of two similar figures described upon the two sides.

31. In an isosceles triangle, if a line is drawn from the vertex to any point in the base, the square of that line, together with the rectangle of the segments of the base, is equal to the square of the side.

32. If one angle of a triangle is equal to 120°, the square of the base will be equal to the sum of the squares of both the sides, together with the square of the altitude; and if those sides are equal to each other, then the square of the base will be equal to three times the square of one side, or equal to twice times the square of the perpendicular.
The teeth of the walrus are used as ivory; but on this subject antiquirs seem to vary considerably; some representing them as superior to common ivory, and others greatly inferior, and more subject to turn yellow. The animal is very generally killed for the sake of the oil; and it is said that a very strong and elastic liquor may be prepared from the skin. See Plate Nat. Hist. fig. 404.

2. Trichechus dugong, Indian walrus. This species is a native of the seas about the Cape of Good Hope and the Philippine Islands. It does not, however, seem to be very clearly known to naturalists. The grinders differ from those of the walrus, being broader in proportion: of these there are four on each side, and the lower ones are large, of which the lower is said to be of a sharper or narrower form. This species, in the Philippine Islands, is said to be called by the name of dugong.

3. Trichechus boricalis, manatee or whale-tailed trichechus. This animal seems to approach so nearly to the dugong or whale tribe, as scarcely to deserve, according to Mr. Pennant, the name even of a fishes; what are called the feet being little more than pectoral fins, which serve only for swimming, and are never used to assist the animal either in walking or landing; for it never goes ashore, nor ever attempts to climb the rocks like the walrus and the seal. It brings forth in the water, and, like the whale, suckles its young in that element. Like the whale, it is also destitute of voice; and has also a horizontal tail, which is broad, and of the form of a crescent, without even rudiments of hind feet.

So complete is the account given by Mr. Pennant of this animal, that we shall here deliver the most material parts of that author's description, rather than attempt a new one. It inhabits the seas about Bering's and the other Aleutian islands, which intervene between Kamtschatka and America, but now appears to have been reduced to a few individuals, as is supposed by a tempest. It is probably the same species which is found above Minhalo, but is certainly that which inhabits near Rodriguez, as it is called Diego Reys, an island to the west of Mauritius, or near, which it is likewise found. It is also probable that it extends to New Holland. They live perpetually in the water, and frequent the edges of the shores; and, in calm weather, swim in great flocks near the mouths of rivers: in the time of flood they come to near the land that a person may stroke them with his hand: if hurt, they swim out to the sea, but presently return again. They live in families, one near another; each consists of a male, a female, a half-grown young one, and a very small one. The females obligé the young to swim before them, while the other old ones surround, and, in a manner, guard them on all sides. The affection between the male and female is very great; for if she is attacked, he will defend her to the utmost; and if she is killed, will follow her corpse to the very shore, and swim for some days near the place it has been landed at.

They are vastly voracious, and feed not only on the thick grass that grow in the sea, but such as are flung on the edges of the shore. When
they are filled, they fall asleep on their backs. During their meals they are so intent on their food, that any one may go among them, and choose which he likes best. Their back and sides are generally above water; and numerous gills of various sizes, on each side of their backs, in order to pick the insects which they find upon them.

They continue in the Kamtschatkan and American seas the whole year; but in winter they are very lean, so that one may count their ribs. They are taken by harpoons and driven to a strong cord; and after they are struck, it requires the force of thirty men to draw them on shore. Sometimes, when they are transversed, they will lay hold of the rocks with their paws, and stick so fast as to leave the skin behind before they can be forced off. When a man is struck, its companions swim to its assistance: some will attempt to overturn the boat, by getting under it; others will press down the rope, in order to break it; and others will strike at the harpoon with their tails, with a view of getting it out, in which they often succeed. They have no voice—a noisy, hard breathing, like the snorting of a horse.

They are of an enormous size: some are twenty-eight feet long, and eight thousand pounds weight: but, if the Miammoo species is the same with this, it decreases in size as it advances southward, for the largest which Damper saw there weighed only six hundred pounds. The head, in proportion to the bulk of the animal, is small, oblong, and almost square; the nostrils are filled with short bristles; the gills are small; the lips are double; near the junction of the two jaws the mouth is full of white tubular bristles, which serve the same purpose as the laminae in whales, to prevent the food from running out with the water: the lips are also full of bristles, which serve instead of teeth to cut the strong roots of sea-plants, which, floating ashore, are a sign of the vicinity of these animals, in the mouth are no teeth; only two flat white teeth, like a jaw, can always be found below, with unsalinated surfaces, which serve instead of grinders.

The eyes are extremely small, not larger than those of a sheep: instead of ears are only two minute orifices, which will scarcely permit a quill to enter. The spines on the tail are short; the neck thick, and its junction with the head scarcely distinguishable; and the last always hangs down.

The circumference of the body near the shoulders is twelve feet; about the belly twenty; near the tail only four feet eight inches: the head thirty-three inches: the neck near seven feet: and from these measurements may be collected the deformity of the animal. Near the shoulders are two feet, or rather fins, which are only two feet two inches long, and have neither fin nor tail; nor, indeed, concave, and covered with hard bristles; the tail is thick, strong, and horizontal, ending in a stiff black fin, and like the substance of whalebone, being much split on the fore part and behind. Both ends are of equal length like the whale.

The skin is very thick, hard, and black; full of inequalities, like the bark of oak; so hard as scarcely to be cut with an ax, and has no hair upon it: beneath the skin is a thick blubber, which is said to taste like oil of almonds. The flesh is coarser than beef, and will not soon putrify: the young ones taste like veal: the skin is used for shoes, and for covering the sides of boats. The Russians call this animal morskaia korovka or sea-cow, and kapung, an animal of pale brown, variegated with spots of a deeper cast. It is native of the Indian seas, and is said to possess a degree of electrical power. There are only these two species.

TRICHOZA, a genus of vernex infrusoria. The generic character is, a worm invisible, pediculid, hairy or hoary. Amebae of this genus, which is very numerous, will be found in Adams's work on the Microscope. See Plate Nat. Hist. fig. 406. There are about sixty species.

TRICOCEPHALUS, a genus of vernex intestina. The generic character is, body round, elastic, and variously twisted; head or fore part much thicker, and furnished with a slender exsertile proboscis; tail or posterior part long, capillary, and terminating to a fine point. There are six species: T. hominis, see Plate Nat. Hist. fig. 405, inhabits the intestines of sickly children, generally the cecum, and in considerable numbers; about two inches long and resembling the ascidians in coloration. The other species are known from animals on which they live, as the equi, apri, mus, vulpis, and lacerata.

TRICHILLA, a genus of the class and order decadraria monogynia. The calyx is mostly five-toothed; petals five; nectarinum toothed; capsules three-celled, three-valved; seeds bearded. There are 12 species, trees chiefly of the West Indies.

TRICHIOPUS, a genus of the class and order polycandra digynia. The calyx is four or five parted; corolla styles two, bifid; capsulae bistris, four-valved, many-seeded. This is one species, a tree of Guiana.

TRICHOMANES, a genus of plants of the class cryptogamia, and order filices. The parts of fructification are solitary; and terminated by a little like a bristle at the edge of the leaf. There are 27 species; of which two are natives of Britain, the pithiferum and tunbrigum. 1. Pithiferum, or cupricharum, has subpinnated leaves, the pinnas being alternate, close, and serrate. It is found among stones in wet grounds in England. 2. Tunbrigum, or Tunbridge tri- chomanes, has pinnated leaves, the pinnas being oblong, dichotomous, decurrent, and dentate. It is found in the fens of most rocks in Wales, and in many rocky places in Scotland.

TRICOCCELE, the name of the 36th order in Linnaeus's Fragments of a Natural Method, consisting of plants with a single three-celled capsule, having 3 cells or internal dis caduceus containing a single seed. See BOTANY.

TRICOSANTHE, a genus of plants of the class monocera, and order synge- nesia, and in the natural system ranging under the 34th order, cucubraceae. There are seven species; only one of which is cultivated in the British gardens, the aquaum or snake-gourd, which is a native of China, an annual, and of the cucumber tribe.

TRICOSTEMA, a genus of the dieldynamia gymnosperma class of plants, with
monopetalous, ringent and falcate flower.

The stamens are four extremely long filaments; and four roundish seeds are contained in the cup. There are three species.

TRIDAX, a genus of the syngenesia polygamous class of plants, with a radiated flower, and the lesser hermaphrodite ones of the disc monopetalous, and tufted-fashion.

The seeds are winged with down, and contained in the cup. There is one species.

TRIENTALIS, chickseed winter-green, a genus of the class heptandria, and order monogynia, and in the natural system ranging under the 20th order, rotacea.

The calyx is heptaphyllous; the corolla is equal and plane, and is divided into seven segments; the berry is unicellular and dry. There is only one species, the europaea, which is indigenous, and the only genus of heptandria that is so. The stalk is single, five or six inches high, terminated with five, six, or seven oval pods or corns; from the centre of which arise on long footstalks commonly two white starry flowers, each generally consisting of seven oval and equal petals, succeeded by a globular dry berry, covered with the natural system and having, one cell, and containing several angular seeds.

TRIFOLIUM, trefoil or clover, a genus of plants of the class diadelfa, and order decandria, and in the natural system ranging under the 32d order, papilionaceae. The flowers are generally in round heads; the pod is scarcely longer than the calyx, valvate, not opening, deciduous. The leaves are three together. There are 51 species; of which 17 are natives of Britain. We shall describe some of the most remarkable of these:

1. Officinal or mellot, has naked racemous pods, dispermous, wrinkly, and acute, with an erect stalk. It grows in corn-fields, and by the waysides, but not common. The stalk is erect, firm, straited, branched, and two or three feet high; the leaves tenuate, smooth, obtusely oval, and serrated; the flowers are small, yellow, pendulous, and generally in long close spikes at the tops of the branches; the pod is very short, turgid, transversely wrinkled, pendulous, and contains either one or two seeds. The plant has a very peculiar strong scent, and disagreeable, bitter, acrid taste, but such, however, as is not disagreeable to cattle. The flowers are sweet-scented. It has generally been esteemed emollient and digestive, and been used in fomentations and cataplasm, particularly in the plaster employed in dressing boils; but is now laid aside, as its quality is found to be rather acrid and irritating than emollient or resolvent. It communicates a hoarseness flavour to wheat and other grain, so as to render it unfit for making bread.

2. Trifolium repens, white creeping trefoil, or Dutch clover, has a creeping stalk, its flowers superabundant, and its pod tetraspernum. It is very common in fields and pastures. It is well known to be an excellent fodder for cattle; and the leaves are a good rustic hygrometer, as they are also a useful relish and relished in dry weather, but creet in moist or rainy.

3. Trifolium pratense, purple or red clover, is distinguished by dense spikes, unequal capsules, by bearded stipulas, ascending stalks, and by the calyx having four equal teeth. The red clover is common in meadows and pastures, and is the species which is generally cultivated as food for cattle. It abounds in every part of Europe, and is even in Siberia. It delights most in rich, moist, and snunny places, yet flourishes in dry, barren, and shady places. See HUSBANDRY.

4. Alpestrae, long-leaved purple trefoil, or mountain trefoil. The spikes are dense; the corollas somewhat equal; the stipulas are bristly and divergent; the leaflets lanceolat; the stalks still, straight, and very simple. It grows in dry, mountainous, woody places, in Hungary, Austria, and Boeotias, &c.; but is not said to be a native of Britain.

5. The medium has been confounded with the two species last mentioned; but it is to be distinguished from them by having loose spikes, corollas somewhat equal, stipulas subulate and convolute, the stalks flexuose and branched. It is found in dry elevated situations, especially among shrubs, or in woods where the soil is chalky or clay, in England, Scotland, Sweden, Denmark, &c.

TRIGLA, gurnard, a genus of fishes of the order of the ophidiiformes. The gurnard is, head large, mailed, and marked by rough lines; Gill-cover spiny; Gill-membrane seven-rayed; finger-shaped processes, in most species, near the pectoral fins.

1. Trigla gurnardus, grey gurnard. Length from one to two feet, or more; body deep grey, with blackish and red spots, beneath silvery; scales small; lateral line very strongly marked, and consisting of a series of larger, rounded, whitish scales with a dusky centre. Native of the European seas, and not uncommon about our own coasts, feeding on worms, insects, &c.

2. Trigla lyra, piper gurnard. Size nearly equal to the former species; lateral line formed of small scales; colour bright rose-red, silvered, and scales small; fins large, and slightly tinged with dull blue; tail of similar colour; the other fins yellowish, with red rays. Native of the European seas, and considered as an excellent fish for the table.

3. Trigla cuculus, cuckow gurnard. An elegant species. Length about a foot; shape more slender than in the preceding kinds; colour, on the upper parts, a beautiful red, more or less distinctly marked by white transverse bars, beneath silvery; scales exceedingly small; lateral line composed of pointed white scales edged with black; a similar row on each side the back; fins transparent; the first dorsal marked on the edge by a black spot, the second tinged near its edge with yellow. Native of the European seas, and esteemed as a food.

4. Trigla hirundo, sapphire gurnard. Size equal to that of the grey gurnard; scales minute-sized; lateral line rough; pectoral fins very large, of a violaceous olive, some times, according to Mr. Pennant, richly edged and spotted with blue. Native of the European seas, occasionally springing out of the water to some distance by means of its large pectoral fins.

5. Trigla vuls, flying gurnard. A highly singular and beautiful species. Length about twelve inches; colour crimson above, pale whitish beneath; head blunt, and armed on each side with two very strong and large spines, pointing backwards; whole body covered with extremely strong carinated and sharp-pointed scales, or furnished as not to be distinctly separable; first dorsal fin pale violet, crossed with deeper lines, and at its origin two separate rays longer than the rest; second dorsal fin pale, with the rays barred brown; pectoral fins extremely large, transparent, of an olive-green, richly variegated with numerous bright-blue spots; pectoral processes six in number, and not separate, as in other species, but united into the appearance of a small fin on each side the thorax; tail pale-violet, with the rays crossed by dusky spots, and strengthened on each side the base by two obliquely transverse bony ribs or bars. Native of the Mediterranean, Atlantic, and Indian seas, where it swims in shoals, and is often seen flying out of the water to a considerable distance, in the manner of the genus exocetus. There are in all 14 species.

TRIGLOCHIN, a genus of plants of the class hexandria, and order trigynia, and in the natural system ranging under the fifth order, tripetaloideae. The flowers are heptaphyllous; the petals are three; there is no style; the capsule opens at the base. There are three species, of which the palustre and maritimus are British.

1. Palustre, or arrow-headed grass, has an oblong trilocular capsule. The stalk is simple, eight or ten inches high; the leaves long and narrow; the flowers are greenish, and grow at the end of a long spike. It is frequent in moist grounds.

2. Maritimus, or sea-spiked grass, has ovate seilocular capsules; the stalk is short; the spike long, and flowers purplish. It is frequent on the sea-coasts. Linnaeus says that cattle eat these two species with avidity.

TRIGONELLA, fenugreek, a genus of plants of the class diadelfa, and order decandria, in the natural system arranged under the 32d order, papilionaceae. The vexillum and ala are nearly equal and patent, resembling a tripetaloid corolla. There are 12 species, of which the most remarkable is Trigonoella linifolia, a native of Montelpier, in France. Fenugreek is an annual plant, which rises with a hollow, branching, herbaceous stalk, a foot and a half long, with trifoliate leaves, placed alternately, whose lobes are oblong, oval, indented on their edges, and have broad furrowed foot-stalks. Fenugreek seeds have a strong disagreeable smell, and an unctuous farinaceous taste, accompanied with a slight bitterness. The principal use of these seeds is in cataplasm and fomentations, for softening, maturing, and discussing tumours; and in emollient and carminative elixirs. They are an ingredient in the oeleum & mucilaginis of the pharmacopoeia, not to be considered a share of their smell, but this is now in use.

TRIGONIA, a genus of the diadelfa decandria class and order of plants. The calyx is five-parted; petals five, unequal; neck; two scales at the base of the germ, slightly tinged some karzones; pedicles triquetrous, three-coriolated, three-celled, three-valved. There are two species, of Guiana.
TRIGONOMETRY is that part of geometry which teaches how to measure the sides and angles of triangles, and of the methods of determining their sides and angles. For this purpose, it is not only requisite that the peripheries of circles, but also that certain right lines in and about a circle, are supposed to be divided into some assigned number of equal parts. These lines are denominated sines, tangents, secants, etc., the sides of plane triangles, and may be estimated in feet, yards, chains, or by any other definite measures, or by abstract numbers; but the angles are measured by the arcs of a circle, as contained between the two legs, having the angular point for its centre.

Every circle is supposed to be divided into 360 equal parts, called degrees; each degree into 60 equal parts, called minutes; each minute into 60 equal parts, called seconds. An angle is said to be of as many degrees, minutes, seconds, &c., as are contained in the arc, or part of the circumference, which it is measured by. The whole circumference of a circle is measured by the fourth part of the circumference, or 90°; an obtuse angle is greater than 90°, and an acute angle is less than 90°.

The difference of an arc from 90°, or a quadrant, is called its complement, and its difference from 180°, its supplement; thus in Plate Misc.; 25°, the arc AB is the complement of HB; but AB is the supplement of BD.

A chord of an arc is a right line drawn from one extremity of an arc to the other; thus BE is the chord or subtenue of the arc BA, or BDE.

The sine of an arc is that sine, which is sometimes called, the right sine, of an arc, is a right line drawn from one extremity of the arc, perpendicular to the diameter passing through the other extremity: thus BE is the sine of the arc AB, or EB.

The versed sine of an arc is the part of the diameter, intercepted between the arc and its sine; thus AE is the versed sine of AB, and DF of the arc DB.

The cosine of an arc is the part of the diameter intercepted between the center and the sine, and is equal to the sine of the complement of that arc. Thus DF is the cosine of the arc AB, and is equal to EB, the sine of its complement HB.

The tangent of an arc is a right line touching the circle in one extremity of that arc, continued from thence to meet a line drawn from the center through the other extremity; which line is called the secant of the same arc: thus AG is the tangent, and CO the secant of the arc AB.

The co-tangent and co-secant of an arc are, the tangent and secant of the complement of that arc: thus HK and CX are the co-tangent and co-secant of the arc AB.

The line here described, belong equally to an angle as to the arc by which it is measured and, except the chords and versed sines, they are all common to two arcs or angles which are the supplements of each other.

Thus, the sine of an arc, whether by degrees, minutes, or seconds, or by any arc or angle above 90° required, is the same thing as to find the sine, tangent, &c., of its supplement, or what it wants of 180°.

They are also called the natural sines, tangents, secants, &c. of an arc or angle by which they are represented, are the logarithmic sines, tangents, &c.

And as one or other of these lines make a part of every trigonometrical operation, they have been made the basis of every degree, minute, &c., of the quadrant, and ranged in tables for use.

Whence, by the help of such a table, the sine, tangent, &c., of any arc or angle, may be found by inspection; and, vice versa:—That is, the tangent or sine of an arc, &c., may be found from the sine or tangent, &c., of that arc, or angle, to which any sine, tangent, &c., belongs.

Upon this table also, and the doctrine of similar triangles, depends the solution of the several cases of plane triangles, which may be performed either by the natural or logarithmic sines, tangents, &c., as occasion requires.

But the logarithmic sines, tangents, &c., are those most commonly used; as the calculator, in this case, are all performed by adding and subtracting only, instead of multiplying and dividing, as is required by the natural sines, &c.

The sine, tangent, &c., of any arc or angle being of the same magnitude as the sine, tangent, &c., of its supplement, it is plain that a table of these lines made for every degree, minute, &c., of the quadrant, or 90°, will serve for the whole circle.

It is also to be observed that, in every such table, the natural sines, tangents, &c., are usually calculated to radius 1; but in order that the logarithmic, sines, tangents, &c., may be all positive, they are usually calculated to radius 0.00000000, or 1 with 10 cyphers, the logarithm of which is 10, so that the latter are the logarithms of the former, with 10 added to the indices.

And, as the natural sines, tangents, &c., of any angles or arcs of different circles, are proportional to the radius of those circles, their values may be readily found, or made to correspond to any radius whatever.

In every plane triangle, three things must be given to find the rest; and of these three one at least must be a side, because the same angles are common to an infinite number of triangles.

It is also to be observed, that all the varieties that can possibly happen in the solution of plane triangles, are comprised under the following cases:—

1. When two of the three given things are a side and its opposite angle.
2. When two sides and their included angle are given.
3. When the three sides are given.

Each of which cases may be resolved, either by geometrical construction, by arithmetical computation, or instrumentally.

In the first of these methods, the triangle is constructed, by laying out the sides from a scale of equal parts, and the angles from a scale of chords, or a protractor, and then measuring the unknown parts by the same scale or instrument from which the others were taken.

In the second method, having stated the proportion, according to the proper rule, multiply the second and third terms together, and divide the product by the quotient: the angles of the first, and the number answering to the remainder will be the fourth term sought.

In the third method, or instrumentally, as the logarithms of the logarithmic lines on one side of the common two-foot scales, extend the compasses from the first term to the second or third as they happen to be of the same kind; and that will give the angle between them together, and from the same place the logarithm of the fourth term required, taking both extents towards the same end of the scale.

The second of these methods, however, or that in which the operation is performed by logarithms, is the one generally employed; the other two being chiefly of use on checks on the calculations, or, in certain cases, where a near approximate value of the quantities to be determined is thought sufficient.

It may here be also further remarked, that if a triangle be supposed to be of the first or second case, and be subtracted, in any operation, it will be better to write down their complements, or what each of them wants of 100°000000 instead of the logarithms themselves, and then add those defects, abutting as many tens in the index of the sum as there were logarithms to be subtracted.

Thus, if the logarithm to be subtracted is 6.5067249, it will be the same thing as to add its complement 0.90749900, and if it is 0.97499900, its complement, or the number to be added, will be 0.92500000; which numbers must be subtracted from the index of the sum, and subtracting each figure of the logarithm from 9, except the last significant figure on the right, which must be subtracted from 10.

If the index of the logarithm, whose complement is to be taken, is 8 7.5067273; and the complement of the logarithm of 3.979234 is 2.04257392.

PROPERTIES OF PLANE TRIANGLES, REQUIRED IN THE PRACTICAL PART OF THIS SCIENCE.

The sum of all the angles of any plane triangle is equal to two right angles, or 180°.

The greater side is opposite the greater angle; and the less side to the less angle.

The sum of any two sides is greater than the third; and if difference of any two sides is less than the third.

The triangle is equilateral, isosceles, or scalene, according as its three angles are all equal, or only two of them equal, or all three unequal.

The angles opposite to the two least sides are acute; and if there is an obtuse angle, it is opposite to the greatest side.

A perpendicular drawn from the opposite angle to the longest side will fall within the triangle; and the greater and less segment will be the greater and less side.

In an isosceles triangle, a perpendicular drawn from the vertex will bisect both the base and the vertical angle.

In a right-angled triangle the hypotenuse is equal to the square root of the sum of the squares of the other two sides; and either of the sides is equal to the square root of the difference of the squares of the hypotenuse and the other side.

Note, also, that if the half difference of any two quantities is added to their half sum, it will give the greater of those quantities; and, if it is subtracted from the half sum, it will give the less.

Case I.—When two of the three given things are a side and its opposite angle, to find the rest.

Rule. The sides of any plane triangle are to each other as the sines of their opposite angles, and vice versa:—That is, as any side is to the sine of its opposite angle, so is any other side to the sine of its opposite angle.

Or, as the sine of any angle is to its opposite side, so is the sine of any other angle to its opposite side.

Hence, to find an angle, begin the proportion with a side opposite to a given angle; and co
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Instrumentally.

In the first proportion, extend the compasses from 236 to 330, upon the line of numbers, and that extent extend, upon the sines, from 38° to 47°, for the \( \angle A \).

In the second proportion, extend from 38° to 23°, or 75° upon the sines, and that extent extend, upon the numbers, from 236 or 184, for the side AB, or BC.

Example II. In the plane triangle ABC, given \( \angle B = 37^\circ 20' \), Ans. \( \angle A = 67^\circ 24' \), and \( \angle C = 124^\circ 14' \). Required the other parts.

Example III. In the plane triangle ABC, given \( \angle B = 37^\circ 20' \), Ans. \( \angle A = 67^\circ 24' \), and \( \angle C = 124^\circ 14' \). Required the other parts.

Example IV. In the plane triangle ABC, given \( \angle B = 37^\circ 20' \), Ans. \( \angle A = 67^\circ 24' \), and \( \angle C = 124^\circ 14' \). Required the other parts.

Example V. In the plane triangle ABC, given \( \angle B = 37^\circ 20' \), Ans. \( \angle A = 67^\circ 24' \), and \( \angle C = 124^\circ 14' \). Required the other parts.

Case II. When two sides and their included angle are given, to find the rest.

Rule. As the sum of any two sides of a plane triangle, is to their difference, so is the tangent of half the sum of their opposite angles, to the tangent of half their difference.

Then, the half difference of these angles, added to their half sum, gives the greater angle, and subtracted from it gives the less.

And as all the angles are now known, the remaining side may be found by Case I.

Note. Instead of the tangent of half the sum of the two unknown angles, we may use the cotangent of half the given angle, or the tangent of half its supplement, which are all equal to each other.

Example'. In any plane triangle ABC, given \( \angle B = 37^\circ 20' \), and side AC = 236. Required the rest. By Construction. 1. Draw BC = 236, by a scale of equal parts.

2. Set off the \( \angle B = 37^\circ 20' \), by a scale of chords, or other instrument.

3. Make \( \mu = 37^\circ 20' \), by the same scale of chords, as before.

4. Join AC, and the triangle is constructed.

Then, the parts being measured, we shall have \( \angle A = 124^\circ 14' \), \( \angle C = 23^\circ 28' \), and side AC = 1630 feet.

By Calculation.

\[
\begin{align*}
\angle A + \angle B &= 164^\circ 0' \quad \angle A = 124^\circ 14' \\
\angle A - \angle B &= 20^\circ 28' \quad \angle C = 23^\circ 28' \\
\angle B - \angle A &= 40^\circ 0' \quad \angle C = 1630 \text{ feet} \\
\angle C - \angle B &= 116^\circ 44' \\
\angle C - \angle A &= 16^\circ 46' \\
\angle B - \angle C &= 141^\circ 44' \\
\angle A - \angle C &= 148^\circ 46' \\
\angle B - \angle A &= 40^\circ 0' \\
\end{align*}
\]

And, in the triangle ACD, right-angled at D, given \( AC = 348 \), and \( CD = 276.75 \). Required the rest.

By Calculation.

\[
\begin{align*}
\angle A + \angle B &= 164^\circ 0' \quad \angle A = 124^\circ 14' \\
\angle A - \angle B &= 20^\circ 28' \quad \angle C = 23^\circ 28' \\
\angle B - \angle A &= 40^\circ 0' \quad \angle C = 1630 \text{ feet} \\
\angle C - \angle B &= 116^\circ 44' \\
\angle C - \angle A &= 16^\circ 46' \\
\angle B - \angle C &= 141^\circ 44' \\
\angle A - \angle C &= 148^\circ 46' \\
\angle B - \angle A &= 40^\circ 0' \\
\end{align*}
\]

This three problems include all the cases or varieties of plane triangles, as well right-angled as oblique, that can possibly happen; but there are some other theorems, for right-angled triangles, that are often more convenient in practice than the general one, the most useful of which is that one which follows.

Case IV. In any right-angled triangle, as ABD is to BCD, so is the tangent of either of the acute angles, to the side adjacent to that angle, to the side opposite to it; and vice versa.
The Solution of the Cases of Oblique Plane Triangles, fig. 294.

<table>
<thead>
<tr>
<th>Given</th>
<th>Sought</th>
<th>Proportion</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Either of the other sides, and one of the acute angles</td>
<td>As, sine of C ; AB ; BC</td>
<td></td>
</tr>
<tr>
<td>2. The other side, and the hypotenuse</td>
<td>As, AB ; sine of C ; BC</td>
<td></td>
</tr>
<tr>
<td>3. The other angle</td>
<td>As, AB ; BC ; AC</td>
<td></td>
</tr>
<tr>
<td>4. The hypotenuse and one leg</td>
<td>As, AB ; BC ; AC</td>
<td></td>
</tr>
<tr>
<td>5. The hypotenuse and one leg</td>
<td>As, AB ; BC</td>
<td></td>
</tr>
<tr>
<td>6. The two legs</td>
<td>As, AB ; BC</td>
<td></td>
</tr>
</tbody>
</table>

TRIGONOMETRY.

Or, as radius is to the cotangent of either of the acute angles, so is the side opposite to that angle, to the side adjacent to it; and vice versa.

It may also be observed, that the sine of either of the acute angles of a right-angled triangle, being equal to the cosine of the other, the latter may be used instead of the former, whenever it renders the operation more simple.

Example I. In any right-angled plane triangle ABC, Required the other parts.

By Construction. Make BC = 294, and \( \angle B = 58^\circ 7' 46'' \) parts.

Then raise the perpendicular CA, meeting BA in A; and the triangle is constructed; in which AB will be found to measure 294, and AC 412; and \( \angle A \), which is the complement of \( \angle B \), is \( 96^\circ 18' \).

By Calculation:

1. \( \text{Rad. or sine} \times 99^\circ = 10.000000 \)
2. Tan, \( \angle B = 58^\circ 7' 46'' \) = 10.1299371
3. Side BC = 294
4. Side AC = 412
5. \( \text{Sine} \times \text{ complement of} \angle B = 9.7781594 \)
6. Side BC = 294
7. \( \text{Rad. or sine} \times \angle C = 90^\circ = 10.000000 \)
8. Side AC = 412
9. \( \text{Sine} \times \text{complement of} \angle A = 2.6835921 \)

And \( 58^\circ 7' 46'' = 36^\circ 59' 12'' \) \( \angle A \).

We shall now give in a tabular form, (1) The solution of the cases of right-angled plane triangles; and (2) The solution of the cases of oblique plane triangles.

The Solution of the Case of right-angled plane Triangles, fig. 294.

<table>
<thead>
<tr>
<th>Case</th>
<th>Given</th>
<th>Sought</th>
<th>Proportion</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. The hypotenuse and one leg</td>
<td>As the radius (or the sine of B) is to the hyp. AC; so is the sine of A, to its opposite side BC.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2. The hypoten. AC and one leg AB.</td>
<td>As, AC ; rad. ; AB ; sine of C ; whose complement gives the angle A.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3. The hypoten. AC and the included angle A.</td>
<td>As, AC ; rad. ; AB ; BC ; whose complement gives the angle A.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4. The hypoten. AC and one leg AB.</td>
<td>As, AC ; rad. (sine of B) ; AB ; AC.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5. The two legs and AC.</td>
<td>As, AB ; BC ; rad. of A ; whose complement gives the angle C.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>6. The two legs AB and AC.</td>
<td>As, AB ; BC ; rad. of A ; whose complement gives the angle C.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Spherical trigonometry. Spherical trigonometry is the art whereby, from three given parts of a spherical triangle, we discover the rest; and, like plane trigonometry, it is either right-angled or oblique-angled. But before we give the analogies for the solution of the several cases of each, it will be proper to premise the following theorems:

Theorem I. In all right-angled spherical triangles, the acute angles, the sides opposite to them, and the angle between the other sides, are equal.

The same thing is true of the sides of these triangles.

Theorem II. In any right-angled spherical triangle, the sine of one of the acute angles is equal to the tangent of the other acute angle.

Theorem III. In any right-angled spherical triangle, the sine of one of the acute angles is equal to the tangent of the other acute angle.

Theorem IV. In any right-angled spherical triangle, the sine of one of the acute angles is equal to the tangent of the other acute angle.

Theorem V. In any right-angled spherical triangle, the sine of one of the acute angles is equal to the tangent of the other acute angle.

Theorem VI. In any right-angled spherical triangle, the sine of one of the acute angles is equal to the tangent of the other acute angle.

The following propositions and remarks, concerning spherical triangles (selected and communicated to Dr. Hutton by the reverend Nevil Maskelyne, D. Astronomer-royal, F. R. S), will also render a correct solution of them picturesque, and free from ambiguity.

1. A spherical triangle is equilateral, isocosceles, or scalene, according as it has three angles all equal, or two of them equal, or all three unequal; and vice versa.

2. The greatest side is always opposite the
TRIGONOMETRY.

The Solution of the Cases of right-angled Spherical Triangles (fig. 252.).

<table>
<thead>
<tr>
<th>Case</th>
<th>Given</th>
<th>Sought</th>
<th>Solution</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>The hyp. AC and one angle A</td>
<td>The opposite leg BC</td>
<td>As radius ( \times ) sine hyp. AC ( \times ) sine A ( \times ) sine BC (by the former part of theor. 1.)</td>
</tr>
<tr>
<td>2</td>
<td>The hyp. AC and one angle A</td>
<td>The adjacent leg AB</td>
<td>As radius ( \times ) co-sine of A ( \times ) tan AC ( \times ) tang AB (by the latter part of theor. 1.)</td>
</tr>
<tr>
<td>3</td>
<td>The hyp. AC and one angle A</td>
<td>The other angle C</td>
<td>As radius ( \times ) co-sine of AC ( \times ) tan A ( \times ) cos C (by theorem 4.)</td>
</tr>
<tr>
<td>4</td>
<td>The hyp. AC and one leg AB</td>
<td>The other angle C</td>
<td>As co-sine AC ( \times ) radius ( \times ) sine AB ( \times ) sine C (by theorem 2.)</td>
</tr>
<tr>
<td>5</td>
<td>The hyp. AC and one leg AB</td>
<td>The opposite angle C</td>
<td>As sine AC ( \times ) radius ( \times ) sine AB ( \times ) sine C (by the former part of theor. 1.)</td>
</tr>
<tr>
<td>6</td>
<td>The hyp. AC and one leg AB</td>
<td>The adjacent angle A</td>
<td>As tang AC ( \times ) tang AB ( \times ) radius ( \times ) co-sine A (by theorem 1.)</td>
</tr>
<tr>
<td>7</td>
<td>One leg AB and the adjacent angle A</td>
<td>The other leg BC</td>
<td>As radius ( \times ) sine AB ( \times ) tan A ( \times ) tang BC (by theorem 4.)</td>
</tr>
<tr>
<td>8</td>
<td>One leg AB and the adjacent angle A</td>
<td>The opposite angle C</td>
<td>As radius ( \times ) sine AC ( \times ) co-sine of AB ( \times ) co-sine of C (by theorem 3.)</td>
</tr>
<tr>
<td>9</td>
<td>One leg AB and the adjacent angle A</td>
<td>The hyp. AC</td>
<td>As co-sine of A ( \times ) radius ( \times ) tan AB ( \times ) tang AC (by theorem 1.)</td>
</tr>
<tr>
<td>10</td>
<td>One leg BC and the opposite angle A</td>
<td>The other leg AB</td>
<td>As tang A ( \times ) tang BC ( \times ) radius ( \times ) sine AB (by theorem 4.)</td>
</tr>
<tr>
<td>11</td>
<td>One leg BC and the opposite angle A</td>
<td>The adjacent angle C</td>
<td>As co-sine BC ( \times ) radius ( \times ) co-sine of A ( \times ) sine C (by theorem 3.)</td>
</tr>
<tr>
<td>12</td>
<td>One leg BC and the opposite angle A</td>
<td>The hyp. AC</td>
<td>As sine A ( \times ) sine BC ( \times ) radius ( \times ) sine AC (by theorem 1.)</td>
</tr>
<tr>
<td>13</td>
<td>Both legs AB and BC</td>
<td>The hyp. AC</td>
<td>As radius ( \times ) co-sine AB ( \times ) co-sine BC ( \times ) co-sine AC (by theorem 2.)</td>
</tr>
<tr>
<td>14</td>
<td>Both legs AB and BC</td>
<td>An angle, suppose A</td>
<td>As sine AB ( \times ) radius ( \times ) tang BC ( \times ) tang A (by theorem 4.)</td>
</tr>
<tr>
<td>15</td>
<td>Both angles A and C</td>
<td>A leg, suppose AB</td>
<td>As sine A ( \times ) co-sine C ( \times ) radius ( \times ) co-sine AB (by theorem 3.)</td>
</tr>
<tr>
<td>16</td>
<td>Both angles A and C</td>
<td>The hyp. AC</td>
<td>As tang A ( \times ) co-tang C ( \times ) radius ( \times ) co-sine AC (by theorem 4.)</td>
</tr>
</tbody>
</table>

Note: The 10th, 11th, and 12th cases are ambiguous; since it cannot be determined by the data, whether ABC, and AC, are greater or less than 90° each.

In any spherical triangle, the area, or surface inclosed by its three sides upon the surface of the globe, will be found by the proportion:

As 8 right angles, or 720°,
Are to the whole surface of the sphere;
Or, as 2 right angles, or 180°,
To one great circle of the sphere;
So is the excess of the 3 angles above 2 right angles,
* To the area of the spherical triangle.

Hence, if \( d \) denotes .7854,
\[ d = \text{diam. of the globe, and} \]
\[ z = \text{sum of the 3 angles of the triangle;} \]
then \[ \frac{\text{add} \times \frac{z}{180}}{180} = \text{area of the spherical triangle.} \]

Hence also, if \( r \) denotes the radius of the sphere, and \( s \) its circumference; then the area of the triangle will thus be variously expressed:

**TRIGUERA,** a genus of the pentandria monogyne class and order of plants. The corolla is bell-shaped; nect. short; berry four-celled, two seeds in each cell. There are two species, of no note.

**TRILLIATAE,** from triv., "three," and halyon, "an external mark on the seed," the name of the 23rd class in Linnaeus's Fragments of a Natural Method; consisting of plants
with three seeds, which are marked with an external cecid of scar, where they are fastened within the fruit. See Botany.

TRILIX, a genus of the class and order polyandra monogynia. The calyx is three-lobed and corolla three-petalled; berry five-celled, many seeded. There is one species, a shrub of Curtangina.

TRILLION, in arithmetic, a billion of a billion.

TRILLIUM, a genus of the hexandria virginia class and order of plants. The calyx is three-leaved; corolla three-petalled; berry three-celled. There are three species, hardy perennials.

TRIM of a ship, her best posture, proportion of ballast, and lashing of her maist, &c., for sailing. To find the trim of a ship, to find the best way of making her sail well, or how she will sail best. This is done by easing of her masts and shrouds; one ship sailing much better when they are slack, than when they are taut or fast; but his depends much upon experience and judgment, and the several trials and observations which the commander and other officers may make aboard.

TRINGA, sandpiper, a genus of birds belonging to the order of gralica. The bill is somewhat tapering, and of the length of the head; the nostrils are small; the toes are in number and divided, the hind toe being frequently raised from the ground. According to Dr. Latham, there are 45 species, which 18 are British. We shall describe some of the more remarkable.

1. Vanellus, lapwing, or tewit, is distinguished by having the bill, crown of the head, crest, and throat, of a black colour; there is also a black line under each eye; the back is of a purplish green; the wings and tail are black and white, and the legs red; the weight is eight ounces, and the length 13 inches. It lays four eggs, making a slight nest with a few bents. The eggs have an olive cast, and are spotted with black. The young, as soon as hatched, run like chickens. He parents show remarkable solicitude for them, flying with great anxiety and clamber ear them, striking at either men or dogs that approach. They are still gathering along the round like a wounded bird, to a considerable distance from their nest, to delute their pears; and to aid the deceit, they become quite clamous when most remote from it.

The eggs are held in great esteem for their delicacy, and are sold by the London poulers for 4 or 5 shillings the dozen. In winter, spings joint in vast flocks; but at that season are very wild: their flesh is very good, their food being insects and worms. During October and November, they are taken in the fens in nets, in the same manner at ruffs are; but are not preserved for hunting, being killed as soon as caught.

2. Ploza. The male of this species is called ruff, and the female reeve. The name is given to the males because they are reared with very long feathers, standing it in a remarkable manner, not unlike the mill-worn by our ancestors. The ruff is of as many difference in size as there are marks in it; in general it is barred with black; the eight is six or seven ounces; the length one or.

The female, or reeve, has no ruff; the common colour is brown; the feathers are plumed with a very pale colour; the breast

TRI...
Trio, in music, a part of a concert wherein three persons sing; or more properly, a musical composition consisting of three parts. Trios are the finest means of composition, and these are what please most in concerts.

TRIOPETERIS, a genus of the decandria trigynia class of plants, the corolla whereof consists of three petaloid, epipetalous, equal and permanent petals, surrounded by three others, smaller than themselves, but equal to one another; there is no pericarpium; the seeds are three, erect, and carinated at the back, each of them has externally at its apex a wing, and at its apex two; these are what in the flowering state of the plant are called petals, but they are not truly such. There are two species, shrubs of the West Indies.

TRISTEOUM, a genus of the pentandria monogynia class and order of plants. The calyx is the length of the corolla; corolla one-petalled, almost equal; berry three-celled, unequal; seeds solitary. There are three species, herbs of North America. The roots are said to be medicinal.

TRIPLARIS, a genus of the diocca dodecandria class and order. The calyx is very large, three or six-parted; corolla three-petalled; nectar, three-sided. There are two species, trees of South America.

TRIPLE, or TRIPLE TIME, in music, a time consisting of three measures in a bar; the two first of which are beaten with the hand or foot down, and the third marked by its elevation. There were formerly in use no less than six different triple measures: first, that of three breves in a bar, denoted by the figure 3; secondly, that of three semibreves in a bar, the sign of which was \( \frac{3}{2} \); thirdly, that of three minims in a bar, marked by \( \frac{3}{4} \); fourthly, that of three crotchets in a bar, implied by \( \frac{3}{4} \); fifthly, that of three quavers in a bar, signified by \( \frac{3}{8} \); and, sixthly, that of three semiquavers in a bar, expressed by \( \frac{3}{16} \). But at present we employ only three different triples; that of three minims, that of three crotchets, and that of three quavers. The reader being informed that the semibreve is now, the longest note in common use, and therefore made the common standard of reckoning, is equal in duration to two minims; or to four crotchets, or eight quavers, will readily conclude the propriety of announcing these different measures by the above figures; and will perceive that, to indicate a time of three minims in a bar (i.e. three halves, or second parts, of a semibreve), no method more concise or simple could be adopted, than that of placing at the beginning of the movement the figures 3; for a time of three crotchets (i.e. three-fourths parts of a semibreve), the figures 4; and for a time of three quavers (i.e. three-eighths of a semibreve), the figures 8.

The old musicians considered the triple, or three-measure, time, as superior to the binary, or two-measure, and for that reason called it the perfect time.

TRIPLE PROGRESSION, an expression in old music, implying a series of perfect fifths. A progression of sounds thus explained by theorists; let any sound be represented by unity, or the number 1; and as the third part of a string has been to produce the twelfth, or octave of the fifth above the whole string, a series of fifths may be represented by a triple geometric progression of numbers, continually multiplied by 3; as 1, 3, 9, 27, 81, 243, 729; and these terms may be equally supposed to represent twelfths, or fifths, either ascending or descending; for whether we multiply or divide these florins by the terms will either be in the proportion of a twelfth, or octave to the fifth.

TRIPlicate ratio, the ratio which cubes bear to one another.

This ratio is to be distinguished from triple ratio, and may be thus conceived. In the geometrical proportions 2, 4, 8, 16, 32, as the ratio of the first term (2) is to the third (8) a duplicate of the first to the second, or of the second to the third, so the ratio of the first to the fourth is said to be triplicate of the ratio of the first to the second, or of that of the second to the third, or of that of the third to the fourth, as being compounded of three equal ratios. See Ratios.

TRIPOli, a mineral found sometimes in an earthy form, but more generally indurated. Its texture is earthy. Special gravity 2 to 2.5. It absorbs water, feels harsh and dry. Searce- taneous, and adheres to, or is detached from, the nodule; does not stain the fingers. Color generally pale yellowish gray; also different kinds of yellow, brown, and white. According to Klaproth, a species of this mineral contained

TRIPsACUM, a genus of the monoeica triandria class and order of plants. The male calyx its glume, four-flowered; corolla, glume membranaceous; female calyx, glume perforated sinuses; corolla, glume two-valved; styles two; seed one. There are two species, grasses of the West Indies.

TRISECTION, or TRISecTion, the dividing a thing into three. The term is chiefly used in geometry, for the division of an angle into three equal parts. The trisection of an angle geometrically, is one of those great problems whose solution has been so much sought by mathematicians for these two thousand years, being in the precise ratio to a given angle, and equal to the arc of the circle, and the duplication of the cube angle.

The cubic equation by which the problem is resolved, is as follows: Let \( x \) denote the chord of a given arc, or angle, and \( x \) the cord of the 5th part of the same, to the radius \( r \) then is \( x = \frac{5}{3} - x = -x \); and the resolution of the cubic equation in which the variable \( x \) is taken as the chord of the 5th part of the given arc or angle, whose chord is \( r \) and the resolution of this equation, by Cardan's rule, gives the chord

\[ x = \sqrt[3]{-\frac{1}{2} \pm \sqrt{\frac{1}{4} - \frac{5}{27}}} \]

TRISetoUs, in entomology, three-bristled, applied chiefly to the tail of insects as in the ephemera.

TRISPAST, in mechanics, a machine with three pulleys, or an assemblage of three pulleys for raising of great weights.

TRITICUM, wheat, a genus of plants of the class triandria, and order caryophyllaceae, and in the natural system ranging under the fourth order, gramina. The calyx is bivalve, solitary, and the fruit categorized as a dry fruit; the corolla is bivalve, one valve being bluish, the other acute. There are 19 species, the Aristum, summer or spring wheat; hybernum, winter, Lanneus, or common wheat, compositum, turgidum, or corn wheat; polo- nicus, or Polish wheat; spelta, or spelt wheat; monococum, or one-grained wheat, prostratum, or trailing wheat-grass; pumilum, or dwarf wheat-grass: juncus, or rush wheat-grass; repens, or couch-grass; tenuilus, or yellow wheat-grass; unialterale, or spiky wheat-grass; uniculme, or linear-spiked wheat-grass; dicthichium, loliaceum, cimicinum, hispanicum. Of what country the first six species are natives, cannot now be determined; the prostratum is a native of Siberia; the juncus, repens unialterale, and maritimum, are natives of Britain; the tenuilus is a native of Spain; and the unialterale is a native of Italy. It may also be observed, that the first three are annuals, the rest are perennials.

Linnaeus comprehends the different kinds of wheat cultivated at present under six species; but cultivation has produced a great many varieties from these.
1. Triticum aestivum, or spring-wheat, has four flowers in a calyx, three of which bear grain. The calyces stand very distantly from each other, on both sides of a flat smooth receptacle. The leaves of the calyx are keel-shaped, smooth, and they terminate with a short arist. The glumes of the flowers are smooth, the outer leaf of three of the glumes in every calyx is terminated by a short arist, but the three inner ones are beardless. The grain is rather longer and thinner than that of barley, but it is supposed to be of a native of some part of Tartary. The farmers call it spring-wheat, because it will come to the sickle with the common wheat, though it should be sown in February or March. The varieties of it are: Triticum aestivum, spica et grana rubente. Spring-wheat, with a red spike and grain. Triticum auratum rubrum, spica alba. Red spring-wheat, with a white spike. 2. Triticum hybrum, winter or common wheat, has also four flowers in a calyx, three of which are mostly productive. The calyces stand on each side a smooth arist and a small arist. The outer leaves of the glumes are smooth, and the outer leaves of the top of the spike, are often tipped with short arist. The grain is rather plumper than the former, and is the sort generally sown in England; whence the name of common wheat. Its varieties are: Triticum hybrum, spica et grana rubente. Common wheat, with a red spike and grain. Triticum hybrum rubrum, spica alba. Common red wheat, with a white spike. Triticum hybrum spica et grana alba. Common wheat, with a white spike and grain. Triticum vulgare, thick-skinned or common wheat. It is easily distinguished from either of the former species, as its calyx has four flowers in a calyx, after the manner of them, yet the whole calyx and the edges of the glumes are covered with soft hairs. The calyces too stand thicker on the receptacle, and make the grain of a larger size. Each of the outer glumes near the top of the spike are terminated by short arist, like those of the common wheat. The grain is shorter, plumper, and more convex on the back than either of the former species. Its varieties are numerous, and have various appellations in different counties, owing to the great affinity of several of them. Those most easily to be distinguished are: Triticum vulgare conicum album. Common wheat, with a white spike. Triticum vulgare conicum rubrum. Red common wheat. Triticum vulgare atrireum. Bearded common wheat. Triticum vulgare spica multiplici. Cone wheat, with many ears. The third variety is what the farmers call clog wheat, square wheat, and rivets. The grain of this is remarkably convex on one side, and when ripe the awn generally break in pieces and fall off. This sort is very productive, but it yields an inferior flour to that of the former two species. 4. Triticum Polonicum, or Polish wheat, has some resemblance to the turgidum, but both grain and spike are longer. The calyx contains only two flowers, and the glumes are furnished with very long arist; the teeth of both are bearded. As this sort is seldom sown, except by Englishmen, there is no telling what varieties it produces. 5. Triticum spelta, or German wheat. At first view this has a great resemblance to barley, but it has no involucrum. The calyx consists of three leaves as the ends of the awns were snipped off, and it contains four flowers, two of which are hermaphrodite, and the glumes bearded, but the intermediate ones are not. There are two rows of grain as in barley, but they are shaped like wheat. It is much cultivated in France, Germany, and Italy. 6. Triticum monococum, St. Peter's corn, or one-grained wheat, has three flowers in each calyx alternately bearded, and the middle one unerect. The spike is shining, and has two rows of grain in the manner of barley. Where it grows naturally is not known, but it is cultivated in Germany; and in common with wheat, is made into bread, which is coarse, and so nourishing as that made of common wheat. Malt made of any of our wheats is often put into beer, and a small quantity of it will give a large fermentation to that liquid in a very short time. Of the perennial kinds, or wild grasses, the repens, or couch grass is unfortunately too well known to the gardener and husbandman; the others are of little note. The respectable president of the Royal Society, whose attention is constantly directed to those branches of knowledge which are most practically useful, has published some remarks on the blight in corn in the year 1805, and we feel ourselves discharging a duty in making them as generally known as our circulation extends. He begins by observing that the blight in corn is occasioned by the growth of a minute parasitic fungus or mushroom on the leaves, stems, and grains of the living plant. Felice Fontana published, in the year 1767, an elaborate account of wheat, with microscopic figures, which give a tolerable idea of its form; more modern botanists have given figures both of corn and of grass affected by it, but hitherto not used high magnifying powers in such figures. He adds, "agriculturists do not appear to have paid, on this head, sufficient attention to the discoveries of their fellow-labourers in the field of nature; for though scarcely any English writer of note on the subject of rural economy, has failed to state his opinion of the origin of this evil, no one of them has yet attributed it to the real cause, unless Mr. Kirby's excellent papers on some diseases of corn, published in the Transactions of the Linnean Society, are considered as agricultural essays. It is, therefore, necessary to premise, that the striped appearance of the surface of a strand which may be seen with a common magnifying glass, is caused by alternate longitudinal partitions of the bark, the one imperforate, and the other furnished with one or two rows of pores or mothies, shut in dry, open in wet weather, and supplied with imbibable fluid whenever the strand is damp. By these pores, which exist also on the leaves and glumes, it is presumed that the seeds of the fungus gain admission, and at the bottom of the hollows to which they lead, (see Plate II. fig. 1, 2,) they permeate and push their minute roots, noddles (through these have not yet been traced) into the cellular texture beyond the bark, where they draw their nourishment, by intercepting the sap that was intended for the maintenance of the grain; the bark becomes shrivelled in proportion as the fungi are more or less numerous on the plant; and as the cortical part is abstracted from the grain, while the cortical part remains mutilated, the proportion of increase in in three days blighted corn, is always reduced in the same degree as the corn is made light. Some corn of this year's crop will not yield in stone of flour from a sack of wheat; and it is impossible that in some cases the corn has been so completely robbed of its flour by the fungus, that if the proprietor should choose to incur the expense of threshing and grinding it, bran would be the produce, with scarcely an atom of flour for each grain. Every species of corn, properly so called, is subject to the blight; but it is observable that spring corn is less damaged by it than winter, and rye less than wheat, probably because it is riped and cut down before the fungus has a chance to affect it. Full says that "white corn, or bearded wheat, which hath its straw like a rush full of pith, is less subject to blight than Lannus wheat, which ripens a week later." The spring wheat of Lincolnshire was not in the least shrivelled this year, though the straw was in some degree affected: the millers allowed that it was the best sample brought to market. Barley was in some cases very considerably injured, but as the whole of the stem of that grain is naturally enveloped in the bionse or basis of the leaf, the fungus can in no case gain admittance to the straw; it is, however, to be observed that barley ris from the field lighter this year than was expected from the appearance of the crop when gathered in. It seems probable that the leaf is first infected in the spring or early in the summer, before the corn shoots up into straw, and that the fungus then of its own accord spreads to the straw. When the straw has become yellow, the fungus assumes a deep chocolate brown: each individua is so small that every pore on a straw will produce from 20 to 40 fungi, as may be seen in the plates, and every one of these will not produce at least 100 seeds; if then one of these seeds falls out into the number of plants that appear at the bottom of a pore in Plate II. fig. 2, how incalculably large must the increase be! A few diseased plants scattered over a field must very speedily infect a whole neighbourhood, for the seeds of fungi are not much heavier than air, ani even when they lie on a ripe pull-ball must have been observed by some dozen among it is seed, rise up and float on him. How long it is before this fungus arrives at puberty, and scatters its seeds in the wind, can only be guessed at by the analogy of others; probably the period of a generation is short, possibly not more than a week in the hot season; so, how frequently in the 1st tier end of the summer must the air be loaded with this animated dust, ready, whenever a gentle breeze, accompanied with humidity, shall give the signal to intrude itself into the
pores of thousands of acres of corn. Providence, however, careful of the creatures it has created, has benevolently provided against the too extensive multiplication of any species of being; it was otherwise, the minute plants and animals, enemies against which man has the least defence, would increase to an inordinate extent; this, however, does not seem to be the case. Tell, in his Horseboarding Husbandry, page 74, tells us, that the year 1725 was a year of blight, the like of which was never before heard of, and which he hopes may never happen again; yet the average price of wheat in the year 1726, when the harvest of 1725 was market, was only 36s. 4d. and the average of the five years of which it makes the first, 3s. 7d. 1797 was also a year of great blight; the price of wheat in 1798 was 49s. 1d. and the average of the five years, from 1792 to 1799, 63s. 5d.

The climate of the British Isles is not the only one that is liable to the blight in corn. It happens occasionally in every part of Europe, and probably in all countries where corn is grown. Italy is very subject to it, and the last harvest of Sicily has been materially hurt by it. Specimens received from the colony of New South Wales, shew that considerable mischief was done to the wheat crop there in the year 1803, by a parasitical plant, very similar to the English one.

It has been long admitted by farmers, though scarcely credited by botanists, that wheat in the neighborhood of a barberry plantation escapes the blight. The village of Rollesby in Norfolk, where barberries abound, and wheat seldom succeeds, is called by the opprobrious appellation of niblew Rollo. The long memory of late has attributed this very perplexing effect to the fumigation of the flowers of the barberry, which is in truth yellow, and resembles in some degree the appearance of the leaves of the barberry, and is very subject to the attack of a yellow parasitical fungus, larger, but otherwise much resembling the rust in corn.

It is, however, notorious to all botanical observers, that the leaves of the barberry are very subject to the attack of a yellow parasitical fungus, larger, but otherwise much resembling the rust in corn.

Another year will not pass without its being confirmed by the observations of inquisitive and sagacious farmers.

It would be presumptuous to offer any remedy for a malady, the progress of which is so little understood; conjectures, however, founded on observation, would be designed to it, may be hazarded without offence.

It is believed to begin early in the spring, and first to appear on the leaves of wheat in the form of rust, or orange-coloured powder; at this season, the fungus will, in all probability, require as many weeks for its progress from infancy to puberty, as it does days during the heats of autumn; but a very few plants of wheat, thus infected, are quite sufficient if the fungus is permitted to ripen its seed, to spread the malady over a field, or indeed over a whole parish.

The chocolate-coloured blight is little observed till the corn is approaching very nearly to ripeness; it appears then in the field in spots, which increase very rapidly in size, and are in calm weather somewhat circular, as if the disease took its origin from a central position.

May it not happen, then, that the fungus is brought into the field in a few stalks of infected straw, uncorrupted, among the mass of dung laid in the ground at the time of sowing? It must be confessed, however, that the idea of wheat having being found in the yard where the corn was used, were as much infected last autumn as the manured crops. The immense multiplication of the disease in the last season, seems, however, to account for this; as the supply of straw was such that they were not equal for seed for miles together, and deposited it indiscriminately on all sorts of crops.

It cannot, however, be an expensive precaution to search diligently in the spring for young plants of wheat infected with the disease, and carefully to extirpate them, as well as all grasses, for several are subject to this or a similar malady, which have the appearance of orange-coloured or of black stripes on their leaves, or on their straw; and if experience shall prove that uncorrupted straw can carry the disease with it into the field, it will cost the farmer but little precaution to prevent any mixture of fresh straw from being carried out with its rotten dung to the wheat field.

In a year like the present, that offers so fair an opportunity, it will be useful to observe attentively whether cattle in the straw-yard thrive better or worse on blighted than on healthy straw. That blighted straw, retaining on it the fungi that have robbed the corn of its flour, has in it more nutritious matter than clean straw which has yielded a crop of plump grain, without doubt; the question is, whether this nutriment in the form of fungi does, or can be made to agree as well with the stomachs of the animals that consume it, as it would do in that of straw and corn.

It cannot be improper in this place to remark, that although the seeds of wheat are rendered, by the exhausting power of the fungus, so lean and shrivelled, that scarcely any flour can be obtained from them, these very seeds will, except, perhaps, in the very worst cases, answer the purpose of seed-corn as well as the fairest and plumpest sample that can be obtained, and, in some respects, better; for as a bushel of much blighted corn will contain one-third, at least, more grains in number than a bushel of plain corn, three bushels of such corn will go as far in sowing land, as four bushels of large grain.

The use of the flour of corn in furthering the process of vegetation, is to nourish the minute plant from the time of its development, its roots in some measure extracting food from the manured earth; for this purpose, one-tenth of the contents of a grain of good wheat is more than sufficient. The quantity of flour in which has been increased by cultured management, to improve its qualities for the benefit of mankind, in the same proportion as the pulp of apples and pears has been increased, by the same means, above what is found on the wildings and crabs in the hedgerow.

It is customary to set aside or to purchase for seed-corn, the boldest and plumpest samples that can be obtained; that is, those that contain the most flour; but this is an unnecessary waste of human subsistence; the smallest grains, such as are sitted out before the wheat is carried to market, or rather consumed in the farmer's family, or given to his poultry, will be found by experience to answer the purpose of propagating the sort whence they sprung, as effectually as the largest.

Every part of a ear is composed of a number of cups placed alternately on each side of the straw; the lower ones contain, according to circumstances, three or four grains, nearly equal in size, but towards the top of the ear, where the quantity of nutriment is diminished by the supply of cups that are nearer the root, the third or fourth grain in a cup is frequently defaumed of its proportion, and becomes shrivelled and small. These small grains, which are rejected by the miller, because they do not contain flour enough for his purpose, have, nevertheless, an ample abundance for all purposes of vegetation, and as fully pactate of the cap, (or blood, as we should call it in animals,) of the kind which produced them, as the fairest and fullest grain that can be obtained from the bottoms of the lower cups by the wasteful process of beating the sheaves.

TRITOMA, a genus of insects of the coleoptera order. The generic character is, elavate, scrobilate; by emarginate; anterior feelers hatchet-shaped; shells as long as the body. There are ten species.

TRITON, a genus of vermcs molusca. The generic character is, body long; month with an involute spiral proboscis; tentacles or arms, twelve, viz. six on each side, divided nearly to the base, the end ones cheliferous. There is only a single species, viz. the litteorous, which is found in Italy, in various cavities of submarine rocks, and may be seen in many species of the lepas, particularly in the anatara.

TRIURATIOn. See Pharmacy.

TRIUMFETTA, a genus of the dodacan- dria monogynia class of plants, the corolla of which consists of five linear, crete, obtuse petals, hollowed, and bent backwards; the point is prominent below the apex; the fruit is a globus capsule, every where surrounded with longed prickles, and contains four cells; the seeds are two, convex on one side and angular on the other; but only one of the two
seeds of each cell usually ripen. There are 11 species, chiefly shrubs of the West Indies.

TRIXIS, a genus of the synsegea polyantha of order of plants. The corolla of the ray are triate, seeds hairy at the top, without any down; recept. chaffy. There are three species, herbs of the West Indies.

TROCHIAL VERSE, in the Latin poetry, a kind of verse, so called because the trochee of the foot prevails as the iambus does in the iambic. It generally consists of seven feet and a syllable; the odd feet, for the most part, consist of trochees, though a tribrachys is sometimes admitted, except in the seventh foot; but all are remarkable for the beauty of the latter part, as is also the spondaic, dactylus, and anaestus. The following is an example:

1. Solus aut rex aut po et non quot
   annis aut usque aut tor.

TROCHANTER, See Anatomy.

TROCHE, See Pharmacy.

TROCHEE; in the Greek and Latin poetry, a foot consisting of two syllables, the first long and the second short, as in the words massa and servat.

TROCHILUS, humming-bird, a genus of birds belonging to the order of picce. The rostrum is subulate, niform, and longer than the head, the apex being tubular; the upper mandible slightly the lower. The tongue is filiform and tubulous, the two threads coalescing; the feet are slender and fit for walking; the tail has ten feathers. There are 65 species, none of which are natives of Britain. They are all remarkable for the beauty of their colours, and most of them for the smallness of their size, though some are eight or nine inches in length. They are divided into two families, viz. those with crooked bills, and those with straight bills. See Plate Nat. Hist, fig. 408. Of these we shall describe the four following species:

1. The exilis, or little humming-bird, has a crooked bill, is an inch and a half in length; the upper mandible is lighter; the tongue is black, and half an inch in length; the body greenish-brown, with a red shining, immittible gloss; the head is crested with a small tuft, green at bottom, but of a sparkling yellow colour at top; quills and tail fine black. It is a native of Guiana; and the oscillation of its body is so great, that the eye can scarcely keep pace with its motion.

2. The mollichus, or ruby-necked humming-bird, according to Mixagrace, is the most beautiful of the whole genus. Its length is three inches four lines; the bill straight, eight lines long, and blackish; the top of the head and hind part of the neck are as bright as a ruby, and of the same colour; the upper parts of the body are brown, with a faint mixture of green and gold; the throat and forepart of the neck are the colour of the most brilliant topaz; the belly, sides, and thighs, are brown; but on the under part of the belly, on each side, is a spot of white; the tail is russet purple, inclining to violet at the ends; the two middle feathers are shortest; the legs and claws blackish. The female has the head golden or topaz on the breast and forepart of the neck; the rest of the under parts are greyish-white. This species is found in Brasil, Curassow, Guiana, and Surinam. See Plate Nat. Hist. fig. 4-9.

3. The minimum, or least humming-bird, is exceeded, both in weight and dimensions, by the T. exilis; its total length is one inch and a quarter; and when killed, weighs no more, according to Sir Hans Sloane, than 20 grains. The bill is straight and black, three lines and a half in length; the upper parts of the head and body, are of a greenish-golden brown, in some lights appearing reddish; the under parts are greyish-white; the wings are violet-brown; the tail of a bluish-black, with a gloss of polished metal; but the outer feather, except one on each side, is grey from the middle to the tip, and the outer one wholly grey; legs and claws brown. The female is less than the male; the whole upper side of a dirty brown, with a slight gloss of green; the under parts of a dirty-white. These birds are found in various parts of South America and the adjacent islands.

4. Superbissimus, white shaft, or superbus-humming-bird, is a very beautiful species. Its wings are very long; the feathers of the tail next the two long shafts are also the longest, and the lateral ones continually decrease to the two outermost, which are the shortest, and this gives the tail a pyramid shape; its quills have a gold gloss on a grey and blackish ground, with a whitish edge at the point, and the two shafts are white through the whole projecting portions; all the upper side of the back and head, and yellow gold-colour; the wing violet-brown; and the under side of the body white-grey.

These birds subsist on the nectar or sweet juice of flowers; they frequent those most which have a long tube, particularly the impatiens noli me tangere, the monarda with crimson flowers, and those of the convolvulus tribe. They never settle on the flower during the action of extracting the juice, but flutter continually like bees, moving their wings very quick, and making a humming noise; whence their name. They are not very shy, suffering people to come within a foot or two of the place where they are, but when approached nearer, fly off like an arrow out of a bow. They are well provided with the right for a flower, and this all on the wing. In this state they often come into rooms where the windows stand open, fight a little, and go out again. When they come to a flower which is juiceless, or on the point of withering, they pluck it off as if in anger, by which means the ground is often quite covered with them. When they fly against each other, they have, besides the humming, a sort of chirping noise like a sparrow or chicken. They do not feed on insects or fruit; nor can they be kept long in cages, though they have been preserved alive for several weeks together, by feeding them with water in which sugar had been dissolved.

This bird most frequently builds in the middle of a branch of a tree, and the nest is so small that it cannot be seen by a person who stands on the ground; any one therefore who wishes to see the lower side, go up to the branch, that he may view it from above: it is for this reason that the nests are not more frequently found. The nest is of course very small, and quite round; the outside, for the most part, seems to be common, composed of two main parts, covered on old pales and trees; the inside of soft down, mostly collected from the leaves of the great mullein, or the silk grass; but sometimes they vary the texture, making use of flax, hemp, hair, and other soft materials; they lay two eggs of the size of a pea, which are white, and not bigger at one end than the other.

The above account of the manners will in general suit all the birds of this genus; for as we have already seen, in their first acquisition, it is by this method alone that they can gain nourishment: no wonder, therefore, they can scarcely be kept alive by human art. Captain Davies, however, kept these birds alive for four months by the following method: He made an exact imitation of the edge of the tubular flowers with paper, fastened round a tobacco-pipe, and painted them of a proper colour; these were placed in the order of nature, in the cage wherein these little creatures were confined, and in the bottoms of the tubes were filled with a mixture of brown sugar and water as often as emptied; and he had the pleasure of seeing them perform every action as if for the first time; for they soon grew familiar, and took the nourishment in the same manner, and ranging at large, though close under his eye.

TROCHOID. See Cycloid.

TROCHUS, a genus of vermes testaceae: the generic character is, animal a linnæus; shell univalve, spiral, more or less conic; aperture somewhat angular or rounded; the upper side transverse and contracted; pillar placed obliquely. See Plate Nat. Hist, fig. 410. There are about 120 species.

TROGON, or cernuus, a genus of birds of the order picae. The generic character is, bill shorter than the head, sharp-edged, hooked, the mandibles separated; none of them having feathers for climbing. There are nine species. They all inhabit warm countries, are solitary, and live in damp unfrequented woods, building on the lower branches; their sight is short, and they feed on insects; body long; nostrils covered with bristles; feet short, woolly; tail very long, consisting of 12 feathers.

TROLLIUS, globeflower, in botany, a genus of plants of the class polyandria, and order polygama, found in the natural system ranging under the 26th order, multisilique. The calyx is wanting; there are about 14 petals; the capsules are very numerous, ovate, and many seeded. There are two species, the asiaticus and europaeus; the latter of which is a British plant. The europaeus, or European globeflower, has its corypate convolvous, and from nine to sixteen nectarins, of the length of the staminal, linear, plane, incurvate, and stellariated at the upper side of the base. The leaves are divided first into five segments down to the base; the segments are again divided, each about half-way, into two or three lobes, which are sharply indented on the edge. In the stalk is a foot high, and scarcely branched; the flower is yellow, globose, and sparcacious. It grows at the foot of mountains, and by the sides of rivulets. The country people in Sweden strew their floors and pavements on holidays with the flowers, which have a pleasant smell, and are ornamental in gardens. The asiaticus is little different, except that the corolla inclines to orange.

TROUPE, the mayor and commonalty of the city of London, are ordained keepers
of the beams and weights for weighing merchants' commodities, with power to assign clerks, porters, &c., of the great beam and the weights of goods and wares, is called tonnage.

TROPIC, EQUATOR. The Indian cress, or Anarthrostis, a genus of the octandria-monogyne class of plants, the flower of which consists of five roundish petals inserted into the divisions of the cypsel, the two upper petals are sessile; the three others have very long and barbated anthers; the fruit consists of three convex capsules, fulculated, and striated on one side, and angular on the other; the seeds are thin, glossy, and marked. This is usually detains.

TROPHY, a name given to the top of the mast, containing the four-petalled compass; the style is two-parted; bery one-seeded. There is one species, the random tree of Jamaica.

TROPHY, sporangium, among the amanites, a pile or heap of arms of a vanquished enemy, raised on the mountain and parts of the field of battle. The trophies were usually dedicated to some of the gods, especially Jupiter. The name of the deity to whom they were inscribed, was generally mentioned, either in the mountain or parts of the field of battle. The gods were at first hung upon the trunk of a tree; but instead of trees, succeeding ages erected pillars of stone, or brass, to continue the memory of their victories. To demolish a trophy was looked upon as a kind of sacrilege, because they were all consecrated to some deity. The representation of a trophy is often to be met with on medals of the Roman emperors, struck on occasion of victories; when relays, besides arms and spoils, are frequently seen one or two captives by the sides of the trophy.

TROPIES. See ASTRONOMY, and Geography.

TROUGHER. The trough is the remedy prescribed by the law, where any person is in possession of the property of another, which he unlawfully detains. Previous to commencing of this action, a demand of the property so detained is to be made in writing by some person properly authorized by the owner of the property; and upon refusal to restore it, the law presumes an unlawful conversion, and the party is entitled to this action, and will recover damages to the value of the property detained. As trough implies trespass, the smallest damages will carry costs. A similar action may be brought for the unlawful detention of any property, on which the specific article so detained may be recovered; but as articles detained must be precisely stated in the declaration, and is attended with some difficulty, this action is very seldom brought.

TROUT. See SMALO.

TROUT-WEIGHT. One of the most ancient and different kinds used in Britain. The ounce of this weight was brought from Grand Cairo in Egypt, about the time of the crusades, into Europe, and first adopted in Troyes, a city of Champagne, whence the name of Troy weight and Troy ounce contains 17 ounces, or 5760 grains. It was formerly used for every purpose; and is still retained for weighing gold, silver, and jewels; in some degree for compounding medicines; for experiments in natural philosophy; and for comparing different weights with each other. It is reckoned to be equal to nearly the weight of 22 pounds, 11 ounces, and 3 pennyweights. 

James I. in the year 1618, who enacted, that only one weight should be used in Scotland, viz. the French Troy stone of 16 pounds, and 16 ounces in the pound. The pound contains 7620 grains, and is equal to 17 or 6 dr. avoirdupois. The ext. or 112 lb. avoirdupois, contains only 103 lb. 25 oz. of this weight, though generally reckoned equal to 104 lb. This weight is nearly, if not exactly, the same as that of Paris and Antwerp, and is generally known by the name of Dutch weight. Though prohibited by the articles of union, it is still used in weighing iron, hemp, flax, most Dutch and Baltic goods, wool, brush-mat, furrowed pewter and lead, and some other articles. See WEIGHTS.

TRUCE, in war, denotes a suspension of arms, or a cessation of hostilities between two armies, in a form of articles of peace, bury the dead, or the like.

TRUFFLES, in natural history, a kind of subterranean puff-ball, being a species of fungi, which grows under the surface of the earth in woods.

TRUMPET, the loudest of all portable wind instruments, and consisting of a folded tube generally made of brass, and sometimes of silver.

The inventors had various instruments of the trumpet kind, as the tuba, cornua, &c., as the scripture informs us, made two of silver to be used by the priests; and Solomon, Josephus tells us, made two hundred like those of Moses, and for the same purpose.

The modern trumpet consists of a mouth-piece, near an inch across. The pieces which conduct the wind are called the branches; the parts in which it is bent the potencies; and the canal between the second bend and the extremity the pavilion; the rings where the branches take asunder, or are soldered together, the knots, which are five in number, and serve to cover the joints.

One particular trumpet, the Porta, or noble instrument, is that, like the horn, it only commands certain notes within its compass.

The trumpet produces, as natural and easy sounds, G above the bass-cliff note, or fiddle G, C on the first ledger line below in the treble, E on the first line of the stave, G on the second line, C on the third space, and all the succeeding notes up to G in alt, including the sharp of B, the fourth of the key.

Solo performers can also produce B flat (the third above the treble-cliff note) and by the aid of a newly invented slide many other notes which the common trumpet cannot sound are now produced. A method has lately been discovered for enriching the inside of trumpets, so as not to injure the fineness of the sound, and yet to prevent the deleterious effects occasioned by drawing in the oxide of copper into the lungs.

TRUMPET marine, a kind of monochord, forming the name and shape of a triangle, triangular body. It has a very narrow neck, with one thick string, mounted on a bridge, which is firm on one side, and tremulous on the other. It is struck with a bow by the right hand, and the thumb of the left hand is depressed on the string. The peculiarity of its sound, which resembles that of the trumpet, is produced by the tremulation of the bridge.

TRUMPET, harmonical, an instrument that imitates the sound of a trumpet, which it resembles in every thing, excepting that it is longer, and consists of more branches; it is also called a portable trumpet.

TRUMPET, speaking, is a tube from six to fifteen feet long, made of tin, perfectly straight, and with a very large aperture; the mouth-piece being large enough to receive the lips.

The speaking-trumpet, or stentorophonic tube, as some call it, is used for magnifying sound, particularly that of speech, and thus causing it to be heard at a greater distance. How it does this will be easy to understand from the structure of it, thus illustrated: Let ACB be the tube, the axis, and B the mouth-piece for conveying the voice to the tube. Plate Miscel. fig. 244.

It is then evident, when a person speaks at B, the trumpet, the whole force of his voice is spent upon the air contained in the cylinder ABCD, so as to move it through the whole length of the tube; and by various reflections from the side of the tube; to the axis, the air along the middle part of the tube will be greatly condensed, and its momentum proportionally increased, so that when it comes to agitate the air at the orifice of the tube AC, its force will be much greater than what it would have been without the tube, as the surface of a sphere, whose radius is the orifice of the tube, is greater than the surface of the segment of such a sphere, whose base is the orifice of the tube.

See SOUND.

For a person speaking at B, without the tube, will have the force of his voice spent in exciting concentric superifices of air all around the point B; and when those superifices or pulses of air are diffused as far as D every way, it is plain the force of the voice will be diffused through the whole superifices of air everywhere. But in the trumpet it will be so confined, that at its exit it will be only diffused through so much of that spherical surface of air, as corresponds to the orifice of the tube. But since the force is given, its intensity will be always inversely, as the number of particles it has to move; and therefore in the tube it will be that without, as the superificies of such a sphere to the area of the large end of the tube.

To make this matter yet plainer by calculation, let BD = 5 feet, then will the diameter of the sphere DE = 10 feet, the square of which is 100, which, multiplied by 0.7854, gives 78.54 square feet for the area of a great circle. And, therefore, four times that area, viz. 4 x 78.54 = 314.16 square feet in the superifices of the aerial sphere. If now the diameter AC, of the end of a trumpet, is one foot, its area will be 0.7854; but 7834 = 314.16, which is the diameter BD; and the former trumpet at the distance of BD, will be agitated by the air of the trumpet, with a force 400 times greater than by the bare voice alone. Again, it is further evident how instruments of this form necessarily for the waking and guiding pulses of the air being received by the
large end of the tube, and greatly multiplied
and condensed by the tremendous motion of
the parts of air which are agitated by
those of another. These are conveyed to
the small end, and strike with an impetus so much
larger than they would have done without it,
that the area of the small end is about 9
less than the area of the larger end AC. From
what has been said, it is evident the effect of
the tube in magnifying sound, either for
speaking or hearing, depends chiefly upon
the length of the tube. But yet some advan-
tage may be derived from the particular
shape. Some have proposed the figure which is made by
the revolution of a parabola about its axis, as
the best of any, where the mouth-piece of the
parabola, and, consequently, the sonorous
rays will be reflected parallel to the axis of
the tube. But this parallel reflection seems
no way essential to the magnifying of sound;
therefore, it appears rather to hinder
such an effect, by preventing the infinite
number of reflected circular reciprocations
of sound; in which, according to sir ISAAC
Newton, its augmentation principally consists.
For all reciprocal motion, in every return,
is augmented by its generating cause, which is
then the transmission of the wave to the tube.
In every repercussion, therefore,
from the sides of the tube, the agitations
and pulses of confined air must necessarily be in-
creased; and consequently this augmentation
of the impetus as the waves must be propor-
tional to the number of such repercussions;
and therefore, to the length of the tube, and
to such a figure as most productive of them.
Whence it appears that the parabolic trumpet
is not all the most useful for this purpose, in-
stead of being the best.

But there is one thing more which contrib-
utes to the augmenting of these agitations
of air in the tube, and that is the proportion
which the several portions of air bear to each
other, when divided by transverse sections,
at very small, but equal distances, from
one end of the tube to the other. Thus,
let those several divisions be made at the points
or stations, a, b, c, d, &c. be taken in geometrical
proportion. Then will the portions of air con-
tained between Band c, a and b and c, cc
and d, &c. be very nearly in the same propor-
tion, as being in the same ratio with their
bases, when the points of division are inde-
minitely near together.

But when any quantity of motion is com-
municated to a series of elastic bodies, it will
receive the greatest augmentation when those
bodies are in geometrical proportion. There-
fore, since the force of the voice is impressed
upon, and gradually propagated through,
a series of elastic portions of air in a geo-
metrical ratio to each other, it shall receive the
greatest augmentation possible.

Now, since by construction it is B = be =
bc = cd, &c. and also aO = ab = bO = cO;
dc, and so on; therefore, the points k, m,
n, a, p, k, r, s, as will, in this case, form
that curve line called the logarithmic curve;
consequently a trumpet, formed by
the revolution of this curve about its axis,
will augment the sound in a greater degree
than any other figured tube whatever.

TRUMPET—FLOWER. See Bignonia.
TRUMPET-SHELL, the English name of
the buccinum of authors. See Buccinum.

TRUNCATED, in general, is an
appellation given to such things as, have
or seem to have, their points cut off: thus we say, a
truncated cone, pyramid, leaf, 

TRUNCNIONS, or TRUNIONS of a piece
of ordnance, are those knobs or
hinges of the gun's metal, which bear up on the
choke of the cannon: and hence the term
ring is the ring about a cannon, next
before the trunnions.

TRUSSES, in a ship, are ropes made fast
to the parcels of a yard, either to bind the yard
to the mast when the ship rolls, or to hold
unto the yards in a storm, &c.

TRUSTEE, one who has an estate, or
money, put or trusted in his hands, for
the use or benefit of another. More
person or persons are appointed trustees, if one of them
receives all or the greater part of the profits
of the lands, &c. and is in a strict sense, and unable to
satisfy the person to whom he is seised in trust, the other, in that case, shall not be
answerable for any thing more than comes to his hands.

TUBE, in general, pipe, conduit, or canal;
a cylinder, hollow withinside, either of lead,
iron, wood, glass, or other matter, for
the air, or some other fluid, to have a free passage
or conveyance through.

Small size or lemon tubes are frequently
used by surgeons to draw off blood, matter,
or water, from the different parts of the body.
They are made of various sizes and shapes.

TUBE, in astronomy, is sometimes used
for a telescope, or, more properly, for that
part into which the lenses are fitted, and by which
they are directed and used. See OPTICS.

TUBIPORA, a genus of zoozoa. The
generic character is, animal a ureas; coral
consisting of erect, hollow, cylindrical, parallel
gap aggregate tubes. There are ten species:
The most eminent inhabits the Indian seas, is fixed to rocks and other corals; builds
scarlet, consisting of an assortment of upright
parallel tubes, rising over each other by
stages, like cells of an honeycomb, divided
by transverse partitions. The Indians use it
in cases of strangury, and wounds inflicted by
venomous animals.

TUBULARIA, a genus of zoozoa. Stem
tubular, simple or branched, fixed by the
base: animal proceeding from the end of the
smaller tubes, and having its head erected with tenta-
cula. There are 20 species: the magnifica
inhabits the West Indies, adhering to rocks,
and is the most splendid genus of them all:
it has the power of withdrawing its tentacula
within the tube, and the tube within the rock
on which it resides.

TUFAS, beds of limestone deposited on
vegetables, which by their destruction give
lightness and porosity to the mass.

TURK, a term for tail; a sort of standard, called so by the
Turks. It consists of a horse's tail, which
is fixed to a long pole or half-pike, by means
of a gold button. The origin of this standard is
curious. It is said, that a new name given to
the Turks, the latter were
broken, and in the midst of their confusion
lost their grand standard. The Turkish
general, being extremely aggrieved at the untoward
conditions which happened, most
especially by the loss of the great standard,
cut off a horse's tail with his sabre, fixed it to
a half-pike, and holding it in his hand, rode
furiously towards the fugitives, and exclaimed,
'Here is the great standard; let those who
love me, follow into action.' This
produced the desired effect. The Turks rallied
with redoubled courage, rushed into the
thickest of the enemy, and not only gained
the victory, but recovered their standard.

TURPENTINE, a spirit which is
obtained from the resinous substance
being distilled from the bark of a
particular sort of fir tree, and is,
when perfectly purified, a clear
liquid. It is employed in medicine
and chemistry, and is very
valuable.

TUSK, a name given to the bone, or
hard, thick white piece, which is
attached to the upper and lower jaws
of the elephant. Some species of
elephant have only one tusk,
whereas others have two.
man Army; they still made use of the flag or turban; and the Turks, in consequence of the victory which was obtained under this mark standard, looked upon it as a happy omen; and that since that period they have always fought under it as their banner, and the signal of victory.

Whatever may have been the origin, it is certain, that when the grand signor takes the field in person, seven of these tails are always carried before him; and when he is in camp, they are placed in front of his tent.

The grand visier is entitled to three of these tails.

The three principal basinews of the empire, viz. those of Bagdad, Grand Cairo, and Breda, have the grand signor's permission to use this mark of distinction, throughout the whole extent of their jurisdiction.

Those basinews that are not visiers have the privilege of having two tails.

The boys, who are subordinate to the basinews, have only one.

TULIPAGE, a genus of plants of the class and order hemixidia monogynia. The corolla is fumose-nod; nect. three-leaved; capsule saccate. There are two species, bulbs of the Cape.

TULIP. See TULIPA.

TULIPA, tulip, a genus of plants of the class hemixidia, and order monogynia, and in the natural system, or common garden tulip, is the commonest, or most popular, of the whole tulip genus, a native of the Levant; the breynianus, or cape tulip, a native of the Cape of Good Hope, the bilora, and the stovaleous.

1. The sylvestris, or wild European tulip, has an oblong bulbous root, sending up long narrow spear-shaped leaves; and a slender stalk, supporting at top a small yellow flower, making on this side, having acute petals.

2. The generica, Gener's Turky tulip of Constantinople garden tulip, has a large, oblong, tumicate, solid, bulbous root, covered with a brown skin, sending up long, oval, spear-shaped leaves; an upright round stalk, from half a foot to a yard high, and bearing a large bell-shaped erect hexapetalous flower, of almost all colours and varieties in the different varieties.

This tulip, and its vast train of varieties, is generally cultivated for the ornament of our gardens, and much admired by all for its great variety and beautiful appearance; it grows freely in the open ground in any common soil of a garden, and proves a very great decoration to the beds and borders of the pleasure-ground for six weeks or two months in spring, by different plantings of early and late sorts; planting the principal part in autumn, and the rest towards Christmas, and in January or February. The autumn plantings will come earliest into bloom, and flower the strongest; and the others will succeed them in flowering. In summer, when the flowering is past, and the leaves and stalks assume the attitude of the chions in all the varieties are generally taken up, the offsets separated, and the whole cleaned from filth; then put up dry till October or November, and planted again for the future year's bloom.

Of this species, which is the florist's delight, the varieties may be divided into two principal early or old; and spring tulips (practicals). 2. Late flowering common tulips (scentuine). 1. Early tulips. The early tulips are, among florists, distinguished by the application of precoces, (early) because they flower early in the spring, a month or more before the others; they are much taller, and the flowers smaller, but in great reputation for their early bloom and their gay lively colours, both of self-colours, and broken into combinations, such as reds, crimson, scarlet, cinnamons, violets, purples, yellow, &c. with flowers of each, edged and flaked with red, yellow, and white, in many diversities. 2. Late flowering common tulips. This class is denominated late flowering, and by the florists called serotine, because they blow later in the spring, a month or more, than the precoces, i.e. not coming into flower before the end of April, May, and June. These are all of tall growth, supporting large flowers, and furnish an almost endless variety in the vast diversity of colours; after, they break from whole flowers into variegations and stripes, exceeding all others of the tulip kind in beauty and elegance of flower.

All the varieties are succeeded by plenty of ripe seed in July and August, contained in an oblong capsule of three cells, having the seeds placed on each other in double rows. By the seeds many new varieties may be raised, which however will not attain a flowering state till they are seven or eight years old; and after that will require two or three years, or more, to break into variegations, when the approved varieties may be marked, and increased by offsets of the root.

The colours in greatest estimation in variegated tulips are the blacks, golden yellows, purple-violets, rose, and vermillion, each of which being variegated various ways; and such as are striped with three different colours distinct and unmixed, with strong regular streaks, but with little or no tinge of the breeder, may be called the most perfect tulips. It is rare to meet with a tulip possessing all the above properties.

As to the colouring of obtaining this wonderful variety of colours in tulips, it is often accomplished by nature alone, but is sometimes assisted and forwarded by some simple operations of art; such as that, in the first place, when the seedling bulbs of the whole flower or breeder are arrived to full size, and have flowered once, to transplant them into beds of any poor dry barren soil, in order that, by a defect of nourishment in the earth, the natural luxuriance of the plant may be checked, and cause a weakness in their general growth, whereby they generally, in this weakened or infirm state, gradually change and break out into variegations, some of the first year, others not till the second or third; and according as they are thus broken they should be planted in beds of good earth.

Another method to assist nature in effecting the breaking the breeding tulips into diversified colours, is to make as great a change as possible in the soil; if they were this year in a light poor soil, and next year in rich garden mould, and another year in a compost of different earths and dung; or transplant them from one part of the garden to another, or into different gar lands, &c. or from one country to another; all of which contributes to assist nature in producing this desirable diversity of colours and varieties.

The double tulip is also a variety of the common tulip, and is very beautiful, though not in such estimation among the florists as the common single variegated sorts, not possessing such a profusion of variegations in the colours and regularity of stripes; they however exhibit an elegantly ornamental appearance.

Tulip roots are sold in full collection, consisting of numerous varieties, at most of the nurseries and seedsmen, who both propagate them themselves by offsets and seed, and import vast quantities annually from Holland, the Dutch being famous for raising the greatest collections of the finest tulips, and other bulbous flowers, in the greatest perfection. TUMOUR, or Tumor, in medicine and surgery, a preternatural rising or hard swelling on any part of the body.

TUN, or Tun, signifying a large vessel or cask of an oblong form, biggest in the middle, and diminishing towards its two ends, girt about with hoops, and used for containing several kinds of merchandise, for convenience of carriage, as wine, oil, &c.

TUN is also a certain measure for liquids; as wine, oil, &c. See Tun and Sound.

Tun, or Tone, in music, that property of sounds whereby they come under the relation of acute and grave to one another. See Tun and Sound.

Sonorous bodies we find differ in tone: 1. According to the different kinds of matter; thus a wedge of silver sounds much more acute than a wedge of gold of the same shape and dimensions, in which case the tones are proportional to the specific gravity. 2. According to the different quantities of the same matter in body, as when, by striking a solid sphere of brass, one foot diameter, sounds acuter than one of two feet diameter; in which case the tones are proportional to the quantity of matter. Here then are different tones connected with different specific gravities and quantities of matter, as their immediate cause. In effect, the measures of tune are only sought in the relations of the motions that are the cause of sound, which are no way so discernible as in vibrations of chords.

In the general we find that in two chords, all things being equal, except tension, or thickness, or length, the tones are different; there must, therefore, be a difference in the vibrations owing to these different tensions, &c., which difference can only be in the velocity of the courses and recourses of the chords, through the spaces wherein they are produced and sprung. Upon examining the proportion of the velocities of the things just mentioned, wherein it depends, it is found, to a demonstration, that all the vibrations of the same chord are performed in equal times. Hence, all one of a sound depends on the nature of the vibrations, whose difference we can conceive no other.
Thus, for but the it and it and a quantity of charcoal, and heated the mixture in a crucible. The result of their experiments is as follows:

With gold and platinum the tungsten did not combine.

With silver it formed a button of a whitish-brown colour, something spongy, which with a few strokes of a hammer extended itself easily, but on continuing it split in pieces. This button weighed 142 grains.

With copper it gave a button of a copperish red, which approached to a dark brown, was spongy, and very ductile, and weighed 133 grains. With crude or cast iron, of a white quality, it gave a perfect button, the fracture of which resembled that of a whitish brown colour; it was hard, harsh, and weighed 137 grains; and with lead it formed a button of a dull dark brown, with very little lustre, spongy, very ductile, and splitting into leaves when hammered: it weighed 127 grains.

The button formed with tin was of a lighter brown than the last, very spongy, somewhat ductile, and weighed 138 grains.

That with antimony was of a dark-brown colour, shining, something spongy, harsh, and broke in pieces easily: it weighed 108 grains.

That of bismuth presented a fracture, which, when seen in one light, was of a dark brown colour, with the lustre of a metal, and in another appeared like earth, without any lustre; but in both cases an infinity of little holes could be distinguished over the whole mass. This button was pretty hard, harsh, and weighed 68 grains.

With manganesine it gave a button of a dark-bluish-brown colour and earthy aspect; and on examining the internal part of it with a lens, it revealed an impure dress of iron; it weighed 107 grains.

TUNGSTIC ACID. The substance called tungstic acid by Scheele and Bergman was discovered by Scheele in 1781. This philosopher obtained it from the tungstate of lime, by treating it with nitric acid and ammonia alternately. The acid dissolves the lime, and the ammonia combines with the tungstic acid. The ammoniacal solution, when saturated with nitric or muriatic acid, deposits a white powder, which is the tungstic acid of Scheele.

This powder has an acid taste, it reddens vegetable blues, and is soluble in 20 parts of boiling water. The De La Vayres have demonstrated, that this pretended acid is a compound of yellow oxide of tungsten, the alkali employed to dissolve it, and the acid used to precipitate it. Thus, when prepared according to the above-described process, it dissolves the carbonates, nitrates, and nitric acid. Their conclusions have been more lately confirmed by the experiments of Vauquelin and Hechel.

This substance must therefore be erased from the class of acids, and placed among the salts. 2 N.

The real acid of tungsten is a yellow powder; the method of procuring which, and its properties, have been already described under the denomination of yellow oxide of tungsten. It ought rather, as Vauquelin and Hechel have properly remarked, to be classed among the oxides than the acids; for it is insoluble in water, tasteless, and has no effect on vegetable blues. It agrees with the acids in the property of combining with salts, and perhaps also with some metallic oxides, and forms with them salts which have been denominated tungstates; but several other metallic oxides, those of lead, sliver, and gold, for instance, possess the same property. These oxides, therefore, may be called acids with as much propriety as the yellow oxide of tungsten.

The affinities of this oxide, as far as they have been ascertained, are as follows:

Lime, Soda, Barytes, Ammonia.

Magnesia, Barytes, Magnesia, Alginate, Potass, Zirconia.

The manner in which it was produced is evident: tungstic acid is composed of oxygen and tungsten; the oxygen combined with the carbon, and left the metal in a state of purity.

TUNICA, a kind of waistcoat or undergarment, in use amongst the Romans. They wore it within doors by itself, and abroad under the gown. The common people could not afford the toga, and so went in their tunics, whence Horace calls them populius tuniciata.

The several sorts of the tunica were the palama, the angustiaca, and the laticavia. The first was worn by generals in a triumph, and perhaps always under the toga picta; it had its name either from the great breadth of the clavi, or buttons, equal to the palm of the hand; or else from the figures of palms embroidered on it. It was by these three different sorts of tunics, that the three different orders of the Roman people were distinguished by it.

TUNNAGE. See Tonnage.

TUNNY. See Scomber.

TURBITHE, or TURBITHE-ROOT. See Convulvulus.

TURBO, the wreath, in zoology, a genus of insects belonging to the order of vernices testacea. The animal is of the small kind; the shell consists of one spiral solid valve, and the aperture is orbicular. There are 166 species: of which the most remarkable age, 1. The luffore, or periwinkle. This is abundant on most rocks far above low-water mark. The Swedish peasants believe that when these shells creep high up the rocks, they indicate a storm from the south. They are eaten by the poor people in most parts of this kingdom. Young lobsters are said to take up their lodgings in the empty shells of these animals, which has given occasion to a notion that periwinkles are changed into lobsters. But we apprehend the mistake to have originated from the circumstance of the cancer, or sooker-crab, which is a kind of small lobster or shrimp, naturally fleshed, which takes shelter in the cast shells of harboured shell-fish. 2. The clathrus, or barbel wreath, has a taper shell of eight spires, distinguished by elevated
divisions, running from the aperture to the apex. There is a variety pelliculoid, with very thin edges. It is too dense to form a curiously ornamental shell, the winkle-trap. See Plate Nat. Hist. fig. 411.

TURBOT. See Pluronectes.

TURUS, the thrush, a genus of birds belonging to the order of pigeons, they breed, but do not extend to the lower parts to feed on the berries of the mountainash. They migrate in France at the latter season; and appear in small flocks about Monthard in Burgundy, in the beginning of October, but seldom stay above two or three weeks.

To these we shall add the description of the orpheus, or mocking thrush, which is a native of America. It is about the size of a thrush, of a white and grey colour, and reddish bill. It is possessed not only of its own natural notes, which are musical and solemn, but it can assume the tone of every other animal in the wood, from the wolf to the raven. It seems even to sport itself in leading them astray. It will at one time allure the lessers birds with the call of their mates, and then terrify them when they come near with the screams of the eagle. There is no bird in Britain that is more heartless, and there is none that it has not at times deceived by its call. But, unlike such as we usually so famed for mimicking with us, and who have no particular merit of their own, the mocking thrush is by far the most itself. At those times it usually frequents the houses of the American planters; and sitting all night on the chimney-top, pours forth the sweetest and the most various notes of any bird whatever. It would also, if accounts are true, that the deficiency of most observant song-birds in that country is made up by this bird alone. They often build their nests in the fruit-trees about houses, feed upon berries and other fruits, and are easily rendered domestic. See Plate Nat. Hist. fig. 412.

TURIONES, among herbalists, denotes the first young tender shoots, which plants annually put forth.

TURRS. See MELEAGRIS.

TURRICICUS. See Cucumin.

TURMENT, or Turnament, a martial sport, or exercise, which the antient cavaliers used to perform to show their chivalrous courtesy.

TURNERA, a genus of the pentaehria, triginya class of plants, the flower of which consists of five petals obversely coriaded, and sharp-pointed; the fruit is an oval, unicellular capsule, containing a great many oblong and obtuse seeds. There are nine species.

TURNING, the art of forming hard bodies, as wood, ivory, or iron, into a round or oval shape, by means of a machine called a lathe. This art was well known to the ancients, and seems to have been carried by them to a very great degree of perfection; at least, if we believe the testimony of Pliny and several other authors, who tell us, that these precious vessels enriched with figures in relief, which still adorn our cabinets, were turned on the lathe. See Lathe.

The art of turning is of considerable importance, as it contributes essentially to the perfection of many other arts. The architect uses it for finishing the cornices of his halls and without finished houses. The mathematician, the astronomer, and the natural philosopher, have recourse to it, not
only to embish their instruments, but also to give them the necessary firmness and precision. In short, it is an art absolutely necessary to the goldsmith, the watchmaker, the joiner, and the smith.

Turning is performed by the lathe, of which there are various forms and several instruments, as gouges, chisels, drills, formers, and screw-taps, used for cutting what is to be turned into its proper form as the lathe turns round. See Plate Mixed, fig. 131; and Plate Lamp, figs. 6, &c.

The lathe should be fixed in a place very well lighted; it should be immovable, and neither too high nor too low. The puppets should neither be so low as to oblige the workman to stoop in order to see his work properly, nor so high that the little chips, which is continually driving off, should come into his eyes.

The piece to be turned should be rounded, (if it is wood) before it is put on the lathe, either with a small lathe made for the purpose, or with a plane, or with a file, fixing it in a vice, and shaving down till the piece is where almost of an equal thickness, and leaving it a little larger than it is intended to be when finished off. Before putting it on the lathe, it is also necessary to find the centres of its two end surfaces, and that they should be exactly opposite to each other, that when the pieces of the puppets are applied to them, and the piece is turned round, no side may belly out more than another. To find these, by putting a piece of wood to be turned upon a plank; open a pair of compasses to almost half the thickness of the piece, fix one of the legs in the plank, and let the point of the other touch one of the ends of the piece, brought into the same plane with the plank on which the compasses are fixed, and very near the fixed leg. Describe four arches on that end at equal distances from each other, at the circumference of the end, and one another within; the point of intersection is the centre of the end. In the same manner must the centre of the other end be found. After finding the two centres, make a small hole at each of them, and insert there two pieces of the puppets, and fix the piece so firmly as not to be shaken out, and yet loose enough to turn round without difficulty.

The piece being thus fixed, it is necessary in the next place to adjust the cord, by making it pass twice round the piece, and in such a manner, that the two ends of the cord, both that which is fixed to the spand and to the footboard, come off on the side on which the turner stands, that the piece may move against the edge of the cutting-tool and be turned. If the lathe is moved by a wheel, the manner of adjusting the cord needs no direction.

If the workman does not chance to be at the trouble to find the two centres of the piece in the manner described above, let him lay, as nearly as he can, the centre of one end upon the point of the left hand puppet, and then let him push forward the right hand puppet, striking it with a mallet till its point is in the centre of the other end of the piece; and then fixing the right hand puppet by a gentle blow of the mallet on the key, let him turn round the piece to see by the eye if the centres have been properly found. If any part of it bullies out, let him strike that part gently with the mallet, and it will correct itself. He should strike one of the puppets pretty smartly to drive the points into the piece, and afterwards fix the puppet by striking the key. If the workman cannot judge by the eye whether the piece is turning properly round its centres or not, he should apply gently the point of an instrument called a triangular graver, leaning it on the rest, and it will mark by a fine line the place where the piece is out of its centre; and by striking this line with a mallet, the piece can easily be placed properly. The rest, of which we have just spoken, ought to be placed upon the two arms of the lathe, and fixed with screws as near the piece as the workman pleases.

The piece being fixed between the two points of the puppets, the cord adjusted, and the rest fixed as near the work as possible without touching it; the workman is now to take a gouge of a proper size in his left hand, and hold it by the handle a little inclined, keeping the back of the hand lowermost. With his right hand, the back of which is to be turned upwards, he is to grasp it near the lower end, and when leaning the gouge on the rest, he is to present the edge of it a little higher than the horizontal diameter of the piece, so as to form a kind of tangent to its circumference; then putting the gouge on the footboard, and turning round the wheel, and holding the gouge firmly on the rest, the piece will be cut nearly in the same manner are the chisels, formers, and other instruments to be used, with the same care, and the operation of the piece by the instrument shall not be pushed improperly, sometimes stronger than at others; and taking care also, that the instrument used does not follow the work, but that it is kept firmly in the hand without yielding.

The young turner ought to endeavour to acquire the management of the gouge and the chisel, which are the instruments by far most necessary in this art; by them, almost entirely, are the soft woods turned; as for hard woods and other things, as box, ebony, horn, ivory, and the metals, they are hardly ever turned except by shaving off. In that case gravers are to be used with square, round, or triangular mouth. They should be held horizontally while applied to the wood, and not obliquely as directed for the gouge and the chisel.

After the work is completely turned, it is next to be polished, and this cannot be done with the instruments hitherto mentioned. Soft woods, as pear-tree, hazel, and maple, ought to be polished with a very soft Dutch or French rushes. There are different species of sharks; some of which have a grayish, others a reddish skin. Shark skin is always the better to be a good deal used; at first it is too rough for polishing. The Dutch rush is the equinoctial hydram of Limnes, which grows in most places among mountains. It is remarkable for having flinty particles in the substance of its leaves, which render it so useful for polishing. The Dutch rush is the material of a writing-pen. The oldest plants are the best. Before using them they should be moistened a little; otherwise they break in pieces almost immediately, and render it exceedingly difficult to polish with them. They are particularly desirable for glass, brass, iron, wooden figures, &c.; after having cleaned up the piece well, it should be rubbed gently either with wax or oil; then wiped clean and rubbed with its own filings for a couple of times, or with a cloth a little wet; by so doing, the iron, silver, gold, and brass, are polished with a micaceous easily pounded and put upon feather or a linen cloth a little moistened: with this the piece is rubbed as it turns round on the lathe; and to prevent any dirt from adhering to any part of it, every now and then it is rubbed gently with a small brush dipped in water. To polish very finely, the workman make use of tripoli, and afterwards of putty or calx of tin. Iron and steel are polished with very fine powder of emery; this is mixed with oil, and put between two pieces or very tender wood, and then the iron is rubbed with it. Tin and silver are polished with a burnisher, and that kind of red stone called in France saugine dune. They may be polished also with putty, putting it dry on shonamy-skin or with the palm of the hand.

To succeed in turning iron, it is necessary to have a lathe excessively well fixed, and the puppets, and exceedingly well fixed. The puppets should be short, and the rest well fixed very near the work; the back of the rest should be two or three lines lower than the iron to be turned.

The lathe and other instruments being prepared, it is necessary to determine the length and thickness of the iron to be turned according to the design which is to be executed, and to make it as thick of a stick as is the more convenient. In this case the importance is, that the iron being forged according to the model, it should be annealed, that is, heated red hot, and allowed to cool slowly on the coals till the foot goes out of itself. Some people, to soften the iron, cover it over with clay and allow it to cool. The iron cylinder being thus made, it is next to be put upon the lathe, finding the centres as formerly directed, and boring a small hole in them that the iron may not escape from the points.

The points should be left from time to time to prevent their being excessively heated and spoiled while the iron is turning. A crotchet is then to be applied to the iron, it is then to be turned a little above its centre, pretty gently, and by this means the inequalities of the cylinder will be taken off. Other instruments are then to be applied to round the iron according to the model; and whenever any of them grow hot, they are to be plunged into a bason of water lying beside the workman. If the iron, after being properly turned, is to be bored like a pen-point, one of the brass points is to be substituted in its place having a square hole through it, into which the collar of the iron is to be fixed firmly, so as not to shake; then borers are to be applied, like those
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which locksmiths use to bore keys; and beginning with a small one, and afterwards taking larger ones, the hole is to be made as wide and deep as necessary; great care must be taken to support the piece firmly in the rest, otherwise there is danger of boring the hole straight. The borer must be withdrawn from time to time to oil it and to clean the hole. Since it is difficult to make a hole quite round with borer alone, it is necessary to have also an instrument a good deal smaller than the hole, one of the sides of which is sharp, very well tempered, and a little hollow in the middle. This instrument being fixed in a p'ty long handle, is to be applied with steadiness to the inner surface of the hole, and it will entirely remove every inequality that may have been there before its application.

For turning ovals, a lathe of somewhat a different construction is used. The axis or spindle, having on it the pulley over which the band-cord passes for turning the lathe, is fixed between the two puppets so as to turn round end of it passes through one of the puppets, and to it is firmly fixed a circular plate of brass, so that it turns round along with the spindle. Upon this plate two broad segments of circles are fastened, the circumference of which correspond to the circumference of the plate; their chords are parallel, and equally distant from the centre of the plate, so that they leave a distance between them. They have a groove in each of them, in which these grooves another plate is placed, which exactly fills up the space between the two grooves, but is shorter than the diameter of the larger circular plate on which it is laid. This plate is made to slide in the grooves. To its centre is annexed a short spindle, on which the piece of wood to be turned is fixed. When the lathe is set a going, the circular plate moves round, and carries the piece along with it; the plate of brass on which the piece is fixed, being fixed loosely in the grooves already described, slides down a little every time that the grooves become perpendicular to the floor (and there are particular contrivances to proceed with in the lathe so far), and by these two motions combined (the circular one of the large plate, and the straight one of the small), the circumference of the piece of wood to be turned necessarily describes an oval; and gores or other tools being applied in the usual manner, supported on the rest, it is cut into an oval accordingly. The small plate may be made to slide either more or less in the grooves; and by this contrivance the transverse diameter of the oval, or rather ellipse, may be made longer or shorter at pleasure. Another, and still simpler method if possible, of turning ovals, is this: Take two ovals of metal, exactly of the size of the oval which you intend to make; fix them firmly on the spindle of the lathe, so as to turn round with it; fix between them the wood to be turned, and then it is easy, by the help of chisels and other tools, to cut it, as the borer goes, into exactly the figure of the external avals. Or an oval may be formed by placing the wood, or whatever is to receive that shape, obliquely on the lathe. There are several other ingenious methods of turning, but these shall not detain us any longer on them. We shall therefore conclude this article with a number of receipts, which every turner ought to know.

1. The method of moulding boxes both of shell and horn. In the first place, form a proper piece of wood of any size, or pieces, viz., of a circle about half an inch thick, which should slope a little in order to draw out the moulded shell the more easily; and a ring fitted to the outside of the circle, so that both together make the shape of a box. These two pieces being adjusted, it is necessary to round the shell to be moulded of such a size, that when moulded, it will be a little higher than the ring of the mould, that there may be no deficiency. The mould is then to be put into a press on a plate of iron, exactly under the screw of the press; put then the shell upon the circle of the mould, so that its centre also is exactly opposite to the screw of the press; then take a piece of wood formed into a truncated cone, and not so thick as the diameter of the circle of the mould, nor so deep as the ring; then put a plate of iron above the cone, and screw down the press gently, and cautiously till the whole is well fast; then, plunge the whole into a cauldron of boiling water placed above a fire. In eight or ten minutes the shell or horn will begin to soften; screw the press a little more; then the wooden cone may sink into the softened shell; repeat this from time to time till the cone is quite sunk in the mould; then take out the press and plunge it into cold water. When it is cold, take the box from the mould, and put it into the incinerator, or it a new mould of exactly the form you wish the inside of the box to be; do the same with the outside, put it again into the press, and plunge it into boiling water; screw the press gradually till the box is fashioned as you desire.

2. Method of preparing green wood so that it will not split in the turning. Having cut your wood into pieces of a proper size, put it into a vessel full of a mixture of wood ashes. Boil it for a few hours, then take it from the vessel, and rub it with pulp of pine-stone; repeat this process a second time, and then rub the wood with the following composition: Put into a glazed earthen vessel a pint of strong vinegar, two ounces of fine filings, and half a pound of pounded galls, and allow them to inton[e] for three or four hours on hot cinders. At the end of this time augment the fire, and pour into the vessel four ounces of copperas (sulphat of iron), and a choping of water having half an ounce of borax and as much indigo dissolved in it; and make the whole boil till a froth rises. Rub several layers of this upon your wood; and, when it is dry, polish it with leather on which you have put a little flour of whiting.

3. Method of giving to plum-tree the colour of Brazil wood. Slack lime with urine, and bedaub the wood over with it while it is hot; allow it to dry; then take off the coat of lime, and rub it with chamois-skin well daubed with olive-oil, and then having a quantity of alum dissolved in it, five or six hours, keep lukewarm during a night; and when it is dry, rub it, as before directed, with chamois-skin well oiled.

4. Method of giving a fine black colour to wood. Steep your wood for two or three days in lukewarm water in which a little alum has been dissolved; then put a handful of logwood, cut small, into a pint of water, and boil it down to less than half a pint. If you then add a little indigo, the colour will more resemble that of the layer of that liquor quite hot on your wood with a pencil, which will give it a violet-colour. When it is dry, spread on another layer; dry it again, and give it a third; then boil verdigris at discretion in its own vinegar, and spread a layer of it on your wood; when it is dry, rub it with a brush, and then with oiled chamois-skin. This gives a fine black, and imitates perfectly the colour of ebony.

5. Method of cleaning and whitening bones before using them. Having taken with a saw the useless ends of the bones, make a strong lea of ashes and quick-lime, and into a pailful of this lea put four ounces of alum, and boil the bones in it for an hour; then take the vessel containing the lea off the fire, and let it cool; then take out the bones and dry them in the shade.

6. Method of soldering shells. Clean the two sides of the shells which you wish to join together; then, having joined them, wrap them up in linen folded double and well moistened; then heat two plates of iron pretty hot, that they may keep their heat for some time; and putting your shells rolled up between them under a press, which you must screw very tight, leave them there till the whole is cool, and they will be soldered. If you do not succeed the first time, repeat the process.

7. Method of moulding shells. Put six pints of water into a kettle; add to it an ounce of olive oil, or other oil; make the water boil; then put in your shell, and it will grow soft. Take it out, and put it into a mould under a press, and it will take the figure you want. This must be done quickly; for if you leave it cool, even so little, the process will fail. It will not work under pressure.

8. Method of tingling bones and ivory red. Boil shavings of scarlet cloth in water. When it begins to boil, throw in a quarter of a pound of ashes made from the drags of wine, which will extract the colour; then throw in a little of alum to clear it, and pass the water through a linen cloth. Sweep your ivory or bone in aqua fortis, and put it into the water. If you wish to leave white spots, cover the places destined for them with wax.

9. Method of tinge ivory black. Steep the ivory during five or six days in water of galls, with ashes made with dried drags of wine and arsenic; then give it two or three layers of the same black with which plum-tree is blackened in order to fix it; or dissolve silver in aqua fortis, and put into it a little rose-water. Rub the ivory with this, and allow it to dry in the sun.

10. Method of hardening wood to make pulleys. After finishing the pulley, boil it in a solution of gum in olive-oil, and it will become as hard as copper.

11. Method of polishing wood to make pulleys. After finishing the pulley, boil it in a solution of gum in olive-oil, and it will become as hard as copper.

12. To make Chinese varnish. Take of

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gam-lac in grains four ounces; put it into a strong bottle with a pound of good spirit of wine, and add about the bulk of a hazel-nut of camphor. Allow them to mix in the sun, or on the hot embers for twenty-four hours, shaking the bottle from time to time. Pass the whole through a fine cloth, and throw away what remains upon it. Then let it settle for twenty-four hours, and you will find a thick layer of the upper part of the bottle, which you must separate gently and put into another vial, and the remains will serve for the first layers.

TURPNIKE, a gate set up across a road, watched by an officer for the purpose, in order to stop travel, vagrants, coaches, &c. to take toll of them towards repairing or keeping the roads in repair.

Justices of the peace, and other commission- ers, are authorised to appoint surveyors of the roads, and collectors of toll. In case any persons shall drive horses or other cattle through runways, to the highways, or to the turnpikes, they are liable to forfeit 10s. Likewise if any one assails a collector of the tolls, or by force passes through a turnpike-gate without paying, he is liable to forfeit 5l. leviable by justice of peace; and maliciously pulling down a turnpike is deemed felony, &c. It is also enacted, that 20s. shall be paid for every hundred that a carriage with its loading weighs above 6000 pounds weight, and that the fines may be set up at turnpikes for weighing such carriages.

TURPENTINE. See Pines, and RESINS.

TURRET, a genus of plants of the class and order decandria monogynia. The calyx is one-leaved, bell-shaped, five-toothed, very small, permanent. There are five species, shrubs of the East Indies.

TURTURIS, tuer-mustard, a genus of the tetradynamia silicosa class of plants, with a tetrapetalous flower; its fruit is an extremely long pod, containing numerous seeds. There are eight species. See Architecture.

TUSCULANO, colis foot, a genus of plants of the class symgenia, and order polyanisia superius; and in the natural system ranging under the 49th order, composita. The receptacle is naked; the pappus simple; the scales of the calyx equal, of the same height as the disk, and somewhat membranaceous. There are fourteen species, three of which are indigenous to Britain, the farfara, hybrid, and petasites. The farfar, or common calf's-foot, grows plentifully on the banks of rivulets, or in moist and clayey soils. The leaves were formerly smoked in the manner of tobacco, and a syrup or decoction of them and the flowers stands recommended in colds and other disorders of the breast and lungs. It seems now to be almost entirely rejected. The downy substance under the leaves, boiled in a lixivium with a little saltpetre, makes excellent tinder. The petals, or corolla, are detached in two orders in the Calyx, and are of different shapes. The leaves are the largest of any plant in Great Britain, and in heavy rains afford a seasonable shelter to poultry and other small animals. The root dug up in the spring is resinous and aromatic.

TYPANTUM, or Typan, in mechanics, a kind of wheel placed round an axis or cylindrical beam, on the top of which are two levers or fixed staves, for the more easy turning of the axis, in order to raise a weight required. The tympanum is much the same with the peritrophicus, but that the cylinder of the axis of the peritrophicus is much shorter, and less than the cylinder of the tympanum.

TYPANTUM OF A MACHINE, is also used for a hollow wheel, wherein one or more people, or other animals, walk to turn it; such as that of some cranes, calenders, &c.

TYPE, a copy, image, or resemblance of some model. This word is much used among divines, to signify a symbol, sign, or figure of something to come.

TYPE, among letter-founders and printers, the same with letter.

TYPES FOR PRINTING. In the business of cutting, casting, &c. letters for printing, the letter-cutter must be provided with a file, hand-vise, hammers, and files of all sorts for watchmakers' use; as also gravers and sculpters of all sorts, and an oil-stone, &c. suitable and sizeable to the several letters, to be cut: a flat gage made of box to hold a rod of steel, or the body of a mould, &c. exactly perpendicular to the flat of the using file: a sliding-gage, whose use is to measure and set off distances between the shoulder and the tooth, and to mark off from the end, or from the edge of the work; a face-gage, which is a square notch cut with a notch into the body of the piece of steel, iron, or brass, of the thickness of a piece of common tin, whose use is to proportion the face of each sort of letter, viz. long letters, ascending letters, and short letters. There must be three gages, and the gage for the long letters is the breadth of the whole body supposed to be divided into 42 equal parts. The gage for the ascending letters, Roman and
The founder must now be provided with a ladle, which differs nothing from other iron ladles but in its size; and he is provided always with ladles of several sizes, which he uses according to the size of the letters he is to cast. Before the caster begins to cast, he must kindle his fire in the furnace to melt the metal in the pan. He therefore takes the pan out of the hole in the stone, and there lays in coals and kindles them; and, when they are well kindled, he sets the pan in again, and puts metal into it to melt; if it is a small-bodied letter it casts, or a thin letter of great bodies, his metal must be very hot; may sometimes red-hot, to form a better circle. As soon as his ladle that holds about as much as the letter and break is, he lays it at the tucking hole, where the flame bursts out, to heat. Then he ties a thin leather, cut with its narrow end against the face to the leather-groove of the matrices, by whipping a brown thread twice about the leather-groove, and fastening the thread with a knot. Then he puts both halves of the mould together, and puts the runners and discs in and places the foot of the mould on the stool of the mould, and the broad end of the leather upon the wood of the upper half of the mould, but not quite up, lest it might hinder the foot of the matrices from sinking close down upon the stool in a train of work. Then laying a little resin on the upper wood of the mould, and having his casting-ladle hot, he puts the boiling side of it on the mould, and, while it is yet melted, he places the broad end of the leather hand down on the wood, and so fastens it to the wood: all this is the preparation.

Now he comes to casting: in the performance of which, placing the under half of the mould in his left hand, with the hook or hag forward, he clutches the ends of its wood between the lower part of the half of his thumb and his three hind fingers; then he lays the upper half of the mould upon the under half, so that the male gages may fall into the female gages, and at the same time the foot of the matrix places itself upon the stool; and, clasping his left-hand thumb strong over the upper half of the mould, he nimly catches hold of the bow or spring with his right-hand fingers at the top of it, and his thumb under it, and raising the handle of the notch in the backside of the matrices, pressing it as well towards the mould as downwards by the shoulder of the notch close upon the mould, with the same time with his handi-est and the deepest part of the mould towards he ball of his thumb, and thrusts by the ball of his thumb the upper part towards his fingers that both the registers of the mould may press against both sides of the matrix, and his thumb and forefinger press both halves of the mould close together.

He then takes the handle of his ladle in
right hand, and with the ball of it gives a stroke, two or three, outwards upon the surface of the molten metal, to scum or clear it from the film or dust that may swim upon it; then takes the half of a metal, and having his mould in his left hand, he a little twists the left side of his body from the furnace, and brings the heat of his ladle (till of metal) to the mouth of the mould, and twists the upper part of his hand towards him to turn the metal into it, while at the same moment of time he jits the mould in his left hand forwards, to receive the metal with a strong shake (as it is called), not only into the body of the mould, but while the metal is yet hot running, switl and strongly, into the very face of the matrixe, to receive its perfect form there, as well as in the shank.

He then takes the upper half of the mould of the under half, by placing his right hand thumb on the end of the wood next his left hand, and his two middle-fingers at the other end of the wood; and finding the letter and break lie in the under half of the mould (as most commonly by reason of its weight does), he throws or tosses the letter, break and all, upon a sheet of waste paper laid for that purpose on the bench, just a little beyond his left hand, and is then ready to cast another letter as before: and also, the whole number that is to be cast with that matrixe.

A workman will ordinarily cast about three thousand of the latter towards day.

When the casters at the furnace have got a sufficient number of types upon the tables, a set of boys come and nimblly break away the jets from them: the jets are thrown into the pots, and the types are carried away in parcels to other boys, who pass them swiftly under their fingers, deteled by leather, upon smooth flat stones, in order to polish their broad-sides.

This is a very dexterous operation, and is a remarkable instance of what may be effected by the power of habit and long practice; for these boys, in turning up the other side of the type, do it so quickly by a mere touch of the fingers of the left hand, as not to require the least perceptible intermission in the motion of the right hand upon the stone. The types, thus finely smoothened and flats, are on the broad-sides, are next carried to another set of boys, who sit at a square table, two on each side, and are ranged up on long runners or sticks, fitted with a small projection, to hinder them from slipping off backwards. When the sticks are so filled, they are placed, two and two, upon a set of wooden pins fixed into the wall, near the dresser, sometimes to the amount of a hundred, in order to undergo the finishing operations. This workman, who is always the most expert and skilful in all the different branches carried on at the foundry, begins by taking one of these sticks, and, with a peculiar address, slides the whole column of types off upon the dressing-stick:

this is made of well-seasoned mahogany, and furnished with two end-pieces of steel, a little lower than the body of the types, one of which is moveable, so as to approach the other by means of a long screw-pin, inserted in the end of the stick. The types are put into this stick with their faces next to the back or projection; and after they are adjusted to one another so as to stand even, they are then bound up, by screwing home the moveable end-piece. It is here where the great and requisite accuracty of the moulds comes to be perceived: for in this case the whole column, so bound up, lies flat and true upon the stick, the two extreme types being quite parallel, and the whole has the appearance of one solid continuous plate of metal. The least inaccuracy in the exact parallelism of the individual type, when multiplied so many times, would render it impossible to bind them up in this manner, by disposing them to rise or spring from the stick by the smallest pressure from the screw. Now, when lying so conveniently with the narrow edges uppermost, which cannot possibly be smoothed in the manner before mentioned by the workman does this more effectually by scraping the surface of the column with a thick-edged but sharp razor, which at every stroke brings on a very fine smooth skin, like polished silver; and thus he proceeds till in about half a minute he comes to the farther end of the stick. The other edges of the types are next turned upwards, and polished in the same manner. It is whilst the types thus lie in the dressing-stick, that the operation of hearing or breaking in is performed, which is effected by running a plane, faced with steel, along the shoulder of the body next to the face; which takes more or less off the corner, as occasion may require it. Whilst in the dressing-stick they are also grooved, which is a very material operation. In order to understand this, it must be remembered, that when the types are first broken off from the jets, some superficial metal always remains, which would make them bear very unequally against the paper whilst under the printing-press, and effectually mar the impression. That all these inequalities may, therefore, be taken away, and that the bearings of every type may be regulated by the shoulders impaled to them all alike from the mould, the workman or dresser proceeds in the following manner: The types being screwed up in the stick as before mentioned with the jet end uppermost, and projecting beyond the wood about one-eighth of an inch, the stick is put into an open press, so as to present the jet-end uppermost, and thus every thing is made fast by driving a long wedge, which bears upon a slip of wood, which lies close to the types the whole length; then a plough or plane is applied, which is so constructed as to embrace the projecting part of the types betwixt its long sides, which are made of polished iron. When the plane is thus applied, the steel cutter bearing upon that part between the shoulders of the types where the inequalities lie, the dresser dexterously glides it along, and by this means strips of every irregular part that comes in the way, and so makes an uniform groove the whole length, and leaves the two shoulders standing; by which means every type becomes precisely like to another, as to the height against paper. The types being now finished, the stick is taken out of the press, and the whole column replaced upon the other stick; and after the whole are so dressed, he proceeds to pick out the bad letters previous to putting them up into pages and papers. In doing this he lays the range into his left hand, and turning the faces near to the light, he examines them carefully; and whenever an imperfect or damaged letter occurs, he Nimby plucks it out with a sharp bodkin, which he holds in the right hand for that purpose. Those letters which, from their form, project over the body of the type, and which cannot on this account be rubbed on the stones, are scraped on the broad-sides with a knife or file, and some of the metal next the face pared away with a pen-knife, in order to allow the type to come close to any other. This operation is called kerning.

The excellence of printing-types consists not only in the due performance of all the operations above described, but also in the hardness of the metal, form, and true proportion of the character, and in the exact bearing and ranging of the letters in relation to one another. See PRINTING.

TYPOHA, cat's-tail, a genus of plants of the class monocotyledon, and order triandra; and in the natural system ranges under the 3d order, calmaria. The amentum of the male flower is cylindrical; the calyx is scarcely distinguishable; there is no corolla. The female has a cylindrical amentum below the male; the calyx is composed of villous hair; there is no corolla, and only one seed fixed on a papillary papus. There are two species, both natives of Britain; the latifolia and angustifolia. 1. Latifolia, great cat's-tail, or reed mace, is frequent in bogs and ditches. The stalk is six feet high, the leaves a yard long, jayndly an inch wide, convex on one side: the amentum, or cylindrical club, which terminates the stalk, is about six inches long, of a dark-brown or fuscous colour. Cattle will sometimes eat the leaves, but Schreber thinks them poisonous: the roots have sometimes been eaten in salads, and the down of the ament used to stuff cushions and mattresses. Limus or Russian cats-tail, is found in ponds and ditches. The leaves are semi-cylindrical, and the male and female spikes are remote and slender.

TYPOGRAPHY. See PRINTING.
U,
or V, the twentieth letter of our al-
phabets. In numerals V stands for five;
and with a dash added at top, thus V, it sig-
nifies five thousand. In abbreviations,
amongst the Romans, V. A. stood for Vete-
ranis assignati; V. B. viro bono; V. B. A. viri
boni arbitratu; V. B. F. vir bona fide; V. C.
vir consularis; V. C. C. F. vale, con-
pujx charissimus, felixiter; V. D. D. veto de-
dicatur; V. G. verbi gratia; Vr. Ve. virgo
vestalis; VL votidieci; V. N. quinto nonu-
rum.

VACCINATION, in law, is the whole time
between the end of one term and the begin-
ing of another.

This word is also applied to the time from
the death of a bishop, or other spiritual per-
son, till the bishopric, or dignity, is supplied
with another.

VACCINATION. Inoculation with the
vaccine virus, for the purpose of securing
against the infection of the small pox.

This subject cannot fail to " come home to
the business and bosom" of every one; for
where is the individual of such slender con-
nection or limited sympathies, as to be indif-
ferent to a question which "involves the
lives annually of 40,000 in Britain alone,"
and of the same proportion throughout the
civilized world?

It would be superfluous, then, to apologize
for making the vaccine controversy a subject
of separate and prominent discussion.

We shall first lay before our readers a ge-
neral history of the circumstances which led
to the introduction of the new, as a substi-
tute for the old, inoculation; we shall then
enumerate the advantages which vaccination
lays claim to, canvass the objections which
have been made to the admission of such
claims, and conclude by describing the gen-
eral characteristics of perfect, and marks de-
noting spurious, cow-pock infection.

It is scarcely necessary to acquaint any
reader by whom the first public proposal was
made respecting the cow-pox inoculation.
Dr. Jenner, while employed in the practice
of surgery in a district of Gloucestershire,
was surprised to find that many individuals
whom he was called upon to inoculate, re-
sisted every attempt to infect them with the
small-pox virus. Upon enquiring into the
occasion of this extraordinary immunity, he
learnt that those in whom it existed had pre-
viously undergone a disease contracted by
milking cows affected with a peculiar erup-
tion on their teats. "It appeared (says
Dr. Jenner) that this disease had been known
among the dairy-maids from time immemo-
rial, and that a vague opinion prevailed that
it was a preventive of the small pox. This
opinion I found was comparatively new
among them; for all the old farmers declar-
ed they had no such idea in their early days:
a circumstance which seemed easily account-
ed for, from my knowing that the common
people were formerly rarely inoculated for the
small pox, till that practice was rendered gen-
eral by the improved method introduced by
the Suttons; so that the working people in
the dairies were seldom put to the test of the
preventive power of the cow-pox."

In prosecuting his enquiries, Dr. Jenner found it to
be an unanimous opinion among medical prac-
titioners in the neighbourhood, that the dis-
ease thus contracted from the cow was by no
means to be relied on as a security against va-
rilous infection; an opinion which he was at
first concerned to find apparently well found-
ed by the occurrence of the latter, in some
individuals, who had been, as was imagined,
supplied to the former.

This discouraging circumstance, although it
angered the ardour of Dr. Jenner, did not oc-
casion the abandonment of his investigation:
and he was shortly gratified in ascertaining
that the cow was subject to several varieties
of eruption on her teats, all capable of pro-
ducing ulcerations on the hands of the mil-
kers, but not of insuring against the infection
of small pox. This discovery removed the
great obstacle to his interesting research, and
our experimentalist was the first to distin-
guish and divide the genuine from the spuri-
ous cow-pox.

His expectations of success were a second
time impalpable, by finding that even among
those who had been infected with the genu-
ine virus, some were afterwards obnoxious to
the small-pox contagion; and this difference
of subsequent susceptibility was even witness-
ed in different individuals who had received
the infection from the same animal.

It required no common share of persever-
ance still to abide by the object of pursuit af-
ter this seemingly almost insurmountable im-
pediment to success. Dr. Jenner, however,
was engaged in an undertaking of too much
magnitude and moment to abandon it, unless
from absolute necessity, and he still per-
severed.

It occurred to him that the specific prop-
erties of the cow-pox matter might vary with
its progressive changes after secretion; and
putting this likewise to the test of experi-
ment, the result coincided with his conjec-
ture, affording an explanation of this second
anomaly equally clear and satisfactory with
the former. He found, by repeated trials,
that the genuine or preventive disease was
only capable of being engendered by the mater-
ial from the ulcer in its earliest stages:
that when from continuance it had undergone
certain decompositions, it was no more capa-
ble of producing the true cow-pox than the e-
ruptions of which we have already spoken.
With these restrictions, Dr. Jenner found that
the immunity, from the variolous occasioned
by the vaccine infection was for life; at least
individuals without any effect were subjected
to the former after the lapse of 15, 27, and
even 50 years from the latter infection.

During this very curious and important in-
vestigation, Dr. Jenner was struck with the
idea that the preventive he had discovered of
small-pox contagion might be propagated
from one individual to another in the manner
of variolous inoculation, and for this supposi-
tion it does not seem improper to notice that
he had, in one sense, the authority of analo-
gy beyond that which could be claimed by
the first ingrafters of variola; for the natu-
ral vaccine distemper is itself produced by
a species of inoculation, which it is well known
is by no means the case with the natural
small pox.

We have stated this circumstance not from
a desire to prejudice the question of the com-
parative merits of the variolous and vaccine
diseases. It is the duty of every one, it is
our especially and officially, to state argu-
ments and facts as we find them, whether in-
trinsic, or in favour of, either one or the
other practice.

In pursuance of the plan we have above
laid down, we now proceed to give as con-
crated a view as possible of the supcrior
advantages contended for by the advo-
cates of inoculation for the cow-pox.

These we shall principally extract from a
popular work on vaccinia, by Dr. Thornton,
and of the most ardent and effective support-
ers and propagators of the new discovery.

1. It is maintained that the constitutional
affection which cow-pox produces, is incom-
parably milder than that from variolous in-
oculation. The proportion of deaths from
inoculated small pox is stated by Dr. Willan
to be 1 in 230. The zealous antivaccinators
have denied it to be greater, under judicious
treatment, than 1 in 1000. In the pre-
zent, as in other instances, we leave the
reader to select his own authority. We have
only to add, that we believe the mortality at
all of the vaccine distemper, in an immate-
direct manner, has not been contended for.
This first proposition, then, in favour of
the vaccine disease, is amply contested.

2. The cow-pox never disfigures the cou-
ument. Of this, likewise, there is no dis-
pact, as it refers to the distemper merely;
indisputably of the supposed consequences of
it, which we are shortly to convey.

3. The cow-pox may be introduced into
the system without any apprehension of con-
sequences, under circumstances which render
even the inoculated small pox, in some measure,
dangerous, such as the periods of teething, of
pregnancy, and of advanced age. The pro-
position we believe to be likewise too well
founded, and generally admitted to need sub-
stantiating by examples.

The cow-pox inoculation does not, like
that of the small pox, disseminate the disease
VACCINATION.

It is not infectious. This is a most material circumstance in favour of the new inoculation; and is an undisputed fact that the mortality of small pox has increased since the adoption of an artificial mode of communicating it, though many individuals have profited by inoculation, it has produced more lives in the aggregate, than it has preserved; and has aggravated the sufferings of those who have been compelled to employ it, in a greater degree than it has relieved those who have avoided them.

5. The cow-pock does not leave any bad umours after it.

6. "Its security, as a prophylactic against small pox, is equal to the small pox itself, neither natural nor inoculated."—Thomson.

Under these six heads we believe that we have included all the benefits which are stated or implied to have resulted from the Jennerian practice by its several advocates; and we apprehend it only in the two last particulars that any material difference of sentiment now prevails among those who are still adverse to vaccine inoculation. It seems to us to be a gratuitous concession that, for the reasons now stated, Jenner's discovery, from an apprehension of an unjustifiable interference with the decree of Providence, we should not only be compelled likewise to abandon various inoculations, but we ought to be prepared to retard the progress of fever, of mitigating the violence of pain, or of extracting a carbuncle.

It is then the two last propositions which demand a separate and particular investigation.

First, Does the cow-pock engender other diseases? or, in the phraseology before used, does it leave any humours after it?

It is necessary to observe, that those gentlemen who have opposed against inoculation, and who have introduced other diseases, have described these affections to be principally cutaneous. Now those who aver that this is an absolute misrepresentation; and that so far from the cow-pox engendering the above mentioned diseases, the number of scrofulous and cutaneous disorders which have followed upon the small pox, naturally and artificially introduced, are in a greater proportion than those which have happened posterior to vaccine inoculation: are much more numerous than the advocates for the contrary side of the question. On this ground, then, the inference from every principle of reasoning would be drawn by an impartial judgment in favour of vacination; but not, we hope, by the antivaccinists, who are constituted as irregular or unfair, to appeal on this to a particular authority, viz. Dr. Willan, who, if he has no title to be considered as "the oracle of the metropolis in all cutaneous diseases," has unquestionably a right to speak on this head "as one having authority." This gentleman asserts that no new disorders have been introduced since the discovery of vaccine inoculation, and that the cutaneous affections which had been previously prevalent have in no measure increased in virulence. But Dr. Willan, it will perhaps be urged, may be a prejudiced, and therefore an incorrect judge. Aware of the possibility of such an objection to the practice merely in order to authorize his assertion, but has inserted in his treatise Dr. Bateman's extract from the register of patients at the public dispensary in London.

In the year 1797, before the publication of Dr. Jenner's enquiry, the total number of diseases was 1730; the number of chronic cutaneous eruptions was 82. In 1798, total number of diseases 1863; chronic cutaneous eruptions 82. In 1804 the proportions are 135—29. In 1805, 190—16. We distinctly state the same proportion, our author adds, may be deduced on comparing Dr. Murray's, Dr. Reid's, Dr. Walker's, and my own reports on diseases in London for the last ten years: and these, it may be added, were made without any reference to the vaccine controversy. Ought, then, the individual cases brought forward by the gentlemen opposed to vaccination to outweigh, or even balance, the contrary evidence above adduced? Here again, we leave the reader to make his own inference.

If it should be urged that we have not brought forward the cases opposed to vaccinia, it is answered, neither have we adduced the more numerous instances which make against the various inoculations. In fact, the uncertainty of medical evidence forbids any satisfactory conclusion but that which is deduced from comparison on a large and general scale.

It would be, however, doing injustice to the cause of vaccination, to omit the following statements from Mr. Trye, surgeon to the Gloucester infirmary: 1st. "A more healthy description of human beings does not exist, nor more free from chronic cutaneous impurities, than those which suffer most from cow-pox, by reason of their being employed in dairies.

2d. "The Gloucester infirmary, one of the largest provincial hospitals, is situated in a county in which accidental cow-pox has been prevalent from time immemorial. Many hundreds among the labouring people have had the cow-pox since the establishment of that institution, and more severely than generally the case in artificial vaccination; and yet not a single patient in half a century, has applied to the infirmary for relief of any disease, local or constitutional, which he or she imputed or pretended to trace to the cow-pox. And let it be repeated and remembered, that the artificial in no respect differs from the accidental cow-pox, except in being generally less virulent."

But the most momentous question still remains to be discussed. Does the cow-pock afford a permanent security against various infections?

Towards the decision of this point it will be found of essential consequence to revert to the two obstacles which we have already stated, as having presented themselves to Dr. Jenner in the commencement of his investigation.

While the reader retains this in mind, he will readily, we think, perceive the self-evident conclusion contained in the following remarks of Dr. Rowley: "No other questions are admissible in vaccination than, Have the parties been inoculated for the cow-pox? Yes. Have they had the small pox afterwards? Yes. As to how, when, where, whether the cow-pox tool, was genuine or spurious, or any arguments, however specious, as pretences for doubts or failures, they are evasive or irrelevant to the question. They may confound fools, but do not heighten the credit of vaccination."

On this declaration it has been forcibly remarked, that "it would be less absurd to convict a jury in a trial for murder, that the only question was, whether a pistol had been fired or not; and that it was of no consequence to inquire whether it was loaded with ball, or whether the sufferer had died of a pistol-shot."

After what we have already stated respecting those emulations which have been indiscriminately thought the same as the true vaccine disease, and of the changes which the cow-pox matter is itself susceptible of, we think our readers will unite in opinion with us, that the only questions to interest are genuine or spurious cow-pox, "the how, the when, and the where" the parties were inoculated, are material points to ascertain, as preliminary steps to decision respecting alleged failures.

By the further statement which will be given in the sequel, it will be perceived that there are several circumstances necessary to the perfection and absolutely preventive power of vaccine inoculation, which it is by no means unlikely should be overlooked, or unknown to, the inoculators in the early periods of the practice. "During the years 1799 and 1800, vaccine inoculation was performed by ten or twelve thousand persons who had never seen the vaccine pasteure." (Dr. Wil
an.) Now, under these circumstances, we cannot help agreeing with this author that it is rather matter of surprise that the number of unsuccessful cases has proved so comparatively small.

Here it is material to observe, that the majority of those examples which have been brought forward as examples of various, after vaccine disease, have been attended with so much irregularity, that they cannot be considered as instructive to the practice.

This we think, has been rendered evident by the very able and dispassionate examination of Dr. Willan on the progress and termination of the most formidable of such cases as have occurred in and about the metropolis.

But let it be granted to the opponent of vaccination, that several instances have been presented of perfect and regular small pox subsequent to the vaccine disease, equally genuine and regular, "yet still the Jennerian practice must maintain its ground triumphantly, if it can be shown to be as effectual a preventive of small pox as the old inoculation."

Now we think it has been demonstrated beyond the possibility of contradiction, that the number of authenticated cases of small pox after the old inoculation, and even after a former attack of the natural disease, are more numerous in proportion than those that are alleged with any probability of such an event after cow-pox inoculation.

The writer of the article from which we have extracted the above observations, goes on to say: "On the whole, we think there are not fewer than twenty distinct
cases of small pox, occurring a second time in the same subject, each of them authenticated far more completely than any one that has been cited by the adversaries of vaccination. We are persuaded, indeed, that we shall be supported by every impartial person who makes the first step of the whole practice, in saying, that there are not so many as ten cases of small pox, after perfect vaccination, proved in such a way as to be entitled to any sort of attention. Now the medical council, consisting of almost all the great practitioners in London, have reported that nearly as many persons have been already vaccinated in this kingdom, as were ever inoculated for the small pox since the first introduction of that practice; so that if the two cases were exactly upon a footing, the risk of failure seems to be at least twice as great in the small-pox inoculation as that for the cow-pox. And yet who is there in the present day who thinks for a moment of alleging possible insecurity as an argument against variolous inoculation? It may be instructive to state that this argument was however used against the old at the time of its introduction, and was urged much in another connexion by another against the new. Dr. Wilson and others, in their respective treatises, have cited many examples of the mode in which the variolous controversy was carried on, a single one of which our limits will only permit us to extract.

"I fear they may be accounted physicians of no value and worthies of lies, who so confidently tell us what it is impossible for them to know, namely, that they who have tried the experiment (the inoculation for small pox) are for ever thereby secured from any future danger of infection." Page 18, Rev. Mr. Mason's sermon against the dangerous and sinful practice of inoculation.

Against the suggestion of Mr. Goldston, that, although the natural cow-pox may secure from variolous infection, the inoculated disease may be more precarious and uncertain, we think it of common place, that were the variolous and vaccine inoculation to be judged and compared a priori upon the ground of analogy alone, the latter would have the fairest pretensions to prevail; but now that the variolous cow-pox, we have already said, are ingrained upon the system in nearly a similar manner; in the instance of variolous infection, this is not the case. Further, the vaccine matter, whether taken directly from the cow, or from the arm of an inoculated person, produces an affection which is not so generally dissimilar as the ingrained and naturally received small pox; what authority then have we for insisting that the virus undergoes that specific change in the human body, which the theory of Mr. Goldston supposes? If then permanence of security is allowed to the natural (and the admission of this, from a man of such ability and candour as Mr. Goldston, is exceedingly material), we cannot but suppose it repugnant to every principle of analogy, to deny it to the inoculated cow-pox.

It is necessary to remark, that the cases which have been collected and recorded, do by no means serve to strengthen the suspicion of immunity for a given time; for the utmost irregularity has been shown, with respect to the period of variolous subsequent to vaccine infection. "The cases," says Dr. Willam, "which I have had occasion of various eruption, took place without any certain order, from five months to seven years after vaccination. If it is said that the preventative power of the cow-pox ceases after one year, it is quite true that sometimes the exit of a matter in two, or three, and to four years; but experience has fully established the falsity of these assumptions, and the most determined sceptic no longer talks of temporary immunity from variolous inoculation.

To urge the argument farther against the doctrine of partial and limited security, would be, we think, superfluous; unsupported by analogy, and unsustained by fact, it falls more suitably.

We now proceed to extract from Dr. Willam's treatise the characteristics of perfect, and marks of spurious, vaccination.

"Vaccination," says our author, "is accounted perfect, when recent lymph has been carefully inserted beneath the cuticle, in a person free from any contagious disorder; and has produced a small, pearl-coloured vesicle, which, after the ninth day, is surrounded by a red areola, and afterwards terminates in a hard dark-coloured scar.

The form and structure of this vesicle are peculiar; its base is circular, or somewhat oval, with a diameter of about four lines on the tenth day. Till the end of the eigtht day, its upper surface is uneven, being considerably more elevated at the margin than about the centre, and sometimes indicated by one or two concentric furrows; but on the ninth or tenth day, the surface becomes plane, and in a very few instances, the central part is highest. The margin is turgid, firm, shining, and rounded so as often to extend a little beyond the line of the base.

"The vesicle consists internally of numerous little cells, filled with clear lymph, and communicating with each other. The areola, which is formed round the vesicle, is of an intense red. The cuticle, or the outer skin, differs from that of two inches, and it is usually attended with a considerable tumour and hardness of the adjoining cellular membrane. On the eleventh and twelfth day, as the areola declines, the surface of the vesicle becomes brown in the centre, and less clear at the margins. The cuticle then begins to separate, and the fluid in the cells gradually congeals. The excreta consists of a redish-brown colour. The scab becomes at length black, contracted, and dry, but it is not detached until after the twentieth day from the inoculation. It leaves a permanent circular cicatrix, a little depressed, the surface being marked with very minute pits or indents, denoting the number of cells, of which the vesicle has been composed."

To such general characteristics of perfect vaccination. * Imperfect vaccination is not characterised by any uniform sign or criterion, but exhibits in different cases very different appearances, as pustules, ulcerations, or vesicles of an irregular form. The vaccine pustule is considoral; it increases rapidly from the second to the fifth or sixth day, when it is raised on a hard inflamed base, with diffuse redness extending beyond it on the skin. It is usually broken before the eighteenth day, and is soon after succeeded by an irregular brownish scar. The redness disappears in a day or two, and the tumour gradually subsides. Vaccination is imperfect or insufficient, 1. When the fluid employed does not contain any of its original properties. 2. When the persons inoculated were soon afterwards affected with any contagious fever. 3. When they are affected at the time of inoculation, with some chronic cutaneous disorders.

1. The qualities of the vaccine fluid are altered, soon after the appearance of an inflamed areola round the vesicle; and the fluid, although taken out of a vesicle in the best possible state, may be injured by heat, exposure to air, rust, moisture, and other causes.

2. When scales are formed over various pustules, and vaccine vesicles, the matter they afford is often acrid and putrescent; and it is frequently observed that the excreta vanishes as if it were before the operation of anatomy, that matter improperly kept, or the thick matter from collapsed and scabbed various pustules, and used for the purposes of inoculation, does not always produce the small pox, nor prevent the future occurrence of that disease, although the persons inoculated may have had inflammation and suppuration of the arm, and pains in the axilla, with fever and eruptions on the ninth or tenth day following. The vaccine fluid employed is taken at a late period, as from the twentieth to the eighteenth day, it does not always produce the genuine cellular vesicle, but in some cases wholly inefficacious; and in others, it is not productive of any ulcer or ulceration, in others an irregular vesicle, and in others erysipelias. Failures may have been occasioned by repeatedly puncturing or draining the vesicle, on two or three successive days.

3. When the cutaneous diseases which sometimes impede the formation of the genuine vaccine vesicle, are herpes (including the shingles, and vesicular ring-worms), the dry and the humid tetter, and the itch; but especially the porrigio (or time), comprising the varieties denominated crustaceous, are, scroches, and fatti, all of which are contrary to those that would perhaps be added the itch and porrigio.

"The right inference," our author in another part of his treatise observes, "from the mistakes or failures, and from the nicety of vaccine inoculation, is, that those only
should be inoculators, who have had a sufficient education, and who have particularly attended to the subject of vaccination." Dr. Wilian then goes on to enforce the propriety of a strict examination, and in dubious cases a reinoculation, of those persons especially who were inoculated at the 1st of Janu-
ary, 1799, and the 1st of January, 1802.

We are under the necessity of stating, that in the present article we have appealed principally to the authority of Dr. Wilian, not merely on account of the interest and universally acknowledged value of such authority; but because this gentleman, being neither an inoculator nor a partisan, cannot fail to be acquitted even by those who are least disposed to liberality of sentiment, of being in any measure influenced by the motives charged upon vaccinators in the following sentences, which, the reader will be surprised to find, are the composition of a learned, sagacious, and most respectable physician:

"The cow-pox inoculators who have been principals, reproach one another as not having the genuine matter, or skilful management, of vaccinating; the labourers in the same vineyard are wrong. If the small pox happens after Peter's operation, James, Paul, and John, are not all surprised; if from James, Paul, or John, disease happens, Peter says it is what he expected. Each pretends to some superior mystery over his brother-vaccinator. Each leader seems to say, —Come to my shop; this is the only true booth in the fair; that booth is the next true one." (Dr. Mosley.)

It would be unjust to conclude without admitting the only shadow of justification, which such language can claim; namely, the equal and perhaps prior interference of medical writers, on the opposite side of the question. We cannot forget the mode in which Mr. Goldstone's first candid and dispassionate inquiry into the merits of vaccination, was referred to by vaccinators; and every rancour ought at least to be excluded from this subject of universal interest.

VACCINIUM, the Whortle-berry, or Brieberry, a genus of plants of the class Vaccinacea, comprises the berries ranges in the natural system under the 18th order, bicorns. The calyx is superior; the corolla monopetalous; the filaments inserted into the receptacle; the berry quadri-locular and polymerspermous. There are 27 species, the most remarkable of which are:

1. The myrtus, black-berets, whortle-berries, or bilberries, growing in woods and on heaths abundantly. The flowers vary much in size, between 5 and 10 inches long, and with a sweet benzal smell. It was discovered by the duke of Aethol, growing in the woods about a mile and a half between his two seats of Dunkeld and Blair. The berries have an astrignent quality. In Arran and the Western Isles they are given in diarrhœas and dysenteries with good effect. The Highlanders frequently eat them in milk, which is a cooling agreeable food; and sometimes they are mixed with whisky, which last they mix with whisky, to give it a relish to strangers. They dye a violet-colour; but it requires to be fixed with alum. The grouse feed upon them in the

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autumn. 2. The euonymus, or great berr- 
bery-bush, is found in low moist grounds, and almost at the summits of the Highland mountains. The leaves are full of veins, smooth and glaucous, especially on the under side; the berries are eatable, but not so much relished as those of Vaccinium. They are apt to be sour if eaten in any quantity, to give the head-ache.

3. The vitis idea, or red whirl-berry, frequent in dry places, in heaths, woods, and on mountains. The berries have an acid cooling quality, useful to quench the thirst in fevers. The Sweedes are very fond of them made into the form of a roll or jelly, which they eat with their meat as an agreeable acid, proper to correct the animal alkali.

4. The oxycoccus, cranberries, moonbe-
"Candida, true vinifera, for juice, each of them might be turned into the vineyard; are as useful as the best of vineyards now."

VAGINAS, a genus of birds of the order grallæ: the generic character is, bill strong, thick, conico-convex, compressed; the upper mandible covered above with a movable horny sheath; nostrils small, placed behind the beak; tongue above found, beneath flattened, pointed at the tip; face naked, papillous; wings with an obtuse excrescence under the flexure: legs strong, four-toed, naked a little above the knee, one of the four being grooved. There is but a single species, which inhabits New Zealand and the South Sea islands, from 15 to 18 inches long, and feeding on shell-fish.

VAGRANTS are divided into three classes: 1st. Idle and disorderly persons. These, as described by the vagrant-act, consist of those who threaten to run away and leave their wives and children to the parish. All persons returning to a parish whence they were removed within the space of 6 months, are bringing a certificate from the parish to which they belong. All who, not having wherewith to maintain themselves, refuse to work. All who beg alms from door to door, or in the streets and highways. Likewise those who, not using proper means to get employment, or possessing ability to work, refuse to do it; or spend money in alehouses, or in any improper manner; and by not employing a proper proportion of the means of their livelihood, of their families, suffer them to become chargeable to the parish.

The punishment for these offences is a commitment to the house of correction, and hard labour, for any definite time not exceeding six months; and the time must be set forth in the warrant of commitment, which must also shew the authority of the person committing. The commitment must be in execution, that is to say, for punishment; and being so, the justice must make a record of the conviction, and of the处sions. Any person may apprehend and carry such persons before a magistrate; and if they resist or escape, they shall be punished as rogues and vagabonds: the reward for such apprehension is $50, to be paid by the overseer of the parish.

2. Rogues and vagabonds. No infant under the age of seven years can be called a rogue and vagabond, but shall be removed to its place of settlement, like other paupers.

The following is a list of those who are deemed rogues and vagabonds: All persons gathering alms under pretended losses; persons going about as collectors for prisons or hospitals; judges; beavers; common players not legally authorised; mistrels; jugglers; or real or pretended gypsies, fortune-tellers; any persons using any craft to impose upon any of his majesty's subjects, or playing at unlawful games, or any who have run away and left their wives and children; any vagabond, and all petty chapmen and peddlars not authorised by law; all persons not giving a good account of themselves; all beggars pretending to be soldiers or seamen, or pretending to go to work in harvest; or illegal dealers in lottery tickets and shares. And all other persons wandering abroad and begging, shall be deemed rogers and vagabonds; the reward for apprehending such persons is $50, to be paid by the high constable, on an order from the justice. There is a penalty of $10, on a constable who refuses or neglects to apprehend them.

3. Incongruous rogues, are all end-gatherers, offending against the statute. 3d Geo. 2d; which is collecting, buying, receiving, or carrying, any ends of yarn, with the intent to sell, or other refuse of cloth or woollen goods. All persons apprehended as rogues and vagabonds, and escaping, or refusing to go before a justice, are not to be enforced to be taken by the pass, or given a false declaration of themselves on examination, after warning. All rogues or vagabonds escaping from the house of correction before the expiration of the time of their commitment; and all who have been punished as rogues and vagabonds, and repeat the offence.

There is by 17 Geo. I. c. 25, a privy search appointed; and the justices or two of them four times a year at least meet, and commit the principal rogues or vagabonds, or their personal and movable estate, to be taken and brought to the house of correction. The rogues and vagabonds are examined upon oath as to their parish,
the written examination signed by them and the justice, and transmitted to the sessions.

The punishment is public whipping, or confinement to the house of correction till the next sessions, or any less time; and if at the sessions a court adjudi- cates a person a rogue and vagabond, or an incorrigible rogue, they may order such rogue or vagabond to the house of correction and hard labour for six months, or such incorrigible rogue for not less than six months or more than two years, and during his confinement to be whipped as they shall think fit. And if such rogue or vagabond is a male above 12 years old, the court may, after his confinement, send him to be employed in his ma-

jesty's service: and if such incorrigible rogue shall make his escape, or offend a second time, he shall be transported for seven years. After such whipping or confinement, the justice may, by a pass under his hand (of which a duplicate shall be filed at the next sessions), cause him to be conveyed to the place of his last legal residence, and if that cannot be found, to the place of his birth; and if they have fourteen or more children, and have parents living, then to the place of their abode; and the parish to which the vagrant shall be conveyed, shall employ him in some workhouse till he gets some employment. Their sufferings, which were severe, should be sent to the house of correction and hard labour.

The general tenor of the laws respecting vagrants, is extremely severe, and very just; for the purpose of preventing the peace to keep his district free from this class, as they are great burthens to the parish, and very difficult to be removed. For the best account of the vagrant-act, vide Barn's Justice, vol. 4, article Vagrant.

VAHILIA, a genus of plants of the class of the order perenandria, the cymals is five-leaved; corolla five-petalled; capsule inferior, one-celled, many-seeded. There is one species, a herb of the Cape.

VALANTIA, a genus of plants in the order monocotyledon, of the class polypodium, and in the natural system arranged under the 41st order, the super-polypodium. There is scarcely any certain demarcation of species, the chief characters being the length of the cymals, and one seed; the pistil of the male flowers are rarely discernible. There are 9 species, only one of which is a native of Britain, the crenulata; the stalks of which are square, the whole plant hairy, the leaves oval and verticillate, four in a whorl; the flowers are yellow, and grow on short peduncles out of the axil of the leaves. The roots, like those of the galingale, to which it is nearly related, will dye red. It is astrin-
gent, and was once used as a vulnerary.

VALENTINANS, in church history, a sect of Christian heretics, who sprang up in the second century, and were so called from their leader Valentinus. The valentinians were only a branch of the gnostics, who rea-
lized the Platonic ideas concerning the Deity, whom they called Pleroma, or plentitude. Their system was this: the first principle is Bythus, i.e. depth, which remained many ages unknown, having with it Emena, the light, and Siga, or silence; from these sprung the Nour, or intelligence, which is the only son, equal to, and alone ca-

pable of comprehending: the Bythus, the sister of Nour they called Aletheia, or truth; and these constituted the first quan-
ternity of roots, which were the source and origin of the world. For Nour and Ale-
then produced the world, and life, and from these two proceeded man and the church. But besides these eight principal roots, there were twenty-two more, the last of which, called Sophia, being desirous to arrive at the knowledge of Bythus, gave herself a great deal of uneasiness, which created in her anger and fear, of which was born matter. But the Floros, or boundary, stopped her, pre-

served her in the Pleroma, and restored her to perfection. Sophia then produced the Christ and the Holy Spirit, which brought the zoos to their last perfection, and made every one of them contribute their utmost to form the Saviour. Her Ethynese, or thought, dwelling near the Pleroma, perfect-
ed by the Christ, produced every thing that is in the world, by its divers passions. The Christ sent unto it the Saviour, accompanied with angels, who delivered it from its pas-
sions, converted it into the Pleroma, and thence was formed corporeal matter.

VALENZANA, a genus of plants, of the class triandria and order monandria, and in the natural system arranged under the 48th order, the super-triaandria. There is hardly any certain species; the corolla is monopetalous, gibbose at the base, situated above the germen; there is only one seed. They are 31 species, of which six are natives of Britain, the officinalis, the rubra, and the diocia; of these only the officinalis is useful.

The root of this plant is ptenial; the stalk is upright, smooth chambered, round, branch-
ed, and rises from two to four feet in height; the leaves on the stem are placed in pairs upon short broad sheaths; they are compose-
d of several lance-shaped, partially dentated, reined, smooth pinnas, with an odd one at the end, which is the largest: the floral leaves are spine-shaped and pointed: the flowers are small, of a white or purplish colour, and terminate the stem and branches in large

bunches. It flowers in June, and commonly grows in hedges and woods.

It is supposed to be the vp of Dioscorides and Galen, by whom it is mentioned as an aromatic and diuretic: it was first brought into estimation in convulsive afections by Fabius Columba, who relates that he cured himself of an epilepsy by the root of this plant; we are told, however, that Columba suffered a relapse of the disorder; and no further accounts of the efficacy of valerian in epilepsy followed till those published by Do-

minica Perrier, fifty years afterwards, in which three cases of its success are given.

The advantages said to be derived from this root in epilepsy, caused it to be tried in several other complaints termed nervous, particularly those produced by increased mo-

bility and irritability of the nervous system, in which it has been found highly serviceable. Bergius states its virtues to be anaphrodisiac, diuretic, emmenagogue, diuretic, anthel-

mintic, in substance is putrid, and is usually given in powder from a scruple to a drachm; its unpleasant flavour may be concealed by a small addition of mice. A mixture of valerian in proof spirit and in volatile spirit is ordered in the Lon-

don Pharmacopoeia. Cats are very fond of the smell of this root, and seem to be intoxicated by it.

VALISNERIA, in botany, a genus of the Acoraceae class of plants, with a monopetalous tripartite flower; its fruit is a long, cylindrical, and unilocular capsule, containing numerous oval seeds. There are two species.

VALVE, in hydraulics, pneumatics, &c., is a kind of lid or cover to a tube, vessel, or orifice, contrived to open one way; but which, the more force with which it presses the other way, the closer it shuts the aperture, like the clipper of a bellows; so that it either admits the entrance of a fluid into the tube, or vessel, and prevents its return; or per-
mits it to escape, and prevents its re-

entrance.

Valves are of great use in the air-pump, and other wind-machines; in which they are usually made of pieces of blister. In hydraulic

engine, as the, emboll or suckers of pumps, are mostly strong leather, of a round figure, and fitted to the aperture either by a bar of brass, or a piece of leather, or by a ring, or a bar, or pipes. Sometimes they are made of two round pieces of leather enclosed between two other pieces of brass; having divers fore and back, which are covered with another piece of brass, moveable upwards and downwards, on a kind of axis, which goes through the middle of them all. Sometimes they are made of brass, covered over with leather, and turned with a line spring, which gives way upon a force applied against it; but upon the re-

cessing of that, returns the valve over the aperture. See Pun, and Hydrostatics.

VALVE, in anatomy, a thin membrane applied on several cavities and vessels of the body, to afford a passage to certain humours in going one way, and prevent their reflux towards the place whence they came.

VAN, VANT, or VAUNT, a term derived from the French avant, or avant, signifying before, or foremost of any thing; thus we say, the van-guard of any army, &c.

VAN, in re-language, denotes the foremost division of any naval armament, or the part that usually leads the way to battle, or advances in the order of sailing.

VANDELLIA, a genus of plants of the class dicotyledon andorder angiosperm. The calyx is quadrid; the corolla rufous; the two exterior filaments proceed from the disc of the lip of the corolla; the anthers are connivent, i.e. connected; the capsule is monocolar and polyspermous. There are only two species known, the diffusus and pratensis.

VANE, in a ship, &c., a thin slip of some kind of matter, placed on high in the open air, and moving easily round on an axis or spindle, and veered down by the wind, to show its direction or course.

VANES, in mathematical or philosophical instruments, are sights made to slide and move upon cross-staves, fore-staves, quad-

rants, &c.

VANGNESIA, a genus of plants of the class and order perenandria monogynia. The calyx is five-toothed; corolla tube globular, stigma bilobate: fruit one-seeded: berry inferior, fleshy and juicy. There is one species, a tree of China.

VANILLA. See Epidendrum.

APOUR. See Evaulation, and Fluidity.
VARIABLE. In geometry and analysis, a term applied by mathematicians to such quantities as are considered in a variable or changeable state, either increasing or decreasing. Thus the abscissae and ordinates of an ellipse, or other curve line, are variable quantities; because they vary or change their magnitude together, the one at the same time with the other. But some quantities may be variable by themselves alone, or while those connected with them are constant; as the abscissae of a parallelogram, whose ordinates may be considered as all equal, and therefore constant. Also the diameter of a cylinder, and the perimeter of a conic section, are constant, while their abscissae are variable. Variable quantities are usually denoted by the last letters of the alphabet, $x, y, z, \ldots$; while the constant ones are denoted by the leading letters, $a, b, c, \&c.$ Some authors, instead of variable and constant quantities, use the terms fluent and stable quantities.

The indefinitely small quantity by which a variable quantity is continually increased or decreased in very small portions of time, is called the increment of the quantity, and is denoted by a line drawn through the equal letters in a, b, c, &c.

And the rate of its increase or decrease at any point, is called its fluxion; while the variable quantity itself is called the fluent. And the calculation of these, is the subject of the new method of differentials, or doctrine of fluxions.

VARIANCE, in law, signifies any alteration of a thing formerly laid in a plea; or where the declaration in a cause differs from the writ, or from the deed upon which it is grounded. 2 Lea, Abr. 669.

If there is a variance between the declaration and the writ, it is error, and the writ shall abate. And if there appears to be a material variance between the matter pleaded, and the manner of pleading it, this is not a good plea; for the manner and manner of pleading ought to agree in substance, or there will be no certainty in it. Cro. Jac. 479.

VARIATION, in geography and navigation, is the deviation of the magnetic needle from the true north point, towards either the east or west; or it is an arch of the horizon, intercepted between the meridian of the place of observation and the magnetic meridian. See MAGNETISM.

VARIATION, in astronomy. The variation of the moon, called by Galliard the refraction of her light, is the third inequality observed in the moon’s motion; which, by which, when out of the quadratures, her true place differs from her place in the equated line. See ASTRONOMY.

Newton makes the moon’s variation to arise partly from the form of her orbit, which is an ellipse; and partly from the inequality of the spaces which the moon describes in equal intervals, or the line drawn to the earth.

To find the greatest variation. Observe the moon’s longitude in the octants; and to the time of observation compute the moon’s place twice equated; then the difference between the computed and observed place, is the greatest correction.

Tycho makes the greatest variation 40' 20"; and Kepler makes it 51' 40". But Newton makes the greatest variation, at a mean distance between the sun and the earth, to be $35' 10''$; at the other distances, the greatest variation is $33' 19''$. The duplicate ratio of the times of the moon’s syzygial and apogee revolutions; and the triple ratio of the distance of the sun from the earth inversely. And therefore in the sun’s apogee, the greatest variation is $35' 19''$, and in his perigee $37' 11''$; provided that the eccentricity of the sun is to the transverse semidiameter of the orbit magna, as $16 \frac{2}{3}$ to 1000. Or, taking the mean motions of the moon from the sun, as they are stated in Dr. Halley’s tables, then the greatest variation at the mean distance of the earth from the sun will be $33' 7''$, in the apoapse of the sun $33' 27''$, and in his perigee $36' 51''$.

VARIATION of curvature, in geometry, is used for that inequality or change which takes place in the curvature of all curves except the circle, by which their curvature is more or less in different parts of them. And this variation constitutes the quality of the curvature at any point of a curve.

Sir Isaac Newton makes the index of the inequality, or variation of curvature, to be the ratio of the fluxion of the radius of curvature to the fluxion of the curve itself; and that Newton, in order to avoid the different notions, connected with the same terms, occasions to learners, has adopted the same denition; but he suggests, that this ratio gives rather the variation of the ray of curvature, and that it has been proper to have measured the variation of curvature rather by the ratio of the fluxion of the curve itself to the fluxion of the curve; so that, the curvature being inversely as the radius of curvature, and consequently its fluxion as the radius itself directly, and the square of the radius inversely, its variation would have been directly as the measure of it according to Newton’s definition, and inversely as the square of the radius of curvature.

According to this notion, it would have been measured by the angle of contact contained by the curve and circle of curvature, in the same manner as the curvature itself is measured by the angle of contact contained by the curve and tangent. The reason of this remark may appear from this example: The variation of curvature, according to this definition, is in the logarithmic spiral, the fluxion of the radius of curvature in this figure being always in the same ratio to the fluxion of the curve; and yet, while the spiral is produced, though its curvature decreases, it never vanishes; which must appear a strange paradox to those who do not attend to the import of Sir Isaac Newton’s definition.

The variation of curvature at any point of a conic section, is always as the tangent of the angle contained by the diameter that passes through the point of contact, and the perpendicular to the curve at the same point; or to the angle formed by the diameter of the section, and of the circle of curvature. Hence the variation of curvature vanishes at the extremities of either axis, and it is greatest when the acute angle, contained by the diameter passing through the point of contact and the tangent, is greatest.

When the conic section is a parabola, the variation is as the tangent of the angle, contained by the right line drawn from the point of contact to the focus, and the perpendicular to the curve. See CURVATURE.

From Sir Isaac Newton’s definition may be derived practical rules for the variation of curvature, as follows:

1. Find the radius of curvature, or rather its fluxion, then divide this fluxion by the fluxion of the curve, and the quotient will give the variation of curvature; exterminating the fluxions when necessary, by the equation of the curve, or perhaps by expressing the help of the tangent, or ordinate, or subnormal, &c.

2. Since $\frac{x}{y}$ or $\frac{1}{y}$ (putting $x = 1$) denotes the radius of curvature of any curve $s$, whose absciss is $x$, and ordinate $y$, if the fluxion of this is divided by $x$ and $y$ are exterminated, the general value of the variation will come out $-\frac{x^2}{y^2} + \frac{1}{y}$; then, substituting the values of $x, y, z$, (found from the curvature of the curve), into this quantity, it will give the variation sought.

Ev. Let the curve be the parabola, whose equation is $ax = y^2$. Here then $2by = ax = s$, and $y = \frac{s}{2b}$; hence $y = \frac{sa}{2b^2}$, and

\[ y = \frac{3a^2y}{2b^2} = \frac{3a^2}{2b^2} = \frac{3}{2b^2}. \]

Therefore

\[ \frac{3a^2}{2b^2} + \frac{1}{y} \left(1 + \frac{3}{2b^2}\right) = \frac{3a^2}{2b^2} + 3. \]

The variation sought.

VARIOLE, the small-pox, in medicine. See MEDICINE, and VACCINATION.

VARNISH, a thick, viscous, shining liquor, used by painters, gliders, and various other artificers, to give a gloss and lustre to their works; as also to defend them from the weather, dust, &c. See RESINS.

A coat of varnish ought to possess the following properties: 1. It should be extended or spread over the surface, without leaving pores or cavities, that it should not crack or scale, and that it should resist water. Resins are the only bodies that possess these properties, consequently they must form the basis of every varnish. For this purpose, they must be dissolved, as minutely divided as possible, and combined in such a manner, that the imperfections of those that might be disposed to scale, may be corrected by others.

Resins may be dissolved by three agents: 1. by fixed, or fat oil; 2. by volatile, or essential oil; 3. by spirit of wine. Accordingly we have three kinds of varnish; fat, volatile varnish, essential oil varnish, and spirit varnish.

The great agents are of such a nature as either to dry up and become hard, or to evaporate, and fly off, leaving the resin fixed behind.
VARNISH.

Varnish should be carefully kept from dust, and in a clean vessel; they should be laid as thin and even as possible, with a large flat brush, taking care to lay the strokes all one way. A warm room is best for varnishing in, as cold chills the varnish, and prevents it from lying even.

Varnishes are polished with pumice-stone and tripoli. The pumice-stone must be reduced to a very fine powder, and put upon a piece of soft moistened with water; with this the polished surface is to be rubbed equally and lightly. The tripoli must also be reduced to a fine powder, and put upon a clean woolen cloth moistened with olive-oil, with which the polishing is to be performed.

The varnish is then to be wiped with soft linen, and, when quite dry, cleaned with starch, or Spanish white, and rubbed with the palm of the hand, or with a linen cloth.

Fat oil varnish. Fixed, or fat oil, will not evaporate; nor will it become dry of itself. To make it dry, it must be boiled with alcohol, or turpentine. Litherer is generally used for this purpose. Oil so prepared is called drying-oil. To accelerate the drying of oil varnish, oil of turpentine is added.

Gum-copal, and amber, are the substances generally used in oil varnishes; the copal being whitest, is used for varnishing light; the amber for dark colours.

It is best to dissolve them before mixing with the oil; because, by this means, they are in less danger of being scratched, and at the same time the varnish is more beautiful. They should be melted in an iron pot over the fire; they are in a proper state for receiving the oil when they give no resistance to the iron spatula, and when they run from it drop by drop.

To make oil varnish, pour four, six, or eight ounces of drying-oil among sixteen ounces of melted copal, or amber, by little and little, constantly stirring the ingredients at the same time with the spatula. When the oil is well mixed with the copal or amber, take it off the fire; and when it is pretty cool, pour in sixteen ounces of the essence of Venice turpentine. After the varnish is made, it should be passed through a linen cloth.

Oil varnishes become thick by keeping; but when they are to be used, it is only necessary to pour in a little Venice-turpentine, and to put them a little on the fire. Less turpentine is necessary in summer than in winter; too much oil hinders the varnish from drying; but when too little is used, it cracks, and does not spread properly.

Black varnishes for coaches and ironwork. This varnish is composed of asphaltum, resin, and amber, melted separately, and afterwards mixed; the oil is then added, and afterwards the turpentine, as directed above. The usual proportions are, twelve ounces of amber, two of resin, two of asphaltum, six of oil, and twelve of turpentine.

A varnish for rendering silk water and air-tight. To render the linseed-oil drying, boil it with two ounces of sugar of lead, and three ounces of litharge, for every pint of oil, till the oil has dissolved them; then put a pound of birdline, and half a pint of the drying-oil, into a pot of iron or copper, holding about a gallon; and let it boil gently over a slow charcoal fire, till the birdline begins to crackle; then pour upon it two pints and a half of drying-oil, and boil it for about an hour longer, stirring it often with an iron or wooden spoon. When the varnish is no longer boiling, swell it much, the pot should be removed from the fire, and replaced when the varnish subsides. While it is boiling, it should be well examined, in order to determine whether it has boiled enough. For this purpose, take some of it upon the blade of a large knife, and after rubbing the blade of another knife upon it, separate the two knives, and when, on their separation, the varnish begins to form threads between the two knives, it has boiled enough, and should be removed from the fire. When it is almost cold, add about an equal quantity of spirit of turpentine; mix both well together, and let the mass rest till the next day; then, having warmed it a little, strain and bottle it. If it is too thick, add spirit of turpentine. This varnish should be laid upon the stuff when perfectly dry, in a lukewarm state; a thin coat of it upon one side, and, about twelve hours after, two other coats should be laid on, one on each side; and in 24 hours the silk may be used.

Mr. Blanchard’s varnish for air-balloons. Dissolve, or dissolve in oil varnishes; oil (carmichael) rubber, cut small, in five times its weight of spirit of turpentine, by keeping them some days together; then boil one ounce of this solution in eight ounces of drying linseed-oil for a few minutes, and strain it. Use it warm.

Essential oil varnish. The essential varnishes consist of a solution of resin in oil of turpentine, or other essential oil. This varnish being applied, the turpentine evaporates, leaving the resin behind. They are commonly used for pictures.

Spirit varnishes. When resins are dissolved in alcohol, commonly called spirit of wine, the varnish dries very speedily, but is subject to crack. This fault is corrected by adding a small quantity of oil of turpentine, which renders it brighter, and less brittle when dry.

To dissolve gum-copal in spirit of wine. Dissolve half an ounce of camphor in a pint of alcohol, or spirit of wine; put it into a circulating glass, and add four ounces of copal in small pieces; set it in a sand-heat, and regulate it so that the copal may be dissolved as they rise from the bottom; and continue the same heat till the solution is completed.

Camphor acts more powerfully upon copal than any other substance. If copal is finely powdered, and a small quantity of dry camphor rubbed with it in the mortar, the whole becomes in a few minutes a tough coherent mass. The process above described will dissolve more copal than the menstruum will retain when cold. The most economical method will therefore be, to set the vessel which contains the solution by for a few days; and when it is perfectly settled, pour off the clear varnish, and leave the residuum for a future operation.

This is a very bright solution of copal; it is an excellent varnish for pictures, and may perhaps be found to be an improvement in fine japanning; as the staves used in japanning those articles may be covered of this copal varnish entirely, and leave the copal pure and colourless upon the work.

A varnish for wagon-cots, cane-chairs, &c. Dissolve in a quart of spirit of wine, eight ounces of gum-sandarach, two ounces of seed-oil, or resin; then add six ounces of Venice turpentine. If the varnish is to produce a red colour, more of the lac and less of sandarach should be used, and a little dragon’s-blood should be added. This varnish is very strong.

A varnish for toilet-boxes, cases, fans, &c. Dissolve two ounces of gum-mastic, and eight ounces of gum-sandarach, in a quart of alcohol; then add four ounces of Venice-turpentine, and mix well; and hang them over a slow fire till they are dissolved; then add two ounces of turpentine.

Varnish for employing vermilion for painting engravings. Dissolve in a quart of alcohol six ounces of sandarach, three ounces of gum-lac, and four ounces of resin; afterwards add six ounces of the cheapest kind of turpentine; mix it with a proper quantity of vermilion when it is to be used.

A varnish for spirit of wine, one quart; put it in a wide-mouthed bottle; add to it eight ounces of seed-lac, that is large-grained, bright, and clear, free from dirt and stucks; let it stand two days, or longer, in a warm place, often shaking it. Strain it through a flannel into another bottle, and it is fit for use.

Shell-lac varnish. Take one quart of spirit of wine, eight ounces of the thinnest and most transparent shell-lac, which, if melted in the flame of a candle, will draw out in the longest and finest hair; mix and shake these together, and let them stand in a warm place for two days, and it is ready for use. This varnish is softer than that which is made from seed-lac, and therefore is not so useful; but may be mixed with it for varnishing wood, &c.

White varnish for clock-faces, &c. Take of spirit of wine (highly rectified) one pint, which divide into four parts; take five six one part with half an ounce of gum-mastic, in a phial; one part of spirit, and half an ounce of gum-sandarach, in another phial; one part of gum-lac, and half an ounce of the whitest parts of gum-benjamin. Then mix, and temper them to your mind. It would not be amiss to add a little bit of white resin, or clear Venice-turpentine, in the mustard-bottle, it will assist in giving a gloss. If your varnish proves too strong and thick, add spirit of wine only; if too hard, some dissolved mastic; if too soft, some sandarach or benjamin. No other rule can be given, unless the quality of the gums and the spirit could be ascertained. When you have brought it to a proper temper, warm the silvered plate before the fire, and with a flat camel’s-hair pencil, stroke it all over until no white streaks appear.

VARNISH, among medalists, signifies the colours antique medals have acquired in the earth.

The beauty which nature alone is able to give to medals, and art has never yet attained to the same extent, is derived from the value of the metal; that is, the colours, with which certain soils, in which they have a long time lain, tinge
VAU

the metals; some of which are blue, almost as beautiful as the turquoise; others with an inimitable vermillion colour; others with a certain shining polished brown, vastly finer than British lignum.

The most usual varnish is a beautiful green, which hangs to the finest strokes without effacing them, more accurately than the finest enamel does on metal. No metal but brass is susceptible of this; for the green rust that gathers on silver always spoils it, and it must be got off with vinegar or lemon-juice.

Falsifiers of metals have a false or modern varnish, which they use on their coppers, to give them the appearance, or air, of being antique. But this may be discovered by its softness, it being softer than the natural varnish, which is as hard as the metal itself. Some deposit their spurious metals in the earth for a considerable time, by which means they contract a sort of varnish, which may impose upon the less knowing; others use sal ammoniac, muriat of ammonia, and others burnt paper.

VARRONIA, a genus of plants of the class and order pantentia monogygia. The thistles, five-clad; drupes with a four-celled nut. There are nine species, shrubs of the West Indies.

VASSAL, in old-law books, denotes a tenant that held in fee of his lord, to whom he vowed fidelity and service.

VATERIA, a genus of the polyandria monogygia class of plants, the flower of which consists of five oval and patent petals; and its fruit is a turbinate, conicaceous, and unilocular capsule, containing a single oval seed.

There are one, a tree of Chine, which is known to contract a sort of varnish, which may impose upon the less knowing; others use sal ammoniac, muriat of ammonia, and others burnt paper.

VAULT, in architecture, an arched roof, so contrived that the stones which form it sustain each other. Vaults are, on many occasions, to be preferred to soffits or ceilings, as they give a greater height and elevations, and are besides more firm and durable.

Salsamius observes, that the antients had only three kinds of vaults. The first was the formix, made cradle-wise; the second a tabula, i.e. tortoise-wise, which the French call car de four, or oven-wise; and the third concha, or trumpet-wise. But the moderns have subdivided these three sorts into many more, to which they have given different names, according to their figures and uses; some of them are circular, and others elliptical.

Again, the sweeps of some are larger, others less, portions of a sphere. All such as are above hemispheres are called high, or surmounted vaults; and all that are less than hemispheres, are called low, or surused vaults, or testudines.

In some vaults the height is greater than the diameter; in others it is less; others again are quite flat, and only made with laurens; others like ovens, or in the form of a cul de four, &c. and others growing wider as they lengthen, like a trumpet.

VAULTS, master, were vaults that cover the principal parts of buildings, in contradistinction to the upper or subordinate vaults, which only cover some little part, as a passage or gate, &c.

VAULTS, double, is one that is built over another, to make the outer decoration range with the inner; or, to make the beauty and decoration of the inside consistent with that of the outside, leaves a space between the concavity of the one and the convexity of the other; instances of which we have in the dome of St. Peter’s at Rome, St. Paul’s at London, and in that of the Invalids at Paris.

Vaults with compartments, are such whose sweep, or inner face, is enriched with panells of sculpture, separated by platbands. These compartments, which are of different figures according to the vaults, and usually gilt on a white ground, are made with stone or brick walls, as in the church of St. Peter at Rome, or with plaster on timber vaults.

VAULTS, theory of. A seicircular arch or vault, standing on two piedrots, or imposts, and all the stones that compose them, being cut, and placed in such manner as that their joints or beds, being prolonged, do all meet in the centre of the vault; it is evident that all the stones must be in the form of wedges, i.e. must be wider and bigger at top; by the nature of which, if each one of them, and mutually oppose the effort of their weight, which determines them to fall. The stone in the middle of the vaults, which stands perpendicular to the horizon, and is called the key of the vault, is sustained on each side by two contiguous stones, just as by two inclined planes; and, consequently, the effort it makes to fall is not equal to its weight. But still that effort is the greater, as the inclined planes are less inclined; so that if they were infinitely little inclined, i.e. if they were perpendicular to the horizon as well as the key, it will tend to fall with its whole weight, and would actually fall but for the mortar. The second stone, which is on the right or left of the key-stone, is sustained by a third, which, by virtue of the figure of the vault, is necessarily more inclined to the second than the second is to the first; and consequently the second, in the effort it makes to fall, employs a less part of its weight than the first. For the same reason, the stones from the key-stone employ still a less and less part of their weight to the third, which, resting on a horizontal plane, employs no part of its weight, or, which is the same thing, makes no effort at all, as being entirely supported by the impost. Now, in vaults, a great point to be aimed at is, that all the vousoirs, or key-stones, make an equal effort towards falling. To effect this, it is visible, that as each (reckoning from the key to the impost) employs still a less and less part of its whole weight; the first, for instance, only employing one-half; the second, one third; the third, one-fourth, &c. there is no other way of making those different parts equal, but by a proportionate augmentation of the whole; i.e. the second stone must be heavier than the first, the third than the second, &c. to the last, which should be infinitely heavier.

M. De la Hire demonstrates what proportion is, in which the weight of the stones of a semicircular vault is to be increased in equilibrio, or to tend with equal forces to fall, which is the firmest disposition a vault can have. The architects before

had no certain rule to conduct themselves by, but did all at random. Beckett, in the treatise of the quadrature of the circle, from the key-stone to the impost, the extremity of each stone will take up so much the greater arch as it is farther from the key.

M. De la Hire’s rule is, to augment the weight of each stone that is at or the key-stone, as much as the tangent of the arch of the stone exceeds the tangent of the arch of half the key. Now the tangent of the last stone of necessity becomes infinite, and of consequence its weight should be so too; but, as infinity has no place in practice, the rule amounts to this, that the last stones should be loaded as much as possible, that they may the better resist the effort which the vault makes to separate them, which is called the shoot or drift of the vault. Mr. Parent has since determined the curve, or figure, which the extrados, or outside of a vault, whose intrados, or inside, is spherical, must have, that all the stones may be in equilibrio.

VAULT, key of, is a stone or brick in the middle of the vault, in form of a truncated cone, serving to bind or fasten all the rest.

VEIL, a veil, or mantilla, a sector of heretics who sprang up in Germany about the year 1590, and maintained that the body of Jesus Christ is ubiquie, everywhere, or, in every place, at the same time. However, they were not quite agreed among themselves; some holding, that the body of Jesus Christ, even during his mortal life, was everywhere; and others dating the ubiquity of his body from the time of his ascension.

VECTOR, in astronomy, a line supposed to be drawn from any planet moving round a centre, or the focus of an ellipse, to that centre or focus.

VEER, a sea-term variously used. Thus veering out a rope, denotes the letting it go by hand, or letting it run of itself. It is not used for letting out any running rope except the sheet.

VEER is also used in reference to the wind; for, when it changes often, they say it veers about.

VEGETATION. See Plants, physiological of.

VEIN. See Anatomy.

Vein, among miners, is that space which is bounded with wougs, and contains ore, spar, canck, clay, chert, croil, brownien, pitcher-chirt, ear, which the philosophers call the mother of metals, and sometimes soil of all colours. When it bears ore, it is called a quick vein; when no ore, a dead vein.

VELEZIA, a genus of the pantentia di- gynia class and order of plants. The calyx is five-clad; petals five; anthers 15, sessile, four-celled. There is one species, a tree of Chine, which is known to contract a sort of varnish, which may impose upon the less knowing; others use sal ammoniac, muriat of ammonia, and others burnt paper.

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When the glue is thoroughly dry, it is taken out of the press, and finished; first with a little planer, then with scrapers, some of which resemble rasps, which take off the dents, &c., left by the planes.

After it has been sufficiently scraped, they polish it with the skin of a dogfish, wax, and a brush, orrather of share-grass, which is the last operation.

VENILE FACIAS, in law, a writ judicial, awarded to the sheriff to cause a jury of the neighborhood to appear, and to take to and bring to the court, or if the jury come not within the time of this writ, then there shall go a habeas corpus, and after a distress, till they appear. 2 Haw. 783.

Venile facies, is also the common process upon any presentment, being in nature of a summons for the party to appear; and this is a proper process to be first awarded upon an indictment for any crime under the degree of treason, or felony, or malum in se, in any case wherein other process is directed by statute. And if by the return to such writ of venire, it appears that the party has lands in the county, whereby he may be distrained upon, then a distress in infinitum shall be issued from time to time till he appears; but if the sheriff return that the party has no lands in his bailiwick, then upon his non-appearance, a writ of capias shall issue to take his body. 4 Black. 313.

VENTILAGO, a genus of the class and order of plants pentandria monogynia. The calyx is tubular; corolla, scales protecting the stamens, which are inserted in the calyx. There is one species, a shrub of the East Indies.

VENTILATOR, a machine by which the air of any close place, as an hospital, goose, ship, &c. may be changed for fresh air.

The moist qualities of bad air have been long known; and Dr. Hales and others have taken great pains to point out the mindless arising from foul air, and to prevent or remedy them. That philosopher proposed an easy and effectual one, by the use of his ventilators; the advantage of which is, was read before the Royal Society in May 1741. In mines, ventilators may guard against the suffocations, and other terrible accidents, arising from stopps. The air of goas has often proved infectious; and we had a fatal proof of this, by the accident that happened some years since at the Old Bailey sessions. After that ventilators were used in the prisons, which were worked by a small windmill, as that placed on the top of Newgate, and the prison became more healthy.

Dr. Hales further suggests, that ventilators might be of use in making salt; for which purpose there should be a stream of water to work them; or they might be worked by a windmill, and the brine should be in long narrow canals, covered with boards of canvas, a foot above the surface of the brine, to confine the stream of air, so as to make it act upon the surface of the brine, and carry off the water in vapours. Thus it might be reduced to a dry salt, with a saving of fuel, in winter and summer, or in rainy weather, or any state of the air whatever. Ventilators, in addition, might also serve for drying linen hung in low, long, narrow galleries, especially in damp or rainy weather, and also in drying woollen cloths after they are fulled or dyed; and in this case, the ventilators might be worked by the falling watermill. Ventilators might also be an useful appendage to mills and hemp-mills; and the same ventilator is farther a ventilation of warm dry air from the adjoining stove, with a cautious hand, might be of service to trees and plants in green-houses; where it is well known that air full of rancid vapours which perspire from the plants, is very unkindly to them, as well as the vapours from human bodies are to men; for fresh air is as necessary to the healthy state of vegetables, as of animals. Ventilators are also of excellent use for drying corn, hops, and malt. Gunpowder may be thoroughly dried, by blowing air up through it by means of ventilators; which is of great advantage to the strength of it. These ventilators, even the smaller ones, will also serve to purify most easily, and effectually, the bad air of a ship's well, before a person is sent down into it, by blowing air through a trunk reaching near the bottom of it. And in a current of air from a ventilator, the breath of a man, and all kinds, &c., be sweetened, &c., by passing a current of air through them, from bottom to top, which will carry the offensive particles along with it.

The method of drawing off air from ships by means of fire-pipes has been preferred to ventilators, was published by Sir Robert Moray, in the Philos. Trans., for 1605. These are metal pipes, about 24 inches in diameter, one of which reaches from the fire-place to the ship, and three others: branch go to other parts of the ship; the stove-hole and ash-hole being closed up, the fire is supplied with air through these pipes.

In the latter part of the year 1741, Mr. Trigland, military architect to the king of Sweden, informed the secretary to the Royal Society, that he laid in the preceding spring a machine for the use of ships of war, to draw out the foul air from under their decks, which consisted of 9172 cubic feet of air in an hour, or at the rate of 21722 tons in 24 hours. In 1742 he sent one of these to France, which was approved of by the Academy of Sciences at Paris, and the navy of France ordered to be furnished with the like ventilators.

There are various ways of ventilation, or changing the air of rooms. Mr. Tindal continued to admit fresh air into a room, by taking out the middle upper sash pane of glass, and fixing in its place a frame box, with a round hole in its middle, about six or seven inches diameter; in which hole are fixed, behind each other, a set of sails of very thin broad copper-plates, which spread over and cover the circular hole, to make the air which enters the room, and turning round these sails, to spread round in thin sheets sideways; and so it is inhaled by persons by blowing directly upon them, as it would be, if it was not hindered by the sails.

This method however is very uneasy, and disagreeable in good rooms; and therefore, instead of it, the late ingenious Mr. John Whitelith substituted another; which was, to make a small square or rectangular hole in the party-wall of the room, in the upper part near the ceiling, at a corner, the distant from the fire; and before it placed a
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thin piece of metal or pasteboard, &c. attached to the wall in its lower part just below the hole, but declining from it upwards, so as to give the air, that enters by the hole, a direction upwards against the ceiling, along which it swims and inwards, and thence itself thence without blowing in a current against any person. This method is very useful to cure smoky chimneys, by thus admitting conveniently fresh air. A picture or painting was also attached before the hole prevents the sight of it when disfiguring the room. This, and many other methods of ventilating, he meant to have published, and was occupied upon, when death put an end to his useful labours. Those since have been published, viz. in 1792, Aby de Willan.

VENTRILLOQUISM, an art by which certain persons can so modify their voice, as to make it appear to the audience to proceed from any distance, and in any direction. Some faint traces of this art are to be found in the writings of the ancients; and it is the opinion of M. De la Chapelle, who in the year 1792 published an ingenious work on the subject, that all sweats of many of the ones were delivered by persons thus qualified, to serve the purposes of delusion. As the ancient ventriloquists, when exercising their art, seemed generally to speak with their own hands, a name by which they were doted was abundantly significant: but it is with no great propriety that modern performers are called ventriloquists, and their art ventriloquism, since they appear more frequently to talk with the pockets of their neighbors, or from the roof or distant corners of the room, than from their own mouths or their own bellies.

From Brodole, a learned critic of the sixteenth century, we have the following account of the feats of a capital ventriloquist and cheat, who was valet-de-chambre to Francis the First. The fellow, whose name was Louis Brabant, had fallen deeply in love with a young, handsome, and rich heiress; but was rejected by the parents as an unsuitable match for their daughter, on account of the lowness of his circumstances. The young lady’s father dying, he set out to win her, totally ignorant of her singular talent. Suddenly, on his first appearance in open day, in her own house, and in the presence of several persons who were with her, she heard herself acceded, in a voice perfectly resembling that of her dead husband, and which seemed to proceed from above, exclaiming, “Give my daughter in marriage to Louis Brabant; he is a man of great fortune, and of an excellent character. I now endure the insupportable torments of purgatory, for having refused her to him. If you obey this admonition, I shall soon be delivered from this place of torment. You will at the same time provide a worthy husband for your daughter, and procure everlasting reposé to the soul of your poor husband.”

The widow could not for a moment resist this dreadful summons, which had not the most distant appearance of proceeding from Louis Brabant, whose countenance exhibited no visible change, and whose lips were close and motionless, during the delivery of it. Accordingly, she consented immediately to receive him for her son-in-law. Louis’s finances, however, were in a very low situation; and the formalities attending the marriage-contract rendered it necessary for him to exhibit some show of riches, and not to give the ghost the lie. Accordingly, he worked upon a fresh subject, one Cornu, an old and rich banker at Lyons; who had accumulated immense wealth by usury and extortion, and was known to be haunted by remorse of conscience in the manner in which he had acquired it.

Having contracted an intimate acquaintance with this man, he, one day while they were sitting together in the insurer’s little back parlour, artfully put off the conversation to religious subjects, on demons and spectres, the pains of purgatory, and the torments of hell. During an interval of silence between them, a voice was heard, which to the astonished banker seemed to be that of his deceased father, complaining, as in the former case, of his dreadful situation in purgatory, and calling upon him to deliver him instantly thence, by putting into the hands of Louis Brabant, then with him, a large sum for the redemption of Christians then in slavery with the Turks; threatening him at the same time with eternal damnation if he did not take this method to expiate like-wise his own sins. The banker naturally supposed that Louis Brabant affected a due degree of astonishment on the occasion; and further promoted the deception, by acknowledging his having devoted himself to the prosecution of the charitable design imputed to him by the ghost. An old usher is naturally suspicious. Accordingly the wary banker made a second appointment with the ghost’s delegate for the next day; and, to render any design of imposing upon him utterly abortive, took him into the open fields, where not a house, or a tree, or even a bush, or a pit, was in sight, capable of screening any supposed confederate. This extraordinary caution excited the ventriloquist to exert all the powers of his art. Wherever the banker conducted him, at every step his ears were saluted on all sides with the complaints and groans not only of his father, but of all his deceased relatives, praying for the love of God, that in the name of every saint in the calendar, to have mercy on his own soul and theirs, by effectually seconding with his purse the intentions of his worthy companion. Cornu complained the voice of heaven had accordingly carried his guest home with him, and paid him down 10,000 crowns: with which the honest ventriloquist returned to Paris, and married his mistress. The catastrophe was fatal. The secret was afterwards discovered, and reached the userer’s ears; who was so much affected by the loss of his money, and the mortifying railleys of his neighbours, that he took to his bed and died.

This trick of Louis Brabant is even exceeded by an innocent piece of waggery played off not forty years ago by another French ventriloquist on a whole community. We have the story from M. De la Chapelle, who informs us, that M. St. Gill, the ventriloquist, and his intimate friend, returning home from a place whither his business had carried him, sought for shelter from an approaching thunder-storm in a neighbouring conveny. Finding the whole community in mourning, he enquired the cause, and was told that one of their body had died lately, who was the ornament and delight of the whole society. To pass away the time, he walked into the church, attended a service in a very solemn manner, and made a most lugubrious address to the corpse of his deceased brother, and spoke feelingly of the scanty honours they had bestowed on his memory. Suddenly a voice was heard, appr. room, proceeding from the pulpit, lamenting the situation of the deject in purgatory, and reproaching the brotherhood with their lukewarm and want of zeal on his own account. The friars, as soon as the astonishment gave them power to speak, consulted together, and agreed to acquit the rest of the community with this singular event, so interesting to the whole society. M. St. Gill, who wished to carry on the joke still farther, dissuaded them from taking this step: telling them that they would be treated by their absent brethren as a set of fools and visionaries. He recommended to them, however, the immediately calling of the whole community into the church, where the ghost of their departed brother might probably reiterate his complaints. Accordingly all the friars, novices, lay-brothers, and even the domestics of the community were immediately invited to a meeting collected together. In a short time the voice from the roof renewed its lamentation and reproaches, and the whole convent fell on their faces, and vowed a solemn reparation. As a further step, they chanted a De profundis in a full choir, during the intervals of which the ghost occasionally expressed the comfort he received from their pious exercises and ejaculations on his behalf. When all was over, some of them entered into a solemn conversation with M. St. Gill; and on the strength of what had just passed, sagaciously inveighed against the absurd incredulity of modern sceptics and pretended philosophers, on the article of ghosts and apparitions. M. St. Gill thought it now high time to disabuse the good fathers. This purpose, however, he found it extremely difficult to effect, till he had prevailed upon them to return with him into the church, and there be witnesses of the manner in which he had conducted this ludicrous deception.

A ventriloquist, who performed feats somewhat similar to these, made his appearance in Edinburgh, the capital of Great Britain, a few years ago. He imitated successfully the voice of a squeaking child, and made it appear to proceed from whatever place he chose; from the pockets of the company; from a wooden doll, with which he held many spirited conversations; from beneath a hat or a wine-glass, and out of any person’s foot or hand. When the voice seemed to come from beneath a glass or hat, it was attributed on a lie, as sounds confined always are; and what evinced his dexterity was, that when the glass was raised from the table during the time of his speaking, the words or syllables uttered afterwards were on a higher key: in consequence, one would have thought, of the air being readmitted to the speaker. This part of the experiment failed, however, when the management of the glass was at a distance committed to any of the company; last of all, the room was not well illuminated, we are inclined to attribute this failure to the ventriloquist not being able to perceive at what precise instant of time the glass was removed from the table.

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The same artist imitated the tones of a scold- ing old woman, disturbed at unreasonable hours by a person denominating admission into her house. We have heard that, when in Edinburgh, the same practicioner astonished a number of persons in the Fishmarket, by making a speech to speak, and give the lie to his vender, who affirmed that it was fresh, and caught in the morning.

The editor of this dictionary heard some years ago, in Portugal, a ventriloquist who was at least equal to any of those above-men- tioned. Indeed, he could scarcely have be- lieved the fact from any authority, had he not been himself an ear-witness. The man held conversation with the figure of a child, which he carried under his cloak, with per- sons apparently out of the room, in the street, and even on the roof of the house. The voices were all varied according to the character of the person with whom he affect- ed to converse, and it was impossible not to believe that they proceeded from the quarter where he pretended they were stationed.

We have never, we confess, found a satis- factory explanation of this phenomenon. The most which are that which refers it to a cer- tain delicacy of ear, proper to the performer. Such an ear, it is observed, perceives every difference which change of place produces in the same sound; and if a person possessed of such an ear has sufficient command over his organs of speech, he can produce by them a sound in all respects similar to another proceeding from any distant object, to the audience the sound which he utters must appear to pro- ceed from that object. If this is the true theory of ventriloquism, it does not seem to be possible for the most expert ven- triloquist to speak in his usual tones of con- versation, and at the same time make the voice appear to come from a distance; for these tones must be supposed familiar to his audience, and to be in their minds associated with the ideas of his figure, place, and distance. There can, however, be no doubt, that if, by a peculiar modification of the organs of speech, a sound of any kind can be produced, which in faintness, tone, body, and in short every other sensible quality, perfectly resembles a sound delivered from the roof of an elevated house, the ear will naturally, with- out examination, refer to that situation and distance; the sound which the person hears being only a sign, which he has from his in- fancy been constantly accustomed, by expe- rience, to associate with the idea of a person speaking from a house-top. If, however, this theory is true, how comes it that ven- triloquism is not more frequently and suc- cessfully practised? The man whom the editor saw in Portugal, was apparently an ignorant and illiterate person, and could not, or would not, give any account of the principles of his art.

VENUE, in law, the neighbourhood whence justice are to be summoned for trial of causes. In local actions, as of trespass and ejectment, the venue is to be from the neighbourhood of the place, where the lands in question lie; and in all real actions, the venue must be laid in the county where the thing in question is brought. In all cases, law, and even cases, will, if any, be tried in the district where the county, court will direct a change of the venue, and oblige the plaintiff to declare in the pro- per county; and the court will sometimes, if the business be of a public nature, (especially of that which is laid against limited kind.) upon a suggestion duly supported, that a fair and impartial trial cannot be had therein. 3 Black, 394.

With respect to criminal cases, it is ordin- ated by stat. 21 Jac. 1. c. 7, that all informa- tions on penal statutes, shall be laid in the counties where the offences were committed. 

VENUS, in astronomy, one of the inferior planets, revolving round the sun in an orbit between that of Mercury and the Earth. See Astronomy.

VENUS, in zoology, a genus of insects be- longing to the order of vermes testacea. This animal is a two-legs; the shell is bivalve; the wings with three teeth near each other, one placed longitudinally and bent inwards. There are a great many species, of which the most remarkable is the mercenaria, or commercial, with a long, thick, weighty shell, covered with a brownish, or olive-brown substance, with slightly striated transversely: circumference above 11 inches. These are called in North America clams; they differ from other spe- cies only in having a purple tinge within. Wampum, or Indian money, is made of them.

VENUS's fly-trap. See Dionaea Mus- cipula.

VEPRECULE, diminutive from verres, "a briar or bramble," the name of the 31st order in Linneus's Fragments of a Natural Method. See Botany. 

VERATRUM, a genus of plants of the class polygamus, and order monocot; and in the natural system arranged under the 23th order, lridaceae. The corolla is rotated, and rather unequal; the capsule is mono- locular and bivalved. There are 19 species, five of which belong to the countries of Britain:

1. The thapsus, or great mullein, which has a stem single, simple, crowded with leaves, about six feet high; leaves large, broad, white, woolly on both sides, sessile, de- current; flowers terminal, in a long spike, yellow,去看pair of two or four, naked or very thinly arilled; stamens two or four. There are 23 species, only one of which is a native of Britain; the officinalis, or common verbain, which grows on the road-sides near towns and villages. The leaves have many jagged edges, the blossoms are pale blue. It manifests a slight de- gree of astrigency, and was formerly much in use as a diuretic, but is now dis- regarded.

2. The nigraum, or black mullein, having a stem set with leaves that are beautifully branched; the blossom a yellow with purple tips. It is a beautiful plant, and the flowers are grateful to bees. Swine eat it; sheep are not fond of it; cows, horses, and goats, refuse it. The other British species are the yellow, lychnitis, blattana, and virginiana.

VERBENA, a genus of plants of the class diandra, and order monogynia; and in the natural system arranged under the 40th order, personate. The corolla is funnel- shaped; calyx one of the teeth truncate; seeds two or four, naked or very thinly arilled; stem two or four. There are 23 species, only one of which is a native of Britain; the officinalis, or common verbain, which grows on the road-sides near towns and villages. The leaves have many jagged edges, the blossoms are pale blue. It manifests a slight de- gree of astrigency, and was formerly much in use as a diuretic, but is now dis- regarded.

Air Miller says, that it is never found above a quarter of a mile from a house; whence the common people in England call it 'simple's joy,' because, wherever it is found, it is a certain sign of a house being near. Swine eat it; cows, horses, and goats, re- fuse it.

VERBESINA, a genus of the syngeneia
polygamy superfluous class of plants, with a radiated flower, made up of hemipatrid tulipose ones on the disc, and a few imitative ones on the verge; the seeds are angulated, and contained in the cup. There are eleven species.

VERDEGRISE, or VERDEGRIS. See COPPER.

Verdegris is an acetat of copper, useful in the arts as a pigment. The principles on which it is formed are these:

Acetic acid attacks copper very slowly in open vessels, converts it into an oxide, and dissolves it; but in close vessels no action takes place. This acid readily combines with the oxide of copper, and forms with it an acetat. This salt was known to the ancients, and various ways of preparing it are described by Pliny. It is usually obtained by exposing plates of copper to the action of vinegar, till they are converted to a bluish-green powder, and then dissolving this powder in acetic acid, and crystallizing it.

Acetat of copper crystallizes in four-sided truncated pyramids. It has a beautiful bluish-green colour. Its specific gravity is 1.779. Its taste is disagreeably metallic, and, like all the compounds into which copper enters, it is poisonous. It is very soluble in water; alcohol likewise dissolves it. When exposed to the air, it effloresces. By distillation it gives out acetic acid. Proust first remarked that acetic acid and acetic acid form the same salt with copper; and hence concluded that there is no difference between the two acids. When sulphureted hydrogen gas is made to pass through a solution of this salt in water, the copper is desvoltized, and precipitates in the state of a blue sulphuret, and there remains behind an acid which possesses the properties of the acetic.

According to Proust, the acetat of copper is composed of:

| 61 acid and water | 39 oxide | 100 |

When the verdigris of commerce is put into water, 0.36 parts of it are dissolved, and there remain 0.44 parts in the state of a fine green powder, which remains long suspended in the solution. Mr. Proust has ascertained that this powder is a subacetat of copper. It is decomposed by sulphuric acid, by potass, and by distillation. According to the analysis of Proust, it is composed of:

| 37 acid and water | 63 oxide | 100 |

Thus it appears from the experiments of this philosopher, that the verdigris of commerce is composed of two different acetats of copper; the one soluble in water, the other insoluble. It is much used as a paint; and crystallized acetat of copper is a frequent ingredient in dying compounds. Verdegris is formed in great quantities at Montpelier. A particular account of the processes followed in that place has been published by Mr. Chaptal.

VERDEROR, a judicial officer of the king's forest, chosen by the king's writ in the full county-court of the same shire, within the forest where he dwells; he is sworn to maintain the assizes of the forest, and to view, receive and enroll the attachments and presents, of all manner of trespasses of vert and venison in the forest.

VERDICT, the answer of a jury, made upon any cause, civil or criminal, committed by the court to their examination, and this is timid, general or special.

A general verdict is that which is given of brought into the court in like general terms to the general issue; as in an action of assize, the defendant pleads no wrong, no dissent; then the issue is general, whether the fact is wrong or not; which being committed to the jury, they upon consideration of the evidence come in and say, either for the plaintiff, that it is a wrong and dissent; or for the defendant, that it is no wrong, no dissent.

A special verdict, is when they say at large, that such a thing and such a thing they find to be true by the present or tenant, so declaring the course of the fact, as in their opinion it is proved; and as to the law upon the fact, they pray the judgment of the court; and this special verdict, if it contains any show of declaration of the cause from the beginning to the end, is also called a verdict at large. Co. Lit. 128.

A special verdict is usually found where there is any difficulty or doubt respecting the law, when the jury state the facts as proved, and pray the advice of the court thereon. A less expensive, and more speedy mode however, is to find a verdict generally for the plaintiff, subject, nevertheless, to the opinion of the judge, or the court above, on a special case drawn up and settled by counsel on both sides.

VERGE signifies the compass of the king's court, which bounds the jurisdiction of the lord steward of the household, and which is thought to have been 12 miles round.

The term verge is also used for a stick or rod, whereby one is admitted tenant to a copyhold estate, by holding it in his hand, and swearing fealty to the lord of the manor.

VERGES, certain officers of the courts kings'-bench and common pleas, whose business it is to carry white wands before the judges.

There are also vergers of cathedrals, who carry a rod tipped with silver before the bishop, dean, &c.

VERJUICE, a liquor obtained from grapes or apples, unit for wine or cider; or from sweet ones, whilst yet acid and unripe. Its chief use is in sauces, ragouts, &c. though it is also an ingredient in some medicinal compositions, and is used by the wax-chandlers to purify their wax.

VERMELS, the sixth class of animals in the Linnaean system, comprehending five orders. See NATURAL HISTORY, and ZOOLOGY.

VERNIER SCALE, a scale excellently adapted for the gradation of mathematical instruments, thus called from the inventor Peter Vernier, a person of distinction in the French Coupé. Vernier's method is derived from the following principles: If two equal right lines, or circular arcs, A, B, are so divided, that the number of equal divisions in B is one less than the number of equal divisions of A, then will the excess of one division of B above one division of A, be compounded of the ratios of one of A to B, and of one of B to A.

For, let A contain 11 parts, then one of A to B is as 1 to 11, or 1/11. Let B contain 10 parts, then one of B to B is as 1 to 10, or 1/10. Now

\[ \frac{1}{11} \times \frac{1}{10} = \frac{1}{110} \]

Or if B contains \( n \) parts, A contains \( n + 1 \) parts; then \( \frac{1}{n} \) is one part of B, and

\[ \frac{n + 1}{n} = \frac{1}{A} \]

is one part of A. And

\[ \frac{n + 1}{n} = \frac{1}{A} = \frac{1}{n + 1} \]

or

\[ \frac{1}{n + 1} = \frac{1}{n} \]

The most commodious divisions, and their aliquot parts, into which the degrees on the circular limb of an instrument may be supposed to be divided, depend on the radius of that instrument.

Let R be the radius of a circle in inches; and a degree to be divided into \( n \) parts, each being \( \frac{1}{n} \)th part of an inch.

\[ \text{Then } 360^\circ = \frac{360}{n} \times 2 \pi \text{ to } \frac{\pi}{n} \times 2 \pi \]

\[ \text{Then } 360^\circ = \frac{360}{n} \times 2 \pi \text{ to } \frac{\pi}{n} \times 2 \pi \]

\[ \text{Or, } 0.01745329 \times R \text{ is the length of one degree in inches.} \]

\[ \text{Or, } 0.01745329 \times R \times p \text{ is the length of } \frac{1}{p} \text{th part of an inch.} \]

But as every degree contains \( n \) times such parts, therefore \( \text{if } 0.01745329 \times R \times p \), the most commodious perceptible division is \( 1 \) of \( \frac{1}{10} \) of an inch.

Example. Suppose an instrument of 30 inches radius, into how many convenient parts may each degree be divided? how many of these parts are to go to the breadth of the vernier, and to what parts of a degree may an observation be made by that instrument?

Now, 0.01745329 \( \times \) R \( = \) 0.2536 inches, the length of each degree; and \( p \) is supposed about \( \frac{1}{8} \) of an inch for one division; then 0.2536 \( \times \) \( \frac{1}{8} \) = 0.0318 shows the number of such parts in a degree. But as this number must be an integer, let it be 4, each being \( \frac{1}{4} \); and let the breadth of the vernier contain \( 11 \) of those parts, or \( \frac{1}{4} \), and he divided into 50 parts.

Here \( n = \frac{1}{4} \); \( m = \frac{1}{30} \); then \( \frac{1}{4} \times \frac{1}{30} = \frac{1}{120} \) of a degree, or \( 0.30 \), which is the least part of a degree that instrument can show.

If \( n = \frac{1}{4} \); \( m = \frac{1}{36} \); then \( \frac{1}{4} \times \frac{1}{36} = \frac{1}{60} \) of a minute, or \( 20' \).

\[ \text{The following table, taken as examples in the instruments commonly made from 5 inches to 8 feet radius, shows the divisions of the inch to the nearest tenths of inches, so as to be an aliquot of 60's, and what parts of a degree may be estimated by the vernier, it being divided into such equal parts, and containing such degrees as their columns show.} \]

\[ \text{Columns} \]

\[ \text{Columns} \]

\[ \text{Columns} \]
VERVAIN. See Verbesa.

VESICA, in anatomy, a bladder; a membranous or spongy part, in which any humour is contained.

VESICATORY, an external medicine, serving to raise a blister; whence it is also itself, though improperly, called a blister.

VESPA, a genus of insects of the order Hymenoptera. The generic character is, mouth with jaws, without proboscis; upper wings plicate; sting concealed; eyes lunetted; body smooth.

The genus Vespina is of great extent, 140 species; and is remarkable, like that of apis or bee, for the singular dexterity with which it constructs its habitation, which in many species is of considerable size. The common wasp, or vespa, is known to every one. The nest of this species is a highly curious structure, and is prepared beneath the surface of some dry bank, or other convenient situation. Its shape is that of an upright oval, often measuring ten or twelve inches at least in diameter; it consists of several horizontal stages or stories of hexagonal cells, the interstices of each story being connected at intervals by upright pillars; and the exterior surface of the pillars is very much like their upper parts, disposed over each other in such a manner as to secure the interior cavity from the effects of cold and moisture; the whole nest, comprising both walls and cells, is composed of a substance very much resembling the coarser kinds of whitish-brown paper, and consists of the fibres of various dry vegetable substances, agglutinated by a tenacious fluid discharged from the mouths of the insects during their operations. The female wasps deposit their eggs in the cells, one in each cell appropriated for that purpose; from these are hatched the larve or maggots, which, in resemblance to those of bees, they are led by the labouring wasps with a coarse kind of honey, and when arrived at their full size, close up their respective cells with a fine tissue of silken filaments, and, after a short period, emerge in their complete or perfect form. The male insects, resembling the male bee, is destitute of a sting. The society or swarm of the common wasp, consists of a vast number of neutral or labouring insects, with a small number of males, and still fewer females. They do not, like the bees, prepare and lay up a store of honey for winter use; but the few which survive the season of their birth, remain torpid during the colder months. Wasps in general are both carnivorous and frugivorous.

The hornet, vespa crabro of Linnaus, is a species of a far more formidable nature than the common wasp, and is of considerably larger size, its body is a tawny yellow with a ferruginous and black bars and variegations. The nest of this species is generally built in the cavity of some decayed tree, or immediately beneath its roots; and not unfrequently in timber-yards and other similar situations. It is of smaller size than that of the wasp, and of a somewhat globular form, with an opening beneath; the exterior shell consisting of more or less layers of the same strong paper-like substance as that prepared by the wasp; the cells are also of a similar nature, but much fewer in number, and less elegantly composed. The hornet, like the wasp, is extremely voracious, and preys on almost any kind of fresh animal substances which it can obtain, as well as honey, fruit, &c. &c. Its sting is greatly to be dreaded, and is often productive of very serious consequences.

A highly elegant wood is sometimes seen during the summer season, attached or hanging by its base to some straw or other projecting substance, from the upper part of unfrequented buildings or out-houses. It does not reach much the size of an egg, but is of a more globular form, and consists of several concentric shells, with considerable intervals between each, the interior alone being fresh and fringed with a small round orifice; the rest is only about two-thirds from the base of the nest. In the centre of the complete or entire bell, is situated the congeries of cells, built round a small central pillar attached to the base: the cells are not so much divided, and their orifices look downwards. See Plate Nat. Hist. fig. 417.

VESPERTILIO, bat, a genus of mammals, of the order Primates. The generic character is, size of the ear-pointed, approximately; hands palmated, with a membrane surrounding the body, and giving the animal the power of flight.

The formation of these animals cannot be contemplated without admiration; the bones of the extremities being continued into long and thin processes, connected by a most delicately formed membrane or skin, capable, from its thinness, of being contracted at pleasure, as into wrinkles, so as to lie in a small space when the animal is at rest, and to be stretched to a very wide extent for occasional flight.

Some speculative philosophers, not aware of the anatomical impossibility of success, attempt, by means of light machinery, to exercise the power of flight, he could not hit on a more plausible idea than that of copying the structure described, and their orifices look downwards. See Plate Nat. Hist. fig. 417.

VESPERTILIO, bat, a genus of mammals, of the order Primates. The generic character is, size of the ear-pointed, approximately; hands palmated, with a membrane surrounding the body, and giving the animal the power of flight.

1. Vespertilio murinus, the common murinus, is about two inches and a half, if measured from the tip of the tail; and the extent of the wings, when fully expanded, is about nine inches. It is of a mouse-colour, tinged with reddish; the wings and ears black; these latter are small and rounded.

2. Vespertilio auritus, or long-eared bat. This species, in its general appearance, is nearly similar to the former, though rather smaller; and the fur less of the reddish tinge; but what immediately distinguishes it as a species, is the very long ear-point of the hind, which is more than an inch long, and of a very considerable width; they are slightly rounded at the tips, and are furnished internally, as in most others of this genus, with a kind of secondary auricle or internal ear, so placed as to serve by way of a valve or guard to the auditory passage. Linnaus, even in the twelfth edition of the Systema Naturalis, seems to entertain a doubt whether this species is at all distinct from the former, or merely a sexual difference.

This and the former are the two most common species in this country; and are those which we so often see flitting about in the
It is also equally evident, that the fabulous
haunts of the antelopes must have originated
from a similar source: the larger bats of
India and Africa, by a little poetical exaggera-
tion of their manners, answering extremely
well to the general description of those mon-
sters.

3. Vespertilio noctula, the noctule bat, is
considerably larger than the former; its ex-
tended wings measuring from 14 to 15 inches;
the length from the nose to the tip of the tail
about four inches and a half. The nose is
slightly bilobated; the ears small and round-
down; the body is bluff; the shoulders very
thick and muscular; the fur very soft and glossy,
and of a bright chestnut-colour. This is an
inhabitant of Britain and of France, but seems
not to have been part-

4. Vespertilio ferrum equi,
the horse-shoe bat, with
a horse-shoe membrane
at the tip of the nose;
ears large, broad at the
base, and sharply-pointed, inclining backward;
no small or internal ear; colour of the
upper part of the body deep-cinereous; of
the lower, whitish. There is said to be
a greater and smaller variety; perhaps
the male and female. The greater is above
three inches and a half long from the nose to the tip
of the tail; the extent of wing is about 15
inches. Native of Guiana.

5. Vespertilio auripendulins,
slouch-eared bat, with
tail large, included in
the membrane, and terminated with a hook;
projecting above the chestnut, lighter on the
belly, and cinereous on the sides; length
three inches and a half, which gives the extent of wing 15
inches. Native of Guiana.

6. Vespertilio leporinus,
Peruvian bat. Linnaeus,
Mr. Pennant well observes,
carried away by the love of system, placed
this species as a third of the family Vespertilinae in the Systema
Nature, under a distinct genus, by the
name of noctula; stationing it at a great distance
from the rest of the bats, in the order gilies,
next to the squirls. This he did merely
on account of its having only two cutting-teeth
in each jaw. But succeeding observations
have conspired to prove that the number and
disposition of the teeth differ greatly in the
different species of the bats; so that if a too
rigid regulation was paid to this particular,
several distinct genera might be instituted in
stead of one; but the general characters of
the bats are so striking as to render this per-
fecfly unnecessary.

The Peruvian bat has a head something like
a pig-dog; the ears large and straight,
sharp at the ends, and pointing forwards;
two canine teeth, and two small cutting teeth be-
tween, in each jaw; tail enclosed in the
membrane while it is flying; hind leg, and
is also supported by two long carinlges
involved in the membrane; colour
of the fur iron-grey; body equal in size to a
flighting rat; extent of wing two feet five
inches. Mr. Pennant observes, that Mr.
Schréder’s figure of this species is erroneously
coloured, being represented covered with
brown. In an extraordinary con-
form, according to Seba, takes place in
the legs of this bat; the tibia and fibula being
placed separately from each other, and each
inserted by a joint and tendon. These, however,
seem to be nothing more
than the two carinlges
mentioned by Mr. Pennant.

The remaining species (except the last) are
distinguished by having no tails.

7. Vespertilio nasutus, great woolen bat,
with a very long, straight, and strong nose,
slipping down at the end; ears long, erect,
dilated towards the bottom, rounded at the end;
colour of the upper part a reddish
chestnut; sides of a clear yellow; remainder of
a dirty white; length five inches and
eight lines; extent of wings two feet.

This species is described in the supple-
menal volume of the count de Buffon’s Natural
History. It is a native of Guiana, where it
is chiefly seen on palm trees. The extent of wings is about two feet
or more; and from the nose to the
rump seven inches and a half. It has
a long nose; large teeth; long, broad, and
upright ears; and at the end of the nose
is an upright, long, conical membrane, bending
at the end. Hair on the body cinereous,
and pretty long; wings full of ruffled fibres; the
membrane extends from hind leg to hind leg.

There is no tail; but three tendons run from
the rump to the edge of the membrane.

Mr. Buffon supposes this to be the
vampire; but if the accounts of that animal’s
extraordinary faculty may be depended upon,
we are still uncertain as to the species; Piso
may be the correct name, who gives the
particular description of the animal; and
indeed, it is most probable that the faculty
which gave rise to the name is by no means
confined to a single species, but may be pro-
cumbent in some of our southern
climates. See Plate Nat. Hist. fig. 416.

9. Vespertilio vampyrus, vampire bat. Of
this tremendous animal there are some vari-
eties in point of size and colour; or perhaps
they may really be distinct races or species,
thought nearly allied. The largest, or
the great Terinate bat, is, in general, about a foot
long; with an extent of wings about four feet;
but sometimes it is found far larger, and it
has been said that specimens have been seen
of six feet in extent. The general colour of
the body is a deep reddish brown; brighter
on the upper part of the neck and shoulders,
as well as on the under parts of the body.
The nose is large and sharp; there are four cutting-teeth
above and below, and the canine teeth are
large and strong; the tongue is pointed,
and terminated by sharp prickles; the ears are
naked, black, and large, and are of a pointed
form. The wings are black, or the colour
of those of the common bat. The
membrane is divided behind, quite to the
rump, there being no tail; the single claw
of
the wings is large and strong, and those on the feet extremely so, as well as much curved. This is the bat to which Linnaeus applied the title of vampire, on the supposition of its being the species of which so many extraordinary accounts have been given relative to its power of sucking the blood both of men and cattle. This it is supposed to perform by inserting its acutated tongue into the vein of a sleeping person, in so peculiar a manner as not to excite pain, fanning at the same time the air with its wings, by which means the sleep rendered still more profound. This is what appears at first so extraordinary as to justify a degree of scepticism as to the fact: it is, however, so solennely related, and seemingly so well authenticated, as to enforce belief. Mr. Comhounne assures us, that the large bats have, in certain parts of America, destroyed, by this means, all the great cattle introduced there by the missionaries. It is affirmed by Bontius, as well as Niederoff, that the bats of Java attack those who sleep by day, and whenever they can gain access; and Gumilla, who mentions a greater and lesser kind, found on the banks of the Orinoco, declares them to be equally greedy after human blood. Persons who had, in consequence, been near passing from a sound sleep into eternity. It is, therefore, very unsafe to sleep with open windows, or in the open air, in those regions.

P. Martyr, who wrote soon after the conquest of South America, says, that in the islandus of Darien, there are bats which suck the blood of men and cattle, when asleep, to such a degree as to awaken, and even kill them.

An instance is also related in Colonel Stedman's Travels in Surinam, as having happened to himself, which puts the matter beyond a doubt.

Lastly, though it seems to have escaped the attention of modern naturalists, the same faculty has been, in time out of mind, attributed to the common European bats, which are said to bite sleeping persons, and to suck the blood with the greatest avidity. This is mentioned by Aldrovandus, and is a generally-received opinion; observing, at the same time, that their attacks are infinitely inferior to the dangerous ones of the large exotic bats in India and America.

It remains to explain the reason of the term vampire, by which the above large species has been distinguished.

A vampire is an imaginary monster, supposed to suck the blood of sleeping persons. It also alludes to one of the most absurd superstitions that ever entered into the human mind. About the year 1732, an idea arose among the vulgar in some parts of Poland and Hungary, that certain bodies when interred, became possessed of the power of absorbing blood from those who were so unfortunate as to pass over or stand near their graves; it was generally supposed necessary to disinter such bodies and wound them with a sword, by which means this pernicious power was supposed to be put to a stop, and the blood they had unjustly gained was released. Although it is very unlikely to appear, it is yet more astounding that a great many treaties were written on the subject, and that some considerable time elapsed before the superstition was completely destroyed.

VESTALS, vestesides, among the ancient Romans, the following titles of Vestas, and had the perpetual fire committed to their charge. They were at first only four in number, but afterwards increased to six; and it does not appear that their number ever exceeded six, among whom one was superior to the rest, and called vestals maxima.

The vestals were chosen from six to ten years of age, and obliged to strict continency for 30 years: the first ten of which were employed in the ceremonies of religion, the next ten in the performance of them, and the tenth in teaching them to the younger vestals. The habit of the vestals consisted of an head-dres, called infilia, which sat close to their heads, and whence hung certain laces called vitae, a kind of surplice made of white linen, and over it a purple mantle with a long train to it.

VESTIBULE, in architecture, a kind of entrance into a large building; being an open place before the hall, or at the bottom of the staircase. Vestibules intended for magnificence, are usually between the court and the garden.

VESTRY, a place adjoining to a church, where the vestments of the minister are kept; also a meeting at such place where the minister, curthicas, and principal men of most parishes, at this day make a parish vestry. On the Sunday before a vestry is to meet, public notice ought to be given, either in the church, or after divine service is ended, or else at the church-door as the parishioners come out, both of the calling of the said meeting, and also of the time and place of the assembling of it; and it is reasonable they also declare for what business the said meeting is to be held, that none may be surprised, but that all may have full time before, to consider of what is to be proposed at the said meeting. Watts, c. 39.

VESUVIAN, a mineral found in lava, especially at Vesuvius, and formerly confounded with hycnath. Its colour is brown or yellow, being found in masses, but usually crystalized in rectangular eight-sided prisms. The primitive form of its crystals is the cube. The specific gravity is from 3.39 to 3.4. It scratches glass; the fracture is imperfect. It causes double refraction. Before the blowpipe it melts into yellowish glass. It is composed of

26.5 silica
40.2 magnesia
16.2 oxide of iron
16.0 lime

98.9

VETCH, See Vicia.

VIBRATION, in mechanics, a regular reciprocal motion of a body, as a pendulum, &c. which, being freely suspended, swings or oscillates, first this way, then that.

VIBRIO, a genus of vernes infusoria. The generic character is, worm invisible to the naked eye, very simple, round, elongated. There are 20 species enumerated, and found chiefly in vegetable infusions.

VIBURNUM, a genus of plants of the class Stammidophores, and in the natural system arranged under the 43rd order. The calyx is quinquepartite and above; the corolla divided into five laciniae; the fruit a monospermous berry. There are 33 species, two of which are natives of Britain.

1. The lantana, common vibrinnium, way-faring, or plant mealy tree, having white flowers, with eight-brown barks; large heart-shaped, veined, serrated leaves, white and hairy underneath, and the branches terminated by umbels of white flowers, succeeded by bunches of red berries, &c.

2. The opulus, or Guelder rose, consisting of two varieties, one with flat flowers, the other globular. The former grows 18 or 20 feet high, branching oppositely, of an irregular growth, and covered with a whitish bark: and large dilated or three lobed leaves on glandular footstalks. The latter has large globular umbles of white flowers at the ends of the branches in great abundance. This tree when in blossom exhibits a singularly fine appearance; the flowers, though small, are collected numerous into three globular umbels, round like a ball; hence it is sometimes called snow-ball-tree.

VICT, common vulgarus, or evergreen vibrinnium. There are a great many varieties of this different species of vibrinnium, both deciduous and evergreen kinds, nothing being of the tree kind, are woody and durable in root, stem, and branches. They may all be propagated by layers; and are of such a nature as to grow freely in the open ground all the year, in shrubberies, and other hardy plantations.

VICAR, one who supplies the place of another. The priest of every parish is called the vicar, unless the parochial tithes are appropriated, and then he is called vicar; and when rectories are appropriated, vicars are to supply the rector's place. For the maintenance of the vicar, there was then set apart a certain portion of the tithes, commonly about a third part of the whole, which are now what are called the vicarial tithes, the rest being reserved to the use of the rectors, which for the like reason are denominated the rectorial tithes.

VICARAGE. For the most part vicarages were endowed with tithes; but sometimes vicarages have been endowed without any appropriation of the parsonage; and there are several churches where the tithes are wholly appropriated, and no vicarage endowed; and there the impropriators are bound to maintain curates to perform divine service, &c. The persons, patron, and ordinary, may create a vicarage, and endow it; and in time of vacancy of the church, the patron and ordinary may do it; but the ordinary alone cannot create a vicarage, without the patron's assent.

VICE, in smithery, and other arts employed in metals, is a machine, or instrument, serving to hold fast any thing they are at work upon, whether it is to be filed, bent, rivetted, &c. To file square it is absolutely necessary that the vice should be placed perpendicular, with its chaps parallel to the workbench.

Vice, hand, is a small kind of vice serving to hold the lighter works in, that require often turning about.

Of these there are two kinds: the broad-chopped hand-vise, which is commonly used; and the square-nosed hand-vise, sel-
VINE

Of these boodmen or villeins, there were two sorts in England: one termed a villain in gross, who was immediately bound to the lord of the manor for life, or for the term of his or her life; the other a villein regardant to a manor, being bound to his lord as a member belonging and annexed to a manor wheresoever the lord was owner.

Both villains regardant, and villains in gross, were transferable by deed from one owner or tenant to another. They could not leave their lord without his permission; but if they ran away or were purloined from him, might be claimed and recovered by action like beasts, or indeed small portions of land to sustain themselves and families; but it was at the mere will of the lord, who might dispossession them whenever he pleased. A villain could acquire no property either in lands or goods; but if he purchased either, the lord might enter upon him, and seize them to his own use. 1 Black. 93.

VILLARIA, a genus of plants of the class pentandria, and order dioecia pentandria. The calyx has five purple, or violet, petals; and is a three-celled berry. It seems to be little known.

VINCA, in botany, a genus of plants of the class pentandria, and order monogynia; and in the natural system arranged under the name of Solanum. There are two species; and there are two erect follicles; the seeds are naked. There are five species, only two of which are natives of Britain: 1. The major, or great periwinkle. 2. The minor, or small periwinkle.

VINCUM, in mathematics, a character in form of a line, or stroke, drawn over a factor, divisor, or dividend, when compounded of several letters or quantities, to connect them, and shew they are to be multiplied, or divided, &c. together by the other term. Thus \(a + b\).

VINDICATRIX, or Vindicatrix, a fixed star of the third magnitude in the constellation Virgo, whose latitude is 16° 12' 34" north, and longitude 5° 37' 40" of Libra, according to Mr. Flamsteed's catalogue.

VINE. See Vitis.

VINEGAR. See Acid, Chemistry, Acetic, and Acetous Acid.

Vinegar was known many ages before the discovery of any other acid, those only existing which were formed in vegetables. It is mentioned by Moses; and indeed seems to have been in common use among the Hebrews, and other Eastern nations, at a very early period. It is prepared from wine, beer, ale, and other similar liquids. These are apt, as every one knows, to turn sour, unless they are kept very well corked. Now sour wine or beer is precisely the same with vinegar.

Boehmna describes the following method of making vinegar, as is said to be still practised in different places:

Take two large oakens vats or hogheads, and in each of these place a wooden grate or hurdle at the distance of a foot from the bottom, and in the grate place a moderately close layer of green twigs or fresh cuttings of the vine. Then fill up the vessel with the foothills of grapes, commonly called the rape, to the top of the vessel, which must be perfectly dry.

Having thus prepared the two vessels, pour into them the wine to be converted into vinegar, so as to fill one of them quite up, and the other half-full. Leave them thus for 24 hours, and then fill up the half-full vessel with liquid from that which is quite full. Four-and-twenty hours afterwards repeat the same operation; and thus go on, keeping the vessels alternately full and half-full during every 24 hours till the vinegar is made. On the second or third day the wine will arise, in the half-full vessel, a fermentative motion, accompanied with a sensible heat, which will gradually increase from day to day. On the contrary, the fermenting motion is still incomprehensible in the full vessel; and as the two vessels are alternately full and half-full, the fermentation is by that means, in some measure, interrupted, and is only renewed every other day in each vessel.

When this motion appears to have entirely ceased, even in the half-filled vessel, it is a sign that the fermentation is finished; and therefore the vinegar is then to be put into a close-stopped, and kept in a cool place.

All that is necessary to convert wine or beer into vinegar, is the contact of the external air, a temperature of 80°, and the presence of some substance to act as a ferments. Vinegar is a liquid of a reddish or yellowish colour, a pleasant sour taste, and a agreeable odour. Its specific gravity varies from 1.0135 to 1.0251, and it differs also in its other properties according to the liquid from which it has been produced. It is very subject to decomposition; but Scheele discovered that if it is made to boil for a few moments, it may be kept afterwards for a long time without alteration. Besides acetic acid and water, vinegar contains several other ingredients, such as mucilage, tarring, a colouring matter, and often also two or more vegetable acids. When distilled at a temperature not exceeding that of boiling water, till about two thirds of it have passed over, all these impurities are left behind, and the product is pure acid diluted with water.

The acid thus obtained is a liquid as transparent and colourless as water, of a strong acid taste, and an agreeable colour, somewhat different from that of vinegar. In this state it is usually called acetic or distilled vinegar. See Acetous Acid.

It may be preserved without alteration in close vessels. When exposed to a moderate heat, it evaporates completely, and without undergoing any change in its properties. When exposed to the action of cold, part of it congeals. The frozen portion, which consists almost entirely of water, may be easily separated; and by this method the acid may be obtained in a high degree of concentration. The more concentrated the acid is, the greater is the cold necessary to produce congelation. Mr. Lowitz has ascertained that the acid itself, how much soever it may be concentrated, crytalizes or congeals at the temperature of — .

When acet of copper, reduced to powder, is put into a retort and distilled, there comes over a liquid at first nearly colourless, and almost insipid, and afterwards a highly concentrated liquid. The distillation is to be continued till the bottom of the retort is dry. What remains in it is then only a powder of the colour of copper. The acid produced,
which should be received in a vessel by itself, is tinged green by a little copper which passes along with it; but when distilled over again in a retort, it is perfectly colorless and transparent. The acid thus obtained is exceedingly pungent and concentrated. It was formerly distinguished by the names of radical vinegar, and vinegar of Venice.

This acid is transparent and colourless like water. It has a peculiar aromatic smell when in the state of acetic acid: but concentrated acetic acid, when procured in the usual way, has a very perceptible, almost tobacco-like odor, mixed with the natural shell of vinegar, owing to a small portion of oil formed during the process.

A much easier method of obtaining acetic acid than that commonly used has been lately pointed out by Mr. Balhofer, apothecary at Chatteris.

All that is necessary is to distil a mixture of equal parts of acetate of lead and sulphat of copper in a glass retort. The acid comes perfectly pure on the application of a moderate heat.

The specific gravity of distilled vinegar varies from 1.007 to 1.0095; but radical vinegar is much more concentrated. In that state it is extremely pungent and acid; and when it is applied to the skin, it is reddish and corrodes it in a very short time. It is exceedingly volatile: and when heated in the open air, takes fire so readily, that one would be tempted to suspect the presence of ether in it. It unites faster than water in any proportion; and as it is more concentrated, the mixture evolves a good deal of heat. See ACID, CHEMISTRY, &c.

VINEYARD, a plantation of vines. See Vine.

The best situation of a vineyard is on the declivity of an hill, lying to the south. For the planting of a vineyard, observe the following method: In the month of July, while the outermost coat of the earth is very dry and combustible, plough up the sward; den- shire, or burn-beat it, according to art, and in January following, spread the ashes. The ground being thus prepared, cut your trenches across the hill, from east to west, because the vines being thus in ranks, the rising and setting of the sun will by that means pass through the intervals, which it would not do if they were set in any other position, neither would the sun dry its rays upon the plants during the whole course of the day.

Afterwards strain a line, and dig a trench about a foot deep; place your sets in it, about three feet distance one from another; trim off the superfluous roots, leaving no more than three or four eyes or buds upon that which is above ground; and plant them near half a foot deep, sloping, after the manner the quick is commonly set, so that they may point up the hill. That done, take long dung or straw, and lay it on the trenches in a convenient thickness to cover the earth, and preserve the roots from the dry piercing winds, which would otherwise much annoy them, and from the excessive searching heats in summer: keep them well hoed, and free from weeds, and water them as occasion serves; the best time to plant is in January.

The first pruning of the new-set vine ought not to be done, however, and till you should cut off all the shoots as near as you can, spar- ing but one of the most thriving, on which you are to leave only two or three buds, and so let all rest till May, the second year after planting. Take care then from time to time to destroy the weeds, and clear the roots of all suckers and old shoots, and to give the virtue of your sets. The same method is to be followed the third year; then dig your whole vineyard, and lay it very level, taking care in this operation not to cut or wound any of the main roots with your grades. If you have the younger roots, it is not so material, as they will grow the thicker; and this year you may enjoy some of the fruits of your vineyard, which, if answerable to your expectations, will tempt you to put your present plants and your vines of about four feet long, which must be placed on the north side of the plant. In May, rub off such buds as you suspect will produce superfluous branches. When the grapes are about the size of birding-shot, break off the branches with your hand at the second joint above the fruit, and tie the rest to the prop: here it is most ad- visable to break, and not cut, your vine; because wounds made with a sharp instrument are not apt to heal, but cause the plants to bleed. See PRUNING.

The fourth year you will be likely to have three or four shoots to every plant; and, in the fifth, many more, if kept in a proper state. The branches, except one of the strongest and most thriving, leave for a standard about four feet high, paring away the rest very close to the body of the mother-plant, which tie to your prop till it is large enough to make a standard of itself. Neither must you suffer any shoot to break out, but such as sprout at the top, four feet from the ground: all which sprouts the French usually prune off every year, and absolutely trust to the new sprouts that are only bearing shoots.

In August, when the fruit begins to ripen, break off such shoots as you find too thick; and if you perceive any plant bleed, rub some ashes on it; or, if that will not do, sear it with a hot iron. When, upon stirring your vineyard, it appears to be poor, prune the vines as before directed; and spread good dung, mixed with lime, over the whole surface of the ground in the winter to warm into the earth, mixing about ten bushels of lime with a load of dung; and if some ashes and soot are likewise thrown on, it will do well. Turn in this manure about the February, with a slight dressing of lime, on the top of the ground, but not too deep, which should be done in a dry season, and not in wet weather, lest it should make the ground bind too much, and occasion the growth of rank weeds.

VIOL, a stringed instrument resembling in shape and tone the violin, of which it was the origin; that impressive and commanding instrument being little more than an improve- ment of the old viol. This instrument formerly consisted of five or six strings, the tones of which were regulated by their being brought by the fingers into contact with the frets with which the neck was furnished. The viol was for a long while in such high esteem as to dispute the pre-eminence with the harp, espe- cially in the early times of music in France; and, indeed, being reduced to four strings, and stripped of the frets with which viols of all kinds seem to have been furnished till the six-teenth century; it holds the first place among treble instruments, under the denote- mination of violin.

VIOLA, a tenor violin. This instrument

is similar in its tone and formation to the violin; but its dimensions are somewhat greater, and its compass lower in the great scale of sounds. Its lowest note is C on the fourth space in the bass. The part it takes in concert is between that of the bass and the second violin.

VIOL, a genus of plants of the class syn- genesia, order monogynia; in the natural system arranged under the 29th order, cam- panaceae. The calyx is pentaphyllos; the corolla five-petalled, irregular, with a necta- rim behind, horn-shaped; the capsule is above the germen, three-valved, monocollicular. There are 43 species, six of which are natives of Britain. The most important of these are:

1. The palastris, marsh violet. The leaves are smooth, reeniform, two or three on each footstalk; flowers pale blue, small, inodorous.
2. The odorata, purple sweet violet, has leaves heart-shaped, notched; flowers deep purple, single; creeping scions. The flowers of this plant taken in the quantity of a dram or two, are said to be gently purgative or taxative, and, according to Bering and some others, they possess the small pectoral and vertebre quality. There is a variety with white flowers.
3. Tricolor, pansies, heart's-ear, or three faces under a hood. The stems are diffuse, procumbent, triangular; the leaves oblong, cut at the edges; the flowers purple, yellow, and light blue, inodorous. This elegant little plant merits culture in every garden, for the beauty and great variety of its three-coloured flowers; it will succeed in the open borders, or other compartments, espoused in patches towards the frost, either by sowing the seed at once to remain, or by putting in young plants. They form the flowers early in summer, and will continue shooting and flowering in succession till winter; and even during part of that season in mild weath- er. The common violet is propagated by parting the roots, sometimes by seed, but the well-known stringed instrument of brilliant tone and active execution. When, or by what nation, this important and interesting instrument was first invented, is not at present known; nor the form and change in the instrument used by the English in the time of Chaucer, who men- tions it, be exactlyascertained. There is, however, much reason for supposing that, from its first introduction it underwent con- tinual alterations and improvements, since even towards the end of the sixteenth cen- tury its shape appears to have been vague and undefined. It has, however, long attained its present excellence, and formed an integral part of every musical instrument. The four strings of which it consists are tuned in fifths from each other. The pitch of the lowest string is G, under the second ledger line in the treble stave; consequently that of the next is D, under the first line of the stave- the pitch of the next above that, A on the second space; and that of the upper string, E, on the fourth space. During the Protector- ship the violin was in little esteem, and gave place to the viol; but at the Restoration, violins began to be of fashion, and violins resumed their for- mer consequence. The antiquity of this instru- ment has long been a subject of dispute.
VIT

with the learned. It is generally supposed, and with much reason, that no instrument laid with the bow was known to the ancients.

VIOLONCELLO, a bass viol, containing four strings, the lowest of which is tuned to double C. The strings are in fifths, consequently the pitch of that next the gravest is $\frac{3}{4}$ an octave; that of the next, D on the third line in the bass; and that of the upper string, F on the fifth line. The violoncello was called the violoncini, a diminutive of the introduction of the double-bass, which assumed that name.

VIPER. See Coluber.

VIRGATA, a genus of plants of the

VIRGO, in astronomy, one of the signs or constellations of the zodiac, and the sixth according to order.

VISEREA. See Anatomy.

VISCUM, a genus of plants of the class Dioscoreaceae, order Tetradneida, and in the natural system arranged under the 46th order, aggregate. The male calyx is quadrinerved; the anthers adhere to the calyx; the female calyx is convex; the stigmas are of the style; the stigma is obtuse; there is no corolla; the fruit is a berry with one seed. There are 12 species, only one of which is a native of Britain, viz., the album, or common mistletoe. It is a shrub growing on the bark of several trees. The leaves are conjugate and elliptical; the stem forked; the flowers whitish in the axil of the leaves. This plant was reckoned sacred among the Druids.

VISION, in law, an act of jurisdiction whereby a superior, or proper officer, visits some corporation, college, church, or other public or private house, to see that the laws and regulations thereof are duly observed.

VITATUM, in law, a court of visitation performed by the bishop in every diocese once in three years, or by the archdeacon every year, by visiting the churches and their rectors throughout the whole diocese. The bishop or commendatory also holds a court of visitation, to which he may cite all churchwardens and wardens; and to whom he exhibits his articles, and makes inquiry by them.

VISMEA, a genus of the dodecandria trigny class and order of plants. The calyx is five-leafed, inferior; the corolla five-petalled; stigmas five; nect. two or three-celled. There are two species, a native of the Canaries.

VITEN, the chaste-tree, a genus of the

didynamia angiosperma class of plants, with a monopetalous ring, and bilabiated flower, each lip of which is tripart; the fruit is a quadrilocular, globose berry, containing four seeds. There are 14 species.

VITIS, a genus of the class pentandria, and order monogynia; and in the natural system arranged under the 46th order, pectoracea. The petals cohere at the top, and are withered; the fruit is a berry with five seeds. There are 25 species; the most important of which is the vinifera, or common

VINE, which has naked, lobed, sinuate leaves. There are many great varieties; but a reclass of their names would be tiresome without being useful. All the sorts are propagated by cuttings or grafting, the former of which methods is generally practised in England, but the latter is much preferable.

In choosing the cuttings, you should always take such shoots of the last year's growth as are strong and well ripened; these should be cut from the old vine, just below the place where they were produced, taking a knot or piece of the two years' wood to each, which should be pruned smooth; then you cut off the upper part of the shoots, so as to leave the cutting about 16 inches long. When the piece or knot of old wood is cut at both ends, near the young shoot, the cutting will resemble a little mallet; whence Colonna gives the title of malletus to the vine-cuttings.

In making the cuttings after this manner, there can be but one taken from each shoot; but most persons cut them into lengths of about a foot, and plant them all.

When the cuttings are properly prepared, if they are not then planted, they should be placed with their lower part in the ground in a dry soil, laying some litter upon their upper parts to prevent them from drying. In this state they may remain till the beginning of April (which is the best time for planting them); when you should take them out, and wash them from the filth they have contracted; and if you find them very dry, you should let them stand in small pans of water six or eight hours, which will disentend their vessels, and dispose them for taking root. If the ground is strong and inclined to wet, you should open a trench where the cuttings are to be planted, which should be filled with lime-rubbish, the better to drain off the moisture; then raise the borders with fresh light earth about two feet thick, so that it may be at least a foot above the level of the ground; then you should open the holes at about six feet distance from each other, putting one good strong cutting into each hole, which should be laid a little sloping, that their tops may incline to the wall; but it must be kept so deep, that the eye may be level with the surface of the ground; for when any part of the cutting is left uppermost, most of the buds attempt to shoot, so that the strength of the cuttings is divided among many; and consequently be weaker than if only one of them grew; whereas, by burying the whole cutting, the sap is all employed on one single shoot, which consequently will be much stronger; besides, the sun and air are apt to dry that part of the cutting which remains above ground, and so prevent the buds from shooting.

Having placed the cutting in the ground, fill up the hole gently, pressing down the earth with your foot close about it, and raise a little hill just upon the top of the cutting, to cover the upper eye quite over, which will prevent it from drying. Nothing more is necessary than to keep the ground clear from weeds until the cuttings begin to shoot; at which time you should look over them carefully, to rub off any small shoots, if such are produced, first射击 the main shoot to which they are attached, which should be tied up as the vine is extended in length, to prevent its breaking or hanging down. You must con-
received at least three or four tons of wine annually as tithe, from the produce of the vineyards in his diocese, and to have made free remissions in his leases of a certain quantity of wine for it. In the reign of King Edward IV., the vineyards in London, which now forms East Smithfield, and some adjoining streets, was withheld from the religious house within Aldgate by four successive constables of the Tower, in the reign of Richard Henry, and Stephen, and made by them into a vineyard, which yielded great emolument. In the old accounts of rectorial and vicarial revenues, and in the lists of episcopal and ecclesiastical suits concerning them, the title of wine is an article that frequently occurs in Kent, Surrey, and other counties. And the wines of Gloucestershire, within a century after the Conquest, were little inferior to the French in sweetness. The beauty of their fruit appeared till the 15th century, when they had not a single vine in the days of Caxton, had numbers so early as the time of Strabo. The south of it was particularly stocked with them; and they had even extended themselves into the interior parts of the country, but the grapes of the latter did not ripen kindly. France was famous for its vineyards in the reign of Vespasian, and even exported its wine to Egypt. The whole province of Narbonne was then covered with vines, and the vine-wine of the country were remarkable for knavish dexterity, tinging it with smoke, colouring it (as was suspected) with dried and noxious dyes, and even adulterating the taste and appearance of it. It was, no doubt, a remarkable fact, that as our first vines would be transplanted from Gaul, so were in all probability those of the Allobroges in Franche-comté. These were peculiarly fitted for cold countries. They ripened even in the frosts of the advancing winter; and they were of the same colour, and seem to have been of the same species, as the black muscadines of the present day, which have lately been tried in this island, and found to be fittest for the climate. These were probably brought into Britain a little after the vines had been carried over all the kingdoms of Gaul, and about the middle of the 1st century, when the numerous plantations had gradually spread over the face of the latter, and must naturally have contributed to their progress into the former.

The Romans, even nearly to the days of Lucullus, were very seldom able to regulate themselves with wine. Very little was then raised at the compass of Italy; and the foreign wines were so dear, that they were rarely produced at an entertainment; and when they were, each guest was indulged only with a single draught. But in the seventh century of Rome, as their conquests augmented the degree of their wealth, and enlarged the sphere of their luxury, wines became the object of particular attention. Many vats were constructed, and good stocks of liquor were deposited in them; and this naturally gave encouragement to the wines of the country. The Falernian rose immediately into great repute; and a variety of others, that of Florence among the rest, succeeded it about the close of the century; and the more westerly parts of the European continent were at once subjected and enriched with the wines of Italy. See VINEYARD, and WINE.

VITIMANNA, a genus of plants of the class and order octandria monogynia. The calyx is four-leaf; corolla four-petalled; stamens, the scale of the base of each filament, is semi-anther, one-celled. There is one species, a tree of the East Indies.

VITREOUS humour of the eye. See OPTIC.

VITRIOL, or sulphur of iron. This salt was known to the ancients, and is mentioned by Pliny under the names of pyrosyris, and calcanthum. In commerce it is usually denominated green vitriol, or copper vitriol. It is not prepared by dissolving iron in sulphuric acid, but by moistening the pyrites which are found native in abundance, and exposing them to the open air. They are slowly covered with a crust of sulphate of iron, which is dissolved in water, and afterwards obtained in crystals by evaporation. Sometimes the salt is found ready-formed, either in a state of solution in water, or mixed with decayed pyrites. In some cases it is found necessary to roast the pyrites before they can be melted, to undergo spontaneous decomposition. This is most probably owing to the compact state of the pyrites in these cases, and the absence of all combined iron. Pyrites is in fact a supersulphuret of iron, or a sulphate of iron. These species of the earth are generally found in the state of a sulphuret of iron, which decomposes very readily.

Sulphate of iron has a fine green colour. Its crystals are transparent rhomboidal prisms, the faces of which are rhombi with angles of 70° 30' and 109° 10', inclined to each other at angles of 98° 37' and 81° 27'. It has a very strong styptic taste, and always reddens vegetable juices. Its specific gravity is 1.3939. It is soluble in about two parts of cold water, and in thirds of its weight of boiling water. It is insoluble in alcohol.

VITRIOL, blue, or sulphate of copper. Sulphuric acid does not attack copper while cold, but at a boiling heat part of the acid is decomposed, the copper is oxidized, and combines with the remainder of the acid. But recourse is seldom had to this process, as the sulphate of copper is found native abundantly, dissolved in mineral waters connected with copper-mines. From these waters it is often obtained by distillation; or it is formed by burning native copper, or by moistening that substance, and exposing it to the air. By either of these methods the sulphur is added, and the sulphate of copper formed. It then appears to have been known to the ancients. In commerce it is distinguished by the name of blue vitriol, and sometimes by that of blue copperas. It is, in fact, an oxysulphate. There are two varieties of this salt known, namely, super-sulphate, and subsulphate.

VITRIOL, white, or sulphate of zinc. This salt, according to the best accounts, was discovered at Rammelsberg in Germany about the middle of the 16th century. Many ascribe the invention of it to the Duke of Brunswick. Henkel and Newmann were the first chemists who proved that it contained zinc; and Brandt first ascertained its composition completely. It has generally been formed for commercial purposes, to supply the sulphate of zinc, or blende, as it is called by mineralogists. This ore is roasted, which converts the sulphur into an acid; it is then dissolved in water, and concentrated, so that, on cooling it crystallizes very rapidly, and forms a mass not unlike laid-sugar. This salt is usually called white vitriol. It is almost always connected with iron, and often with copper and lead. Hence the spots which are visible on it, and hence also the reason that in its solution in water lets fall a dirty-brown sediment; a circumstance very much explained by surgeons when they use that preparation. The solution is then to be evaporated, and the sulphate of zinc may be obtained from it in crystals by proper evaporation.

We have inserted these three articles under the vulgar names in compliance with a common prejudice. They are, however, noticed under their proper head; and a true advancement of chemical knowledge will shortly banish these barbarous terms.

VITUS'S DANCE. See MEDICINE.

VIVERRA. See MEDICINE.

VIVERRA, or Family of Quadrupeds of the order of foxes. The generic characters are--teeth six, sharpish; canine teeth longer; tongue in some smooth, in others acutated above; body of a lengthened form. This genus comprehends certain species of the viverrine and linncean family, in which latter genera the otters are also included. This particular species, Mr. Pentrant seems to have named judiciously, for it is certainly viverrine.

We shall therefore follow his example, and unite the two genera, preserving the name Viverra, in contradistinction to the generic name Mus, which is smaller.

The general character of the viverrine tribe (of which there are about 31 species) is, a certain slenderness and length of body; with a shaggy visage, short legs, and, in most species, a longish tail (though in some few it is short).

1. Viverra Ichneumon. The ichneumon is a species of which there seem to be two distinct varieties, one of which is a native of India, and the other of Africa. The African is by far the larger in their general appearance, but the Indian variety is considerably larger than the Indian, measuring more than forty inches from the point of the tail to the end of the same; whereas the Indian ichneumon scarcely reaches one-third of this length. Exclusive of size alone, the Egyptian ichneumon is distinguished by having the tail slightly tufted at the end, which the other has not; and from this circumstance it is placed, in the Ometian edition of the Systema Naturae, as a distinct species. The ichneumon is of a pale reddish-grey colour, each hair being mottled with brown or dusky spots, so that the whole appears speckled in the manner of the hair on some of the large baboons. The eyes are of a bright red or flame-colour; the ears rounded, and almost closed; the nose long and slender; the body rather thicker than in most of this genus; and the tail is very thick at the base, and then gradually tapers almost to a point; the legs are short; the hair on the whole animal is bristled, and coarse, and it varies somewhat as to the colour and cast of its colours in different individuals. In India, but particularly in Egypt, the ichneumon has always been considered as one of the most useful and estimable animals; since it is an inveterate enemy to serpents, rats, and other noxious creatures.
which infest those regions. In India it attacks, with the greatest eagerness and courage, that most dreadful reptile the cobra de pellejo, or hooded snake, and easily destroys it. It also haunts the woods for the eggs of serpents and crocodiles; for which reason, as well as for its great usefulness in destroying all manner of troublesome reptiles, it was held in such a high degree of veneration by the ancient Egyptians to be regarded in the light of a minor deity, one of those benevolent beings proceeding from the parent of the universe.

For the purposes above specified it is still domesticated by the Indians and Egyptians; and it has also the merit of being easily tamed, and of performing all the services of the cat with a still greater degree of vigour and acuteness. When in pursuit of prey, it sometimes springs suddenly upon it with the greatest agility; and at other times will glide along the ground like a serpent, without raising its body, till it arrives at a proper distance for its intended attack. Of the other animals of this genus, the most dangerous enemy to several creatures larger than itself; over which it gains a ready victory, by fastening itself upon them, and sucking their blood. In a word, it is the principal agent in the banks of rivers; and in times of flood to approach the higher grounds and inhabited places, in quest of prey. It is reported to swim and dive occasionally, in the manner of the otter; and to continue beneath the water for a great length of time.

The ichneumon is found not only in various parts of India, but in the Indian islands, as Ceylon and others. It also occurs in many parts of Africa besides Egypt, as in Barbary, and at the Cape of Good Hope, &c. &c. as it is a native of warm countries, it is of course greatly injured by a removal to the colder regions of Europe, and generally falls a victim to the alteration of climate. See Plate Nat. Hist. fig. 418.

2. Viverra surikatta. The surikata is distinguished by a long sharp-pointed nose, depressed head, and inclined cheeks; the upper jaw is much longer than the lower, and on its upper part, the lower jaw is shorter; the tail is round black; the ears are small and rounded; the tongue is oblong, blunt, and acutated backwards; the length of the animal, exclusive of the tail, is about a foot, and of the tail about eight inches; the legs are short; the claws on the fore feet much exceed in length those of the hind feet. The general colour of the surikata is a deep grey; the tail is subferruginous, tipped with black. It is an inhabitant of the Cape of Good Hope, where it is called meerkat. It feeds on fresh, and preys on mice, and other small animals. It commonly sits erect, in the manner of a squirrel; and when pleased makes a rattling noise with its tail, for which reason it is also surikata. It is also found in the islands of Java, where it is named surikatje by the Dutch, on account of a peculiar acid scent, which it is said to emit. It is an inhabitant of the Cape of Good Hope, and is often seen in a state of captivity. In having only four toes, it differs from most of this tribe.

3. Viverra nausa. The size of this animal is at least equal to that of a cat. Its general colour is a cincereous brown, or ash-colour, with a cast of reddish; the tail, which is of very considerable length, is annulated with short biting circles of black; its most remarkable character is the long, flexible snout, somewhat truncated at the end. By the assistance of this it turns up the earth, in the manner of a hog, in quest of earthworms, &c. Like the polecat, it also preys on the smaller quadrupeds, birds, &c. It is a native of South America, and seems to have been first described by Mariegrave in his History of Brazil. There is a particularity sometimes observable in this animal, which seems worthy of notice, viz. a kind of protrusion of the skin at the back of the heel into several horny processes, of about a quarter of an inch in length; these in some specimens are scarcely visible. The tongue is marked on the upper part with several furrows, so disposed as to resemble the fibres of a leaf.

4. Viverra vulpulca. Coarse. This animal is about the size of the polecat, measuring 18 inches from nose to tail. The tail is long and slender. The whole animal is of a deep black, or blackish chocolate-colour, but the tail is sometimes mixed with white. It is a native of Mexico and many other parts of America, and colours the power of emitting its oil, when attacked or irritated, such powerful offensive effluvium, as, in most instances, effectually to disinfect and repel its pursuers.

5. Viverra striata. Striped weasel. It has been imagined, and not without a degree of probability, that this animal is the female of Viverra vulpulca, or coase. It is of the same size and general aspect, but is distinguished by five parallel longitudinal white stripes on the back; the tail is very bushy or full of hair. In the different specimens of this animal there is some slight variation observable in the proportion of the dorsal stripes, as well as in the colour of the tail, which is sometimes marked with a pair of lateral white bands, and sometimes almost entirely white. Its manners and horrid va pour, when irritated, perfectly agree with the viverra vulpulca; and the same description of this offensive quality may be applied to some other species. It seems as if, on account of this odious vapour are not aggravated by the abhorrent recollection of those who have experienced its effects, every other ill smell which nature can produce is surmounted by the overpowering force of these extraordinary quadrupeds. In consequence of the dreadful emanation, the dogs are said to relinquish their pursuit, and the men toly with precipitation from the tainted spot; and if unfortunately the last particle of the fluid which the animal commonly discharges at this juncture, should happen to light on the clothes of the hunter, he becomes a general nuisance wherever he appears, and is obliged to divest himself of his dress, and practice all the arts of ablation, in order to be restored to the society of mankind.

To add to the history of these strange circumstances, it is affirmed that the animal is sometimes turned, and rendered domestic, in which state it is to be considered as a pet. It has a subglandular vesicle, or gland of a peculiarly acid and caustic nature, which is used in medicine, in the same state of a powder, and is also used in the preparation of unguents and perfumes. It is said that the Chinese, the Malays, and the inhabitants of the Cape call it klapper-maus. It is also found in the islands of Java, where it is named surikatje by the Dutch, on account of a peculiarly acid scent, which it is said to emit. It is an inhabitant of the Cape of Good Hope, and is often seen in a state of captivity. In having only four toes, it differs from most of this tribe.

6. Viverra capensis. The Cape weasel, or one of the larger animals of the genus, measuring two feet from nose to tail, which is eight inches long. Its colour is a cincereous grey above, and brownish black below; the two colours being separated along the whole length of the animal, from the head to the tip of the tail, by a stripe of the same white; the ears are scarcely visible; the tail rather thick; the legs rather short, and the head large; the snout short and somewhat pointed; the body seems of a thicker form than is usual in this genus. This animal, when irritated, ejects a fetid liquid, accompanied by a smell as insufferable as that of some of the American weasels or skunks, and productive of the same effects.

7. Viverra ceylon. The ceylon viverra, or civet, by the name of the civet-cats, is a native of several parts of Africa and India. The general length of this animal, from nose to tail, is something more than two feet, and the tail measures fourteen inches. The greater part of the body is yellowish ash-grey, marked with large blackish, or dusky spots, disposed in longitudinal rows on each side, and sometimes a tinge of ferruginous appears intermixed, the hinder parts, and along the top of the back stand up, so as to form a sort of mane; the head is of a lengthened or sharpish form, with short rounded ears; the eyes are of a bright sky-blue; the tip of the nose black, the sides of the face, chin, breast, legs, and feet, are black; the remainder of the face, and part of the sides of the neck, are of a yellowish white; from each ear are three black stripes, terminating on the tip and shoulders; the tail is generally black, but sometimes is marked with pale or whitish spots on each side the base. It is an animal of a wild disposition, and lives in the usual manner of others of this genus, as it feeds on carrion, noisily quadrupeds, &c. It is remarkable for the production of the drug called civet (sometimes erroneously confounded with musk). This substance is a secretion formed in a large double glandular receptacle, situated at some little distance beneath the tail, and which the animal empties spontaneously. When the civet-cats are kept in a state of confinement (as is usual with the perfumers at Amsterdam and other places), they are induced by time, in strong wooden cages or receptacles, so constructed as to prevent the creature from turning round and biting the person employed in collecting the secreted substance: this operation is said to be generally performed twice a week, and is done by scraping out the civet with a small spatula, or sponge. This substance is of a yellowish colour, and of the consistence of an unguent; of an extremely strong and even unpleasant odour when fresh, so as sometimes to cause giddiness and headache, but becomes more agreeable by keeping; the quantity obtained each time amounts about a dram.
VIVERRA.

8. Viverra zibetha. Zibet. This, which is figured as a variety by Geay, and more precisely discriminated by Buffon, seems to be considered by modern naturalists as a distinct species. The zibet is chiefly found in Asia and the Indian islands. Its general spact is similar to that of the forms species, but its snout is somewhat sharper, and its tail longer.

In short, this species may be called the Indian, and the former the African, civet.

In disposition and manners they both appear to agree, as well as in the secretion of the perfume before described, which is collected from both animals in the same manner.

9. Viverra geneetta. The geneet is one of the most beautiful animals of this genus. It seems to be of the size of a very small cat, but is, on the contrary, a form with a sharp-pointed snout, bright eyes, slightly pointed, and very long tail.

The colour of the geneet is generally light reddish gray, with a black or dusky line running along the back, where the hair is much longer than on the other parts, and from the appearance of a very slight shine among the sides of the body run rows of roundish black spots, which sometimes in- clude the tail to a squarish form; the muzzle is dusky; beneath the eye is a white spot; the cheeks, sides of the neck, and the hairs of the ears are spotted in a proportionally smaller pattern than the body, and the tail is annulated with black.

The geneet is an animal of a mild disposition, and easily tamed. In various parts of the East, as well as in Constantinople, it is domesticated like the cat, and is said to be equal, or superior, to that animal in clearing houses from rats or mice. It is a cleanly animal, and has a slight musky smell. It is a native of the western parts of Asia, but is said likewise to occur in Spain, and even occasionally in some parts of France.

10. Viverra fossa. The fossa appears to be closely allied to the geneet, that it might almost pass for a variety of that animal. This animal is a native of Madagascar, Guiana, Bocas, Cochininha, and the Philippine Islands. It is said to be possessed of considerable strength, and to be very difficult to tame. It destroys poultry in the most ruinous manner.

The fossa is a large animal, having a prehensile tail, ten inches in length from the nose to the throat, which is seventeen inches long. The nose is short and dusky; the eyes small; the ears short, broad, and hairy, and placed at a great distance from each other; the head flat and broad; the cheeks swelling out, the tongue very long; the legs and thighs short, thick, with five toes to each foot; claws are, slightly hooked, and flesh-colored, to court yelpers. A skilful or dexterous hunt runs down the back, on the tail to tail, and a similar one half way from the belly. This animal is of gentle manners, active and playful, and hangs by its tail, the manner of the prehensile-tailed monkeys. It is supposed to be native of Jamaica.

11. Viverra foina. The foina is a small animal of a highly elegant appearance. Its general length, from nose to tail, is about the height of a botanic half, and the tail is ten inches long.

The maron is of a blackish tawny colour, with a white throat; and the belly is of a dusky brown, with a lilac, or full of hair, and of a darker colour than the dusky parts; the ears are moderately large and rounded, and the eyes lively. This animal is a native of most parts of Europe; inhabiting woods and thickets, and preying on birds and other small animals. If taken young, it may be easily tamed, and even rendered domestic. It breeds in the hollows of trees, and brings forth from three to five young.

The skin of the foina is valuable.

12. Viverra zibellina. The sable is greatly allied to the maron in its appearance, but has a longer or sharper head, and more lengthened ears. Its general colour is a deep glossy brown; the hair being ash-coloured at the roots and black at the tips; the chin is cinereous, and the edges of the ears yellow. Its size is equal to that of the maron; but, exclusive of other differences, a principal one consists in the tail, which is much shorter in the sable than in the maron. The sable is an inhabitant of the northern parts of Asia, and is an extremely important article in the fur-trade. It principally lives in holes under ground, especially under the roots of trees, which, like the maron, forms its nest in the hollows of trees. It is an active, lively animal, preying, in the manner of the maron, on the smaller quadrupeds, birds, &c. Like the maron, it is also more lively during the night, and sleeps much by day. In autumn the sable is said to eat cranberries, whortles, &c. It brings forth early in the spring, and has from three to five young at a time. The chase of the sable, according to Mr. Pennant, was, during the more barbarous periods of the Russian empire, the principal task of the unhappy exiles who were sent into Siberia, and who, as well as the soldiers sent there, were obliged to furnish, within a given time, a certain quantity of furs; but as Siberia is now become very populous, the sable have a great measure quitted it, and have retired farther to the north and east, into the desert, forests, and mountains.

Sables are numbered among the most valuable of furs. From an abstract drawn up by the late Dr. Forster, from Muller's account of its commercial history, it appears that the price varies, from one to ten pounds sterling and above. The blackest, and that which have the finest bloom or gloss, are repented the best. The very best are said to come from the confines of Norway and Yakutsk, and in this latter district the country about the river Ud sometimes affords sables of which a single fur is sold at the rate of sixty or seventy rubles, or twelve or fourteen pounds sterling. Sometimes the furs of sables are fraudulently dyed, and otherwise prepared, in order to give them a more rich or mottled colour, but these are very inferior to the finest natural ones, and are distinguishable by a kind of withered or dull appearance of the hair itself when accurately inspected.

This sable occurs in North America, as well as in Asia. An Indian sable is said to be chiefly of a chestnut-colour, and more glossy, but coarser, than the Siberian sables. It is necessary to observe, that the sable varies in its cast of colour at different seasons and in different districts; instances have been known, though rarely, of its being found perfectly white.

13. Viverra putorius. The porcupine is one of the largest European species of the weasel tribe. Its tail is extremely deep blackish-brown, with a tawny cast slightly intermixed; the ears are edged with white, and the space round the muzzle is also white. The general length of this animal is seventeen inches, exclusive of the tail, which measures about six inches. The porcupine is found in most parts of Europe, as well as in some of the Asiatic regions, as in Siberia, where it is said to be generally found with the rump of a whistling or yellowish tawny, sur- rounded with black.

The porcupine commonly forms itself a subterraneous retreat, sometimes beneath the roots of large trees, and sometimes under hay-ricks, and in barns. It preyed indiscriminately on the smaller animals, and is very destructive to poultry; it is also, like the ferret, a cruel enemy to rabbits, which it destroys by bleeding them immediately in pieces. It steals into barns, pigeon-houses, &c., where it occasionally makes great havoc; biting off the heads of fowls and pigeons, and then carrying them away. It is said sometimes to carry off the heads of geese; and sometimes it carries off the heads of swine and the necks of the summer, however, it principally frequents rabbit-warrens, or the hollow trunks of trees; &c. and prows about in quest of young birds, etc., etc., etc. According to Mr. Pennant, the count de Buffon, and a single fact of his, it is said that the porcupine is sufficient to destroy a whole warren of rabbits; and he observes, that this would be a simple method of diminishing the number of rabbits where they are too abundant. In Spain the ferret is said to have been formerly introduced for a similar purpose. The porcupine also preys occasionally on fish, of which a curious instance is recorded in Mr. Beck's History of Quadrupeds.

During a severe storm, one of these animals was tracked in the snow from the side of a rivulet to its hole, at some distance from it; as it was observed to have made frequent trips, and as other marks were observed, which could not easily be accounted for, it was supposed to be a matter worthy of more diligent enquiry; its hue was accordingly examined, the animal taken, and eleven fine eels were discovered to have been covered with the fruits of its former excursion; the unusual marks in the snow were made by the motion of the eels while dragged along in the animal's mouth. That the porcupine, however, sometimes feeds in this manner, is, in reality, no observation; since Aldrovandus assures us that it will occasionally take up its residence in the hollow banks of rivulets, in order to lie in wait for, and prey upon, fish. The porcupine is also distinguished by a milk, which is said to be white, and to acid the dairy, in order to indulge in this article. It has been known to attack bee-hives in the winter season, and to feed on the honey. The spring is the season in which it breeds; the female producing three or four at a birth, which she is said to suckle but a short time, accustoming them early to suck the blood of the animals which she brings to them, as well as eggs.

The porcupine has been known to breed with the ferret; and it is said to be a practice with warreners, who keep these animals, to procure a mixed breed from time to time, which
are of a colour between the ferret and the polecat, or of a dullish yellowish-brown.

The ferret a lively creature, and will spring with great vigour and celerity when preparing to attack its prey, or to escape from pursuit, at which time it arches its back considerably, in order to assist its efforts to escape. A petty field, being furnished, like several others of the weasel tribe, with certain receptacles which secrete a thickish fluid of a peculiarly strong and offensive odour. The fur, however, is beautiful, and the skin, when properly dressed, is numbered among the commercial furs, and used for tippets and other articles of dress. It is added by Aldrovandus, that the furriers endeavour to obtain skins taken from such animals as have been killed during the winter, as being far less feathery than those killed in the spring and summer.

15. *Viverra ferox*. Ferret. Of similar manners to the polecat is the ferret, the natural history of which has been so well detailed by the Count de Buffon, that it is scarcely possible to add any thing material to that elegant author's description. The ferret in general form resembles the polecat, but is a smaller animal, weighing about seven ounces, and measuring about nine inches, exclusive of the tail, which is about five. Linnaeus, in the twelfth edition of the Systema Natœae, seems to entertain a doubt whether it is truly distinct from the polecat; it is, however, a native of Africa, and not of Europe, and supports with difficulty the cold of an European winter; whereas the polecat is found not only in the temperate, but also in the colder parts of the European continent, of which many species are found, that, exclusive of its smaller size, it is of a more slender shape, and the snout is sharper in proportion than in the former animal. The ferret is used for rabbit-hunting in preference to the polecat, because it is more easily trained; but it is necessary to keep it in a warm box, with wood, or some other substance, in which it may imbibe itself. It sleeps almost continually, and when awake, immediately goes to sleep. It is usually fed with bread and milk; but its favourite food is the blood of the smaller animals. It is by nature an enemy to the rabbit; and it is affirmed by Buffon, that it is a animal, which after its first time to a young ferret, he flies upon it in an instant, and bites it with great fury; but if it is alive, he seizes it by the throat, and sucks its blood. When let into the burrows of rabbits, the ferret is always muzzled, that it may not kill the rabbits in their holes, but only drive them out, in order to be caught in the nets. If the ferret is put in without a muzzle, or happens to disembowel himself from it, he is often lost: for, sucking the blood of the rabbit, he falls asleep, and cannot be regained, except sometimes by smoking the hole, in order to oblige him to come out; but as this is a practice which does not always succeed, it continues to lead a rapacious and solitary life in the warren, as long as the summer continues, and perishes by the cold of the winter.

We are told by Strabo that the ferret was brought from Africa to Greece; and it is supposed that this was done in order to furnish that country from the vast number of rabbits with which it was over-run; and from Spain it was gradually introduced into other European countries. The ferret is an animal of an irreproachable nature, and, when irritated, its colour, which is all at times disagreeable, becomes its chief mark. The general colour of the ferret is a pale yellowish-brown, or cream-colour; and the eyes are of a bright and lively red.

16. *Viverra vulgaris*. Common weasel. One of the smallest species of this numerous tribe of quadrupeds. Its general length is about seven inches, exclusive of the tail, which measures near two inches and a half. Its colour is a pale reddish, or yellowish-brown, and beneficial in winter; but below the corners of the mouth, on each side, is a brown spot: the ears are small and rounded, and the eyes are black. This little animal is possessed of a considerable degree of elegance in its aspect, and its audacity is light and easy; but it has the same unpleasant smell with the stoat, and some other species. It is an inhabitant of the cavities under the roots of trees, as well as of humps near rivulets, &c., and occasionally sallies out in quest of birds, field-mice, &c. It even attacks young rabbits, and other animals of far superior size to itself; but its chief prey, at least in this country, seems to be the common field-mouse, which it pursues with great rapidity. From the extreme flexibility of its body, and its wonderful activity, it readily ascends the sides of walls, and by this means escapes its prey into the most distant retreats; and in a short instant the most of birds and grannies. The weasel produces four or five young at a time; preparing for them a bed of moss, grass, &c. An instance is given by the count de Buffon of a weasel's nest being found in the carcase of a wolf, which had been hung up near a wood; the nest was made in the cavity of the thorn. The count de Buffon, in his first description of the weasel, affirmed that it was a perfectly harmless animal; but he afterwards received very authentic accounts of weasels which had been so completely tamed as to exhibit every mark of attachment to their breeders, and to be as familiar as a cat or lap-dog; and that one of his correspondents gave a specimen of one of his correspondents in the seventh supplementary volume of his Natural History, which amply confirms the truth of this; and among other curious particulars, it is observed, that of the little animal which exists in a state of extreme flaccidity, so that it may be taken up by the head, and swung backwards and forwards, in the manner of a pendulum, several times, before it wakes.

17. Viverra erminea. Stoot. This animal much resembles the weasel in its general appearance, as well as in colour, but is considerably larger; the body, exclusive of the tail, measuring ten inches, and the tail five inches and a half; the tip of the tail is also constantly black, whatever may be the gradation or cast of colour on the body; for the stoot, in the northern regions, becomes milk-white during the winter, in which state it is commonly called the ermine. It is sometimes found of this colour in our own country; and instances are not very uncommon in which it appears parti-coloured, or white in the summer, and the change of colour having not been completed. Its smell is strong and unpleasant. The stoot is similar in its manners to the weasel, living in hollows under the roots of trees, in banks near rivulets, &c. and preying on all manner of smaller animals, as well as on rabbits, &c. It is not a curious animal. It is a common weasel, not hunted, but consines itself to the fields. It is an inhabitant both of the northern part of Europe and of Asia. It occurs in Katschatka and the Kurile islands. It is also to be found in several parts of North America.

In Norway and in Siberia the stoat is a great article of commerce; most of ther-
ULNA. See Anatomy.
ULVA, a genus of plants of the class cryptogamia, and order of algae. The fruticulose
viscous, and phaeophyceous membrane.
There are 26 species of British plants. They are all sessile, and without roots, and grow in
mounds, and on stones along the sea-coast.
None of them are applied to any particular use different from that of the algae which
are the unbluish, which in England is pickled with salt, and preserved in jars, and afterwards
steamed and eaten with oil and lemon
juice. This species, called in English the
mouldy layer, is flat, orbicular, sessile, and
co-ameous.
UMBELLE, umbels, among botanists, the round tufts or heads of certain plants set
thick together, and all of the same height.
UMBELLIFEROUS PLANTS, are such as have their tops branched and spread out like
an umbrella, on each little subdivision of which there grows a small flower; such
are fennel, dill, &c. See Botany.
UMBER, or UMBRE, umbria, among painters, &c., a kind of dry dusky-coloured
earth, which, diluted with water, serves to make a dull-colour, generally called with the
hair-colour. It is called umbre, from umbra, a shadow, as serving chiefly for the
shading of objects; or, perhaps, from Uhmbria a country of Italy, whence it was used
to be brought.
UMBER, or grayling, in ichthyology. See
Salmo.
UNCARIA, a genus of plants of the class and order pentandria monogynia. The corolla is
valve-shaped; germ. crowned with a gland; stigma two-keeved, pere. two-celled, many-
seeded. There are two species.
UNCIA, in general, Latin term denoting the twelfth part of any thing, particularly
the twelfth part of a pound, called in English an ounce; or the twelfth part of a foot, called
an inch. See Measure, and Weight.
UNCLE, in algebra, the numbers prefixed before the letters of the members of any
power produced from a binomial, residual, or monomial. Thus, in the earth power
of a-b, viz. a"b^-a^-b^-a^-b-^-b, the
uncies are 4, 6, and 4, being the same with what
other call coefficients. See Algebra.
UNDECAGON, is a polygon of eleven sides; a regular undecagon is 1, its area will be 9.306.690 = \(\frac{11}{73.2}\) square
degrees; and therefore if this number is
multiplied by the square of the side of any
other regular undecagon, the product will be
the area of that undecagon.
UNGUIS. See Anatomy.
UNGULA, in geometry, is a part cut off
from a cylinder, cone, &c., by a plane passing
obliquely through the base, and part of the
surface of the cylinder, so called from its resemblance to the (ungula) hoof of a horse, &c.
UNGULATED. See FISH. See NOWDON.
UNIOLA, or the triandra digyna class of plants, the corolla whereof consists of a bivalve
plume; the valves are of a lacerated-cone shaped figure, like those of the
clam; the inner valve appears somewhat higher than the outer one; the corolla perfoms the
office of a pericarpium, inclosing the
seed, which is single, and of an ovated
oblong figure. There are three species.
UNION, in music, that consonance, or coincidence of sounds, proceeding from an
equality in the number of vibrations made in a
given time by two sonorous bodies; or the
union of two sounds so directly similar to
each other in respect of gravity, or acute-
ess, that the ear perceiving no difference,
receives them as one and the same.
The antist are much disputed in opinion
respecting the question whether the union is a
consonance. Aristotle speaks in the negative;
Murius Mersennus, and others, declare in the affirmative. The decision of the ques-
tion, however, depends on the definition we
give to the consonance. If by a con-
sonance we only understand two or more sounds
agreeable to the ear, the union is a con-
sonance; but if we include in the consonance
sounds of a different pitch, i.e. sounds less
or greater, they will be bound by such an act;
but a thing is only voidable which is done
by a person who ought not to have done it,
but who, nevertheless, cannot avoid it him-
self after it is done; though it may be by
some act, and not made void by his heir, &c.
2 Liti. Abr. 807.
VOLCANO, in natural history, a burning
mountain, or one that occasionally vomits
forth fire, flame, ashes, cinders, &c. Vol-
canoes are of two kinds, and have two
necessary connection with any other
mountains, but seem to have some with the
sea, as the relics of fishes, sea-weed, and
sometimes sea-water itself. Sir William
Hamilton observes in the Phil. Trans, for
1776, that "the operations of Vesuvius are
very capricious and uncertain, except that
the sea is always considerably and const-
antly when the sea is agitated, and the wind
blows from that quarter. Volcanic moun-
tains are of all heights; some, as that of
Tanase, so low as 430 feet; Vesuvius is
3800 feet high; and Etna, 11000. They in general
are very lofty spires; and the volcano itself is
frequently shaped like an inverted cone,
placed on a broader basis. This cone is
called the crater, or bowl, and through it the
lava generally passes, the springs at the
bottom, and sometimes in the middle
of the mountain. Sometimes the crater falls in, and
is effaced; sometimes, in extinguished volca-
noes, it is filled with water. Submarine vol-
canoes have been observed, and from some
al exert a power derived from the origin. Vol-
canic fires taking place at the bottom of the
ocean, would freely, by the expansive
force of the streams which are generated,
elevate those parts which were once at the
bottom of the ocean, and bring those which
were habitable earth. It is conjectured, that
subterraneous convulsions operated more
powerfully in the early ages of the world than
any other period; and indeed such an hy-
pothesis is supported by the most probable
reasoning, since we may well conceive that
at the first formation of the earth, much
heterogeneous matter would be included in
the different masses, which might produce
more frequent fermentations than at any after
periods, when these have been, if we may so
express it, purged off by frequent eruptions,
and in many parts, perhaps, rectified and
assimilated by slow and secret processes in
the bowels of the earth. But history was not
cultivated till a very late period, and the
most eventful ages of nature have passed
without record.
The force of subterraneous fires, or rather
of the steam which is generated by them,
is so great, that considerable rocks have
been raised, and thrown for distances of eight
miles. A stone was once taken from the
crater of that volcano twelve miles, and
told upon the marquis of Lauro's house at
Nola, which it set on fire. One also, which
measured twelve feet in height and forty-five
feet in circumference, was carried, in 1707,' by
the projectile force of the steam, a quarter of
a mile from the crater. In an eruption of
Etna, a stone, fifteen feet long, was ejected
from the crater in the distance of a mile, and
buried itself eight feet deep in the ground.
A volcano broke forth in Peru in 1600,
accompanied with an earthquake, and the
sand and ashes which were ejected covered the
fields ninety miles one way, and one hundred
and twenty another. Dreadful thunders
and lightning were heard and seen for upwards
of ninety miles round Arapappu during this
eruption, which seemed to denote some con-
nection between the electric matter and these
volcanic fires; and this fact is strongly con-
firmed by the very accurate observations
of Sir William Hamilton, which we shall after-
wards have occasion to notice more at large.
Sir William Hamilton measured these
many volcanoes, consist of lava, either entire
or decomposed, nearly as low as the level of
the sea; but they finally rest either on gran-
ite, as in Peru, or schist, as the extin-
guished volcanoes in Spain and Bohemia,
or on limestone, as those of Silesia, mount Ve-
suvius, &c. No one is found in these
mountains, except that of iron, of which
lava contains from twenty to twenty-five parts in
the hundred, and some other fragments of the
ores of copper, antimony, and arsenic.
Vesuvius ejected, from the year 1779 to
1783, 369,658,101 cubic feet of matter of
different kinds; we must therefore conclude
that Vesuvius to the distance of these several
miles below the level of the sea; and iron makes
it one-fourth to one-fifth of these ejections,
we may infer that the internal parts of the
earth abound with such metal.
The origin of these subterraneous fires is
not easily explained. Iron-fillings mixed with
Volcanic sulphur, and the whole massened with water into it, will swiftly become hot, and if the quantity is considerable, will throw out a blue flame. It is a mixture of this kind which is used for making an artificial earthquake; for such a quantity of inflammable gases is the secret of the phenomenon of an earthquake. M. Lenormy seems to have been the first person who illustrated, in this manner, the origin of volcanic fires and earthquakes. He mixed twenty-five pounds of iron filings with an equal weight of sulphur, and having made them into a paste, with the addition of water, he put them into a pot, covered them with a cloth, and buried them a foot under ground. In about eight or nine hours the earth swelled, became warm, and cracked, and hot sulphureous vapours were perceived. Now large beds of mottled pyrites, sulphuret of iron, are known to exist in different parts of the earth; the only difficulty which attends this explanation of the origin of volcanoes, as well as of earthquakes, is, that there is no inflammation necessary for the production of actual flame. It is well known, however, that sulphuret of iron, when moistened, acquires heat; and if we suppose it to have been in contact with black and petroleum, we may suppose the flame to arise, as we see it produced by art, from the desiccation of the former substance, and its mixture with mineral oil. Many minerals, when heated, afford oxygen gas, a very active inflammable gas; in the case of that produced in the volcano, a remnant of that, at the foot of which the Giant Causeway is situated, he presumes cannot be less than five or six hundred feet perpendicular above the level of the Atlantic ocean, and yet composed entirely of lava; the same appearances extend towards the south upwards of twenty miles.

The most remarkable volcanoes in Europe are Etna and Vesuvius; and as these are not too far distant, we have the most accurate descriptions of them from travellers of the first talents and reputation.

Etna, which is the most striking object in Sicily, and indeed one of the most magnificent productions of nature, rises from an immense base, and is equally on all sides to its summit. The ascent up each side is computed at about thirty miles, and the circumference of its base, at one hundred and thirty-three; but as it has never been measured with any great degree of accuracy, its dimensions are but imperfectly known.

The whole mountain is divided into three distinct regions, called La Region Culta, or Piedmontese, the fertile region; La Regione Sylvia, or Nemorosa, the woody region; and La Region. Desertæ, or and seats, the barren region. These differ as materially both in climate and production as the three zones of the earth, and perhaps with equal propriety might have been styled the torrid, the temperate, and the frigid zone.

The first region of Etna surrounds the base of the mountain, and constitutes the most fertile country in the world on all sides of it, to the extent of fourteen or fifteen miles, which begins. It is composed almost entirely of lava, which, in time, becomes the most fertile of all soils; but the roads, which are entirely over old lava, now converted into orchard, vineyards, and corn-fields, are execrable. The lava, which form this region, arise from a number of beautiful little mountains, every one of which seems to have immense declivities of Etna. These are all either of the oval or hemispherical figure, and are generally covered with beautiful trees, and the most luxuriant verdure. The formation of them is one to the internal fires of Etna, which, raging for a vent, at so vast a distance from the great crater, that it cannot possibly be carried to the height of twelve or thirteen thousand feet, which is probably the height of the Summit of Etna, must necessarily be discharged at some other orifice. After shewing the mountain, and its neighbourhood, for some time, at length the fire bursts open its side, and this is called an eruption. At first it emits only a thick smoke and showers of ashes. These are followed by red-hot stones, and rocks of a great size, which are thrown to an immense height in the air. These stones, together with the quantities of ashes discharged at the same time, form those mountains, which cover the defects of the crater, and its neighbourhood, for some time, at length the fire bursts open its side, and this is called an eruption. After the formation of the new mountain, the lava commonly bursts out from its lower side, and, sweeping every thing before it, is generally terminated by a fire-sea, which issues from the side of the mountain, without these attending circumstances, which are commonly the case with the eruptions of Vesuvius. It was at this time, that the first appearance of the lava appeared.

Many striking remains of the great eruption in 1669 are still to be seen, and will long continue as memorials of that dreadful event which overwhelmed Catania, and all the adjacent country. Tremendous earthquakes shook the island, and monstrous hollows were heard in the mountains. During some weeks, the sun ceased to appear, and the day seemed changed into night. Borelli, who was a witness to these terrible phenomena, says, that at length a torrent, twelve miles in length, was opened in the country, in some places of which, when they threw down stones, they could not hear them reach the bottom. Burning rocks, sixty palms in length, weighing to the value of a mile, and lesser stones were carried thirteen miles. After the most violent struggles, and a shaking of the whole island, an immense torrent of lava washed from the rent, and sprung up into the air to the height of sixty palms, whence it poured down the mountain, and overwhelmed every object in its way in one tremendous ruin.

This destructive torrent, which burst from the side of the mountain, covered the country with a vast sea of molten rock, and rolled with ruthless impetuosity against the beautiful mountain of Montpelleri, and pierced into the ground to a considerable depth; then dividing and surrounding the mountain, it
VOLOCANO.

The eruption of Vesuvius, which was a witness in the year 1717, and the reader will find his narrative in the first volume of Dr. Goldsmith's History of the Earth and Animated Nature, p. 94. Mr. Wollaston's short, and philosophical account of this formidable phenomenon, a volcanic explosion, is that with which Sir William Hamilton has favoured the public, in describing the dreadful eruption of that mountain in June 1794, and this we shall endeavour to give, as nearly as possible, in his own words.

Sir William begins his narrative with remarking that the frequent slight eruptions of lava for some years past had issued near the summit, and rain in small channels in different directions down the flanks of the mountain, and from running in covered channels, had often an appearance as if they came immediately out of the crater; but Vesuvius had not sufficient force to reach the cultivated parts at the foot of the mountain. In the year 1779, the whole quantity of the lava in fusion having been at once thrown up with violence from the crater of Vesuvius, and a great part of it falling and cooling on its cone, added much to the solidity of the walls of this huge natural chimney, and had not of late years allowed of a sufficient discharge of lava to calm that fermentation, which by the subterraneous noises heard at times, and by the explosions of scarce ashes, was known to exist within the bowels of the volcano. The eruptions, therefore, of late years, before this last, were simply from the lava having boiled over the crater; and though, indeed, after a small earthquake and storm, it is not quite to confine it, and oblige it to rise and overflow. The mountain had been remarkably quiet for seven months before the late eruption, nor did the usual vapour issue from its crater, but at times a light cloud of smoke that floated in the air in the shape of little trees. It was remarked by Father Antonio di Petrizzi, a Capuchin friar, (who printed an account of the late eruption,) from his convent close to the unfortunate town of Torre del Greco, that for some days preceding this eruption, a thick vapour was seen to surround the mountain, about a quarter of a mile beneath its crater, and it was observed by him and others at the same time that both the sun and the moon had often an unusual reddish cast.

The water of the great fountain at Torre del Greco began to decrease some days before the eruption, so that the wheels of a mill were brought to a standstill, and, of course, very slowly; it was necessary in all the other wells of the town and its neighbourhood to lengthen the ropes daily, in order to reach the water; and some of the wells became dry. Although most of the inhabitants were sensible of this phenomenon, not one of them seems to have been sensible of the true cause. Eight days after the eruption, a man and two boys being in a vineyard along the crater of Vesuvius (and precisely on the spot where one of the new mouths opened, whence the principal current of lava that destroyed the town issued,) were much alarmed by a sudden puff of smoke which issued from the earth close to them, and was attended with a slight explosion.

Had this circumstance, with that of the subterraneous noises heard at Resina for two days before the eruption (with the additional one of the decrease of water in the wells,) been observed at the time, it would have required no great foresight to have been certain that an eruption of the volcano was near at hand, and that its force was directed particularly towards that part of the mountain.

On the 12th of June 1794, in the morning, there was a violent fall of rain, and soon after the inhabitants of Resina, situated directly over the antient town of Herculaneum, were sensible of a rumbling subterraneous noise, which was quite heard at Naples.

From the month of January to the month of May, the atmosphere had been generally calm, and there was continued dry weather. In the month of May there was a little rain, but the weather was unusually sultry. For some days wrought by that rain, the duke della Torre, a learned and ingenious nobleman, who published two letters upon the subject of the eruption, observed by his thermometers, that the atmosphere was charged with heat, and had an eruption with an earthquake and storm immediately followed, and it continued for several days during the eruption.

About eleven o'clock on the night of the 12th of June, the inhabitants of Naples were all sensible of a violent shock of an earth quake; the undulatory motion was evidently from east to west, and appeared to have lasted near half a minute. The sky, which had been quite clear, was soon after covered with black clouds. The inhabitants of the towns and villages, which are very numerous round Mount Vesuvius, were very much terrified, and most of them thought that an earthquake was more sensible, and say, that the shock at first was from the bottom upwards, after which followed the undulation from east to west. This earthquake extended all over the Campagna Felice, and the royal palace at Caserta, which is fifteen miles from Naples, and one of the most magnificent and solid buildings in Europe (the walls being eighteen feet thick,) was shaken in such a manner as to cause great alarm, and all the chamber bells rang. It was likewise much felt at Beneventi, about thirty miles from Naples; and at Arzano in Puglia, which is at a much greater distance; both these towns, indeed, have been often afflicted with earthquakes.

On Sunday the 15th of June, soon after ten o'clock at night, another shock of an earthquake was felt at Naples, but did not appear to be so violent as that of the day before. It was at the same moment a fountain of bright fire, attended with a very black smoke and loud report, was seen to issue, and to rise to a great height, from about the middle of the cone of Vesuvius. Soon after the same kind broke out at some little distance lower down; then, as is supposed, by the blowing up of a covered channel full of red-hot lava, it had the appearance as if the lava had taken on its course up the steep sides of the volcano. Fresh fountains succeeded one another hastily, and all in a direct line, tending, for about a mile and a half, down towards the towns of Resina and Torre del Greco. Sir William Hamilton could count fifteen of them, but believes there were others obscured by the smoke. It seems probable, that all these fountains of fire, from their being in such an exact line, proceeded from the same point on the flanks of the mountain, and that the lava and other volcanic matter forced its way out of the widest parts of the crack, and formed there the little mountains and craters that have been described, or which are to be seen in that place. It is impossible that any words can give an idea of the blazing scene, or of the horrid noises that attended this great operation of nature. It was a mixture of the loudest thunder, with incessant reports, like those from a numerous heavy artillery, accompanied by a continued hollow murmur, like that of the roaring of the ocean during a violent storm; and, added to these was another blowing of a different kind, that of a large flight of sky-rockets, or rather like that which is produced by the action of the enormous belows on the furnace of the Carron iron-foundry in Scotland. The frequent falling of the huge stones and scorches, which were thrown up to an incredible height from some of the new mouths, (one of which, having been since measured by the able Tata, was found to be ten feet high, and thirty-five inches in breadth,) was so near the tops of the houses to the concussion of the earth and air. As the lava did not appear to have yet a sufficient vent, and it was now evident that the earthquakes already felt had been occasioned by the air and fiery matter combined within the
Volcano.

Towers of the mountain, and probably at no small depth, considering the extent of those earthquakes, sir William recommended to the company that he and his friends, with their sick, should begin that day to ascend, rather to go and view the mountain at some greater distance, and in the open air, than to remain in the house, which was on the sea-side, and in the part of Naples which is nearest and most exposed to Vesuvius. They accordingly proceeded to Posillipo, and viewed the conflagration, now become still more considerable, from the sea-side under that mountain; but whether from the eruption having increased or from the long reports of the volcanic explosions being repeated by the mountain behind them, the noise was much louder and more alarming than that they had heard in their first position, at least a mile nearer to Vesuvius.

After some time, about two o'clock in the morning of the 16th, it was observed that the lavas ran in abundance, freely, and with great velocity, having made a considerable progress towards Resina, the town which it first attacked; and that the fiery vortices which had been confined now free vent through many parts of a crack of more than a mile and a half in length, as was evident from the quantity of inflamed matter and black smoke, which continued to issue from the sea-side. Our author therefore concluded that at Naples all danger from earthquakes, which had been its greatest apprehension, was totally removed, and he returned to his former station at St. Lucia near the city.

During all this time there was not the smallest appearance of fire or smoke from the crater on the summit of Vesuvius; but the black smoke and ashes issuing continually from so many new mouths or craters, formed an enormous and dense body of clouds over the whole mountain, and began to give signs of being replete with the electric fluid, by exhibiting flashes of that sort of zig-zag lightning, which in the volcanic language of the country is called ferilli, and which is the constant attendant on the most violent eruptions.

Sir William Hamilton proceeds to remark, that during a thirty years residence at Naples, and during which time he had been witness to many eruptions of Vesuvius, he never before saw the cloud of smoke replete with the electric fire, excepting in the two eruptions of 1794, and in that of 1779. The electric fire, in the year 1779, which played constantly within the enormous black cloud over the crater of Vesuvius, and seldom quitted it, was exactly similar to that which is produced, on a very small scale, by the conductor of an electrical machine communicating with an insulated plate of glass, thinly spread over with metallic filings, &c. when the electric matter continues to play over it in zig-zag lines without quitting the surface. He was not sensible of any noise attending that operation in 1779; whereas the discharge of the electrical matter from the volcanic clouds during this eruption, and particularly on the second and third days, caused explosions like those of the loudest thunder; and indeed the storm raised evidently by the sole power of the volcano, resembled in every respect all other thunder-storms, including lightning, and destroying every thing in its course. The house of the marquis of Berio at St. Lucio, situated at the foot of Vesuvius, during one of these volcanic storms, was struck with lightning, which having shattered many doors and windows, and damaged the furniture, left for some time a strong smell of sulphur in the rooms it passed through; and these gigantic volcanic clouds, besides the lightning, the author adds, he had, with many others, both during this eruption, and in 1779, seen balls of fire issue, and some of a considerable magnitude, which bursting in the air, passed as from the ducal air-balloons in fireworks; the electric fire, as it came out, having the appearance of the serpents with those firework-balloons are often filled. The day before this, the 15th, there was in the crater danger from the volcanic clouds, two small balls of fire, joined together by a small link like a chain-shot, fell close to his casino at Posillipo; they separated, and one fell in the vineyard, at the house, and the other in the sea; the latter so close to it that he heard the splash in the water. The abbe Tata, in his printed account of this eruption, mentions an enormous ball of fire which flew out of the crater of Vesuvius while he was at the edge of it, and which burst in the air at some distance from the mountain, soon after which he heard a noise like the fall of a number of stones, or of a heavy shower of hail.

About four o'clock in the morning of the 16th, the crater of Vesuvius began to show signs of being replete, by some black smoke issuing out of it; and at day-break another body of smoke, tinged with red, issued from an opening near the crater. On the other side of the mountain, and opposite the town of Ottiano, it became evident that a new mouth had opened, from which a considerable stream of lava issued, and ran with great velocity through a wood, which it burnt; and having run about three miles in a few hours, it stopped before it arrived at the vineyard and cultivated lands. The crater, and all the conical part of Vesuvius, were soon involved in clouds and darkness, and remained so for several days; but above these clouds, by the heat of that great height, from columns of smoke were seen from the crater, rising furiously still higher, until the whole mass remained in the usual form of a pine-tree; and in that gigantic mass of heavy clouds the fire, or volcanic lightning, was frequently visible, even in the day-time.

About five o'clock in the morning of the 16th, the lava which had first broken out from the several new mouths on the south side of the mountain, had wandered into the sea, and was running into it, having overwhelmed, burnt, and destroyed, the greatest part of Torre del Greco, the principal stream of lava having taken its course through the very centre of the town.

Soon after the beginning of this eruption, ashes fell thick on the foot of the mountain, all the way from Portici to Torre del Greco; and what is remarkable, although there were at that time any clouds in the air, except those of smoke from the mountain, the ashes were wet, and accompanied with large drops of water, which to the taste were very salt; the road, which was paved, was as wet as if there had been a heavy shower of rain. These ashes were black and coarse, like the sand of the sea-shore; whereas those which fell there and at Naples some days after, were of a light-grey colour, and as fine as Spanish snuff, or powdered bark. They consisted of ashes which lay on the ground, exposed to the burning sun, had a coat of the whitest powder on their surface, which to the taste was extremely salt and pungent.

By the time that the lava had reached the sea, between five and six o'clock in the morning of the 16th, Vesuvius was so completely involved in darkness, that the violent operation of nature which was going on there could no longer be discerned, and so it remained for several days; but the dreadful noise, and the red tinge on the clouds over the top of the mountain, were evident signs of the activity of the fire underneath. The lava ran but slowly to Torre del Greco after it had reached the sea; and on the 17th of June in the morning, its course was stopped; excepting that at some a little relapse of red fire issued from under the smoking scoria into the sea, and created all this time a great quantity of large scoriae, which were dashed on to the surface of the body of the lava into the sea, discovering that it was red-hot under that surface. Even to the latter end of August, the summit of the thick crust of lava that covered the tower retained its red heat.

The breadth of the lava that ran into the sea, and formed a new promontory there, after having destroyed the greatest part of the town of Torre del Greco, having been exactly measured by the duke deli Torre, is 1204 English feet. Its height above the sea is twelve feet, and as many feet under water; so that its whole height is twenty-four feet; it extends into the sea 606 feet. The sea-water was boiling as in a cauldron, where it washed the foot of this new-formed promontory.

The rapid progress of the lava, however, was such, after it had altered its course from Resina, which town it first threatened, and had joined a fresh lava that issued from one of the mouths of the mountain, that in a few days, it was five or six miles from the town, that it ran like a torrent over the town of Torre del Greco, allowing the unfortunate inhabitants scarcely time to save their lives. Their goods and effects were entirely absorbed, and several of the inhabitants, whose houses had been surrounded with lava while they remained in them, escaped from them, and saved their lives the following day, by coming out of the tops of their houses, and walking over the scoria on the surface of the red-hot lava.

The lava over the cathedral, and in other parts of the town, is said to be upwards of forty feet in thickness; the general height of the lava, during its whole course, was between twelve and fourteen feet, and in some parts not less than a mile, in breadth.

On Wednesday June 18, the wind having for a short space of time cleared away the thick cloud from the top of Vesuvius, it was now discovered that a great part of its crater was filled by a heavy column of smoke, and violently thrown out of it, and that one of the west side opposite to Naples, had fallen; in which it probably did about four o'clock in the morning of that day, as a violent shock of an earthquake was felt at that moment at Resina, at some parts of the foot of the volcano. The clouds
of smoke, mixed with the ashes, were of such a density as to appear to have the greatest difficulty in forcing their passage out of the now widely-extended mouth of Vesuvius, which, since the top fell in, is described as not much short of two miles in circumference. One cloud descended on another, and succeeded one another incessantly, in a few hours such a gigantic and elevated column of the darkest hue over the mountain, as seemed to threaten Naples with immediate destruction: with a quadrat the elevation of a mass of clouds of which certainly, however it may contradict our idea of the extension of our atmosphere, rose many miles above the mountain, it appeared like a molehill, although the depth and height of Vesuvius, from the level of the sea, is more than three thousand six hundred feet. The abbe Braccini, as appears in his printed account of the eruption of mount Vesuvius in 1831, states that he ascended an elevation of a mass of clouds of the same nature, which was formed over Vesuvius during that great eruption, and found it to exceed thirty miles in height. Dr. Scotti, in his printed account of this eruption says, that the height of the threatening cloud of smoke and ashes, measured from Naples, was found to be of an elevation of thirty degrees.

The hable curiosity of our author induced him to go upon mount Vesuvius, as soon as it was possible with any degree of prudence, which was not until the 30th of June, and even then it was attended with some risk. The crater of Vesuvius, except at short intervals, had been continually obscured by small clouds from the 18th; and was so on that day, with frequent flashes of lightning playing in those clouds, and attended as usual with a noise like thunder; and the fine ashes were still falling on Vesuvius, but still more on the mountain of Somma. Sir William went up the usual way by Resina, and observed, in his way through that village, that many of the stones of the pavement had been loosened, and were deranged by the earthquakes, particularly of that of the 18th, which attended the falling in of the crater of the volcano, and which had been so violent as to throw many people down, and obliged all the inhabitants of Resina to quit their houses hastily, to which they did not dare to return for two days. The leaves of all the vines were burnt by the ashes that had fallen on them; and many of the vines themselves were buried under the ashes, and great branches of the trees that supported them had been torn off by their weight. In short, nothing but ruin and desolation was to be seen. The ashes at the foot of the mountain were about ten or twelve inches thick on the surface of the earth; but in proportion as he ascended, their thickness increased to several feet, not less than nine or ten in some spots. On the surface of the old rugged lavas, which before was almost impracticable, was now become a perfect plain, over which he walked with the greatest ease. The ashes were of a light-grey colour, and exceedingly fine, so that by the footsteps being marked on them as on snow, he learnt that three small parties had been up before him. He saw likewise the track of a fox, which appeared to have been quite bewildered by the many turns he had made. Even the traces of lizards and other little animals, and of insects, were visible on these fine ashes. Sir William and his companion ascended to the spot whence the lava of the 13th first issued, and followed the course of it, which was still very hot (although covered with such a thick coat of ashes) quite down to the sea at Torre del Greco, which is more than five miles. It was not possible to go up to the great crater of Vesuvius, nor had anyone attempted it. The horrid chasms that existed from the spot where the late eruptions first took place, in a straight line for near two miles towards the sea, were at once perceived. They formed valleys more than two hundred feet deep, and from half a mile to a mile wide; and where the fountains of fiery matter issued during the eruption, were little mountains with deep craters. Ten thousand men, in as many years, could not have made such an alteration on the face of Vesuvius. Except the exhalations of sulphurous vapours, which broke out from different spots of the line above-mentioned, and tinged the surface of the ashes and scoria in those parts with either a deep or pale yellow, or a reddish ochre-colour, or a bright white, and in some parts with a deep green and azure blue (so that the whole together had the effect of an iris), all had the appearance of a sandy desert. Our adventurers then went on the top of seven of the most considerable of the new-formed mountains, and looked into their craters, which on some of them appeared to be little short of half a mile in circumference; and although the exterior perpendicular height of them did not exceed two hundred feet, the depth of their inverted cone within was three times as great. It would not have been possible to have breathed at all, near these mountains, near their craters, if they had not taken the precaution of tying a double handkerchief over their mouths and nostrils; and even with that precaution they could not resist long the flames of the sulphurous acid and were so exceedingly penetrating, and of such a suffocating quality. They found in one a double crater, like two tunnals joined together; and in all there were some little smoke and deposition of salts and sulphurs, of the various colours above-mentioned, as is commonly seen adhering to the inner walls of the principal crater of Vesuvius.

Two or three days after they had been there, one of the new mouths into which they had looked, suddenly made a great explosion of stones, smoke, and ashes, which would certainly have proved fatal to any person who might unfortunately have been present at the time of the event, for they were on the mountain, two whistlings, exactly like those that form water-spouts at sea, made their appearance; and one of them, which was very near, made a strange rushing noise; and having taken up a great quantity of the lavas, formed them into an elevated spiral column, which, with whirling motion and great rapidity, was carried towards the mountain of Somma, where it broke and was dispersed. One of our author's servants, employed in collecting sulphur, or sal ammoniac, which is carried on the near mountains, in which they at one time, as they are called, with the hot vapours out of the fresh lava), found to his great surprise, an exceeding cold wind from a fissure very near the hot fumarole, usual in vinegar. In a vineyard not in the same line with the new-formed mountains just described, but in a right line from them, at the distance of little more than a mile from Torre del Greco, they found three or more of these new-formed mountains with craters, out of which the lava flowed; and by uniting with the streams that came from the higher mouths, and adding to their heat and fluidity, enabled the whole to make a rapid progress over the unfortunate town.

In the town of Somma, our author found four churches and about seventy houses without roofs, and full of ashes. The great damage on that side of the mountain, by the fall of the ashes and the torrents, happened on the 18th, 19th, 20th, and 25th of June, and on the 12th of July. The 18th, the ashes fell so thick at Somma, that unless a person kept in motion, he was soon fixed to the ground by them. This fall of ashes was accompanied also by loud reports, and frequent flashes of the volcanic lightning so that, surronded by so many horrors, it was impossible for the inhabitants to remain in the town, and they all fled; the darkness was so great, although it was mid-day, that even with the help of torches it was scarcely possible to keep in the high road. On the 16th of July, signor Giuseppe Sacco went up to the crater; and, according to his account, which is printed at Naples, the crater is now of an incredible size. The supposes (not having been able to measure it) of about a mile and a half in circumference; the inside, as usual, in the shape of an inverted cone, the inner walls of which on the eastern side, and on the western side of the crater, which is lower, the descent was practicable, and Sacco with some of his companions actually went down one hundred and seventy-six palms; from which spot having lowered a cord with a stone tied to it, they found the whole depth of the crater to be about five hundred palms. Such observations, however, on the crater of Vesuvius, are of little consequence, as both its form and apparent depth are subject to great alterations from day to day.

On the 22d of July, one of the new craters, which is the nearest to the town of Torre del Greco, threw up both fire and smoke; which circumstance, added to that of the lava's retaining its heat much longer than usual, which was also the fact, that there was still some fermentation under that part of the volcano. The lava in cooling often cracks, and causes a loud explosion, just as the ice does in the glaciers in Switzerland; such reports were frequently heard at the time at the Torre del Greco; and a vapour was seen to
issue from the body of the lava, and taking fire in the air, fall like those meteors vulgarly called falling stars.

The archbishop of Taranto, in a letter to Naples, and dated from that city the 18th of June, observes: "We are involved in a thick cloud of minute volcanic ashes, and we imagine that the mass of that cloud was deposited either at mount Etna or of Stromboli. The bishop did not suspect their having proceeded from Vesuvius, which is about two hundred and fifty miles from Taranto. Ashes also fell at the late eruption, at the very extremity of the province of Loccro, which is still farther off; and at Martino, near Taranto, a house was struck and much damaged by the lightning from one of the clouds. In the course of the great eruption of Vesuvius in 1631, mention is made of the exten-

sive progress of the ashes from Vesuvius; and of the damage done by the fertil, or volcanic lightning, which attended them in their course.

Our author in this place mentions a very extraordinary circumstance, which happened near Sienna, in the Tuscan state, about eighteen hours after the commencement of the late eruption of Vesuvius on the 15th of June, which adds, that phenomenon must not be related to the eruption; it was communicated to him, in the following words, by the earl of Bristol, bishop of Derry, in a letter dated from Sienna, July 12, 1794: "In the midst of a most violent thunder-storm, about a dozen stones of various weights and dimensions fell at the feet of different people, men, women, and children; the stones are of a quality not found in any part of the Siennese territory; they fell about eighteen hours after the enormous eruption of Vesuvius, which circumstance leaves a choice of difficulties in the solution of this extraordinary phenomenon: either these stones have been generated in this igneous mass of clouds, which produced such unusual thunder; or, which is equally incredible, they were thrown off from Vesuvius at a distance of at least two hundred and fifty miles; judge then of its paradox." One of the largest stones, when entire, weighed upwards of five pounds. The owner of this stone, a man of business, and ascendant to have fallen from the cloud near Sienna, was evidently fresh-vitrified, and black, with indubitable signs of having passed through an extreme heat; when broken, the inside was found of a light-grey colour mixed with black spots, and some shining particles, supposed to be pyrites. Stones of the same nature, at least as far as the eye can judge of them, are frequently found on mount Vesuvius; and it is probable he might find, with the same vitrified coat on them, the question would be decided in favour of Vesuvius; unless it could be proved that there had been, about the time of the fall of these stones to the Siennese territory, some nearer opening of the earth, attended with an emission of volcanic matter; which might very possibly happen, as the mountain of Kadefon, within fifty miles of Sienna, is so near that place. The celebrated father Ambrogio Spinola, professor in the university of Siena, has printed there a dissertation upon this extraordinary phenomenon: and, it is said, has decided that those stones were generated in the air independently of volcanic assistance. See Meteoric Stones.

Until after the 7th of July, when the large cloud broke over Vesuvius, and formed a tremendous torrent of mud, which took its course across the great road between Torre del Greco and the Torre dell' Aumunziata, and destroyed many villages, the eruption could not be said to have finished, although the force of it was over the 22d of June. The power of attraction in mountains is well known; but whether the attractive power of a volcanic eruption is greater than that of any other mountain, is not known. During this eruption, however, it appeared that every watery cloud was evidently attracted by Vesuvius, and the sudden dissolution of these clouds left marks of their destructive power on the face of the country all round the basis of the volcano. After the mouth of Vesuvius was enlarged, our author says he has seen a great cloud passing over it, which not only was not attracted, but even sucked in, and disappeared in the atmosphere.

After every violent eruption of mount Vesuvius, we read of damage done by a mephitic vapour; which proceeding from under the ancient lavas, insinuates itself into low places, such as the cellars and wells of the houses standing at the foot of the volcano. After the eruption many years, there were several instances, as this, of people, going into their cellars at Portici, and other parts of that neighbourhood, having been struck down by the vapour, and who would have expired if they had not been hastily removed. These occasional vapours, or mepote, are of the same quality as that permanent one in the Grotte del Cane, near the lake of Agerano, and which has been proved to consist chiefly of fixed air. The vapours which, in the volcanic language of Naples, are called funamori, are of another nature, and issue from spots all over the fresh and hot lavas while they are cooling; they are sulphureous, and are observed that often the birds which are flying over them are overpowered, and fall down dead.

The interior of a volcano, that immense treasury of devastation, must undoubtedly be an object of philosophical curiosity: yet when we consider the attempt, that the incompact state of the materials, by affording no proper support, may harass the incipient adventurer into the burning abyss; that the mephitic vapours may produce instantaneous suffocation; and that a sudden explosion may overwhelm him with destruction; we cannot wonder that so few have engaged in an exploit so replete with danger. We should have remained ignorant of this state of this immense territory of 1767, if there had not the spirit or tenacity of eight Frenchmen, in the year 1801, enabled them successfully to explore this cavern of destruction. The mouth, or upper base, of the crater of Vesuvius, which is a little inclined to its axis, is represented by these travellers as 372 feet in circumference. After walking round the aperture of the volcano, in order to choose the most commodious part for descending, M. Donnelle, a jurist, ambassador, and M. Wickar, a painter, first descended, with any accident at the determined point; but, however, they found themselves stopped by an excavation of 50 feet, which it was neces-

sary to pass. Finding it impossible to obtain a fixed support on ashes so movable, and being convinced that the friction of ropes would have destroyed both the proper support and the neighbouring masses, they resolved to return. Some stones at the same moment rolled from the summit, and occasioned an agitation as they passed; the ground shook under their feet, and they had scarcely quitted it when it disappeared and fell in.

After walking once more round the mouth of the crater, they discovered at length a long eddication, smooth though steep, which appeared to conduct to the focus. When they had proceeded half-way, amidst a torrent of ashes which rolled down along with them, they found means to fix themselves on the edge of the precipice, twelve feet in height, which it was necessary to pass. With one of the Lazarus, however, they plunged down this precipice; and found themselves on the brink of another, which, however, not being quite so high, they passed with more ease. At length, amidst showers of falling lava, ashes, and stones, they reached the bottom of the crater.

They found the immense furnace still smoking in several places; near the bottom of the crater, which from above appeared so perfectly smooth, was found on the contrary, when they reached it, exceedingly rough and uneven. They passed over lava very porous, in general hard, but in some places, and particularly where they entered, still soft, so as even to yield under their feet. The spectacle, however, which most attracted them was the spiracles; which either at the bottom or interior sides, suffer the vapours to escape. These vapours, however, did not appear of a noxious quality. In traversing the crater they perceived a focus half-covered by a large mass of pumice stone, and which from its whole circumference emitted a strong heat. Reaumur's thermometer, on the summit of Vesuvius, stood at twelve degrees; in the crater it rose to sixteen; placed at one of the spiracles it indicated forty-four, at another twenty-two; and at the entrance of the Krater it never rose higher than twenty-two degrees.

The volcanic productions in the crater were large, exceedingly porous, and reduced by the fire in some parts. It was of a dark-brown colour in general; and in some places reddish, with a very little white. The substances nearest the spiracles were covered or impregnated with sulphur, which sometimes, in cavities of the rock, escaped. Some basaltic lava was also found; but in a small quantity. The burning focus produced the same results.

On the north side of the crater there were two large fissures, one of which was twenty feet in depth, the other fifteen. They were shaped like an inverted cone, and the matter with which they were covered was similar to the rest of the surface, but they emitted neither smoke nor heat.

The ascent of our adventurers was accomplis

hished with more difficulty, though perhaps with less danger, than the descent. It also occupied a greater space of time; for they could only ascend one at a time after considerable intervals, for fear of being swallowed under torrents of dust and volcanic matters, when who immediately suffered.
brown; the back, scapulars, and wings, crossed with broad bars of white and black; the rump is white; the tail consists of only ten feathers, white marked with black, in form of a crescent, the horns pointing toward the end of the feathers. The legs are short and black, the toes are closely united at the bottom to the middle toe. See Plate Nat. Hist. fig. 413.

According to Linnaeus, it takes its name from its note, which has a sound similar to the word; or it may be derived from the French, burophe, or "crested." It breeds in hollow trees, and lays two ash-coloured eggs: it feeds on insects, which it picks out of or- dure of all kinds. Dr. Pallas affirms, that it breeds in preference in putrid carcasses; and that he had seen it as a pet of a lady of an uninhabited house, in the suburbs of Tarzisyn. Ovid says that Tereus was changed into this bird.

URANIA, a genus of the hexandria monogynia class and order of plants. There is no flowers of the corolla is two-petalled; acci- turine two-leaved; capsule two-celled, many-seeded. There is one species.

URANIUM, a mineral found in Saxony, partly in a pure and partly in a mixed state. There are two varieties of these; the first of a blackish colour, quite opaque, tolerably hard, and with a specific gravity of about 7.5. The second is distinguished by a finer black colour, with here and there a reddish cast; by a stronger lustre, not unlike that of pitch; by an inferior hardness; and by a shade of green, which tinges its black colour when it is reduced to powder.

This fossil was called pechblende; and min- eralogists, misled by the name, had taken it for an ore of zinc, till the celebrated Werner, convinced from his text, hardness, and specific gravity, that it was not a blende, placed it among the ores of iron. After- wards he suspected that it contained tung- sten; and this conjecture was seemingly confirmed by the experiments of some German mineralogists, published in the Miners' Jour- nal. But Klaproth, the most celebrated ana- lyst in Europe, examined this ore in 1789, and found that it consists chiefly of sulphur combined with a peculiar metal, to which he gave the name of uranium.

Uranium is of a dark-grey colour; inter- nally it is somewhat inclined to brown. Its malleability is unknown. Its hardness is about 6. It requires a stronger heat for fusion than manganese. Indeed Klaproth only obtained it in very small conglutinated metallic grains, forming all together a porous and spongy mass. Its specific gravity is 6.440.

When exposed for some time to a red heat, it suffers no change. By means of nitric acid, however, it may be converted into a yellow powder. This is the yellow oxide of uranium, which seems to be composed of about 50 parts of uranium and 44 of oxygen. This oxide is found native, mixed with the mineral above described. From the experiments of Proust we learn that this metal is capable of forming only two oxides, but no description of the protioxide has been published; and the ore is so scarce that it is not every chemist who can gratify his curiosity by an examination of uranium.

Uranium is capable of combining with sul-
U R E

The mineral from which Mr. Klapp-oth first obtained it is a native sulphur of potassium.

URANOSCIUS, star-gazer, a genus of fish of the order Jurellidae. The generic character is the head large, depressed, rough; mouth furnished with an internal cirrus; gill-ridges edged by a ciliated border; gill-membrane five-rayed.

Uranoscopus scaber, bearded star-gazer. The head of this fish is large, square, and covered by a strong bony case, roughened by an infinite number of small warts or protuberances: each side of this case is terminated above by two spines, the hindermost of which is the strongest, and covered by a skin: the under part has five spines smaller than those above: the mouth, which is wide, opens in an almost vertical direction: the tongue is thick, short, and roughened with numerous small teeth; near the interior tip of the lower jaw is a membranous process which terminates in a long cirrus or beard extending to some distance beyond the lips, which are themselves edged with smaller ones: the eyes are situated very near each other on the top of the head; the body is of a somewhat squarish form as far as the vent, and thence becomes cylindrical: it is covered with small scales, and marked near the back by a lateral line composed of small pores or points bending from the neck to the pectoral fins on each side, and thence in a straight line to the tail, on the back are two fins, of which the first is much shorter than the latter, and furnished with stronger spines; the pectoral fins are small; the tail of moderate size, and rounded at the end. The colour of the body is brown, with a whitish or silvery cast towards the abdomen; the head, pectoral fins, and tail, having a strong ferruginous cast, and the first dorsal fin being marked towards its kind part by a large black spot.

The star-gazer is an inhabitant of the Mediterranean and northern sea, chiefly frequenting the shallower parts near the shores, where it lies concealed in the mud, with the tip of the head alone exposed: in this situation it waves the beards of the lips, and particularly the long cirrus of the mouth, in various directions, like that of some fishes and marine insects which happen to be swimming near, and which mistaking these organs for worms, are instantly seized by their concealed enemy. The usual length of this fish is about twelve inches. It is in no esteem as an article of food, being generally considered as coarse and of an ill flavour: the gall was consequently considered as of peculiar efficacy in external disorders of the eyes. There are only two species, viz. the scaber and lipiscus.

UREA, the constituent and characteristic matter of urine, may be obtained by the following process: Evaporate by a gentle heat a quantity of human urine, voided six or eight hours after a meal, till it is reduced to a thick syrup. In this state, when put to cool, it concretes into a crystalline mass. Pour at different times upon this mass four times its weight of alcohol, and apply a gentle heat; a great part of the mass will be dissolved, and there will remain only a number of saline substances. Pour the alcohol solution into a retort, and distil by the heat of a sand-bath till the liquid, after boiling some time, is reduced to the consistency of a thick syrup. The whole of the alcohol is then now separated, and what remains in the retort crystallizes as it cools. These crystals consist of the substance known by the name of urea.

Urea, obtained in this manner, has the form of crystalline plates crossing each other in different directions. Its colour is yellowish white: it has a feebid smell, somewhat resembling that of garlic or arsenic; its taste is strong and acrid, resembling that of ammoniacal salts; it is very volatile and difficult to cut, and has a good deal of resemblance to thick honey. When exposed to the open air, it very soon attracts moisture, and is converted into a thick brown liquid. It is extremely soluble in water, with traces of its solution a considerable degree of cold is produced. Alcohol dissolves it with facility, but scarcely in so large a proportion as water. The alcohol solution yields crystals much more readily on evaporation than the solution in water.

When nitric acid is dropped into a concentrated solution of urea in water, a great number of bright pearl-coloured crystals are deposited, composed of urea and nitric acid. No other acid produces this singular effect.

The concentrated solution of urea in water is brown, but it becomes yellow when diluted with a large quantity of water. The infusion of mugwells gives it a yellowish-brown colour; but causes no precipitation; neither does the infusion of tan produce any precipitation.

When heat is applied to urea, it very soon melts, swells up, and evaporates with an inoffensively fetid smell. When distilled, there comes over first benzoic acid, then carbont of ammonia in crystals, some benzoin, and carbont of prussic acid and oil; and there remains behind a large residuum, composed of charcoal, muriat of ammonia, and muriat of soda. The distillation is accompanied with an almost insupportable acidish allaceous odour. Two hundred and eighty parts of urea yield by distillation 200 parts of carbont of ammonia, 10 parts of carbureted hydrogen gas, 7 parts of charcoal, and 68 parts of benzoic acid, muriatic acid, and carbont of soda. These last three ingredients Fourcroy and Vauquelin consider as foreign substances, separated from the urine by the alcohol at the same time with the urea. Hence it follows, that 100 parts of urea, when distilled, yield 92.057 carbont of ammonia 4.608 carbureted hydrogen gas 3.225 charcoal

99.856

Now 200 parts of carbont of ammonia, according to Fourcroy and Vauquelin, are composed of 80 ammonia, 80 carbont of aed gas, and 24 water. Hence it follows that 100 parts of urea are composed of 39.5 oxygen 32.5 azote 14.7 carbon 13.3 hydrogen

100.0

But it cannot certainly be doubted that the water which was found in the carbont of ammonia existed ready-formed in the urea before the distillation.

When the solution of urea in water is kept in a boiling heat, and new water is added as it evaporates, the urea is gradually decomposed, a very great quantity of carbonic acid is given off, and ammonium is discharged: this acid is at the same time acetic acid is formed, and some charcoal precipitates.

When a solution of urea in water is left to itself for some time, it is gradually decomposed. A froth collects on the surface, and bubbles arise in it which have a strong disagreeable smell, in which ammonium and acetic acid are distinguishable. The liquid contains a quantity of acetic acid. The decomposition is much more rapid if a little gelatin is added to the solution. In that case more ammonia is disengaged, and the proportion of acetic acid is not so great.

When the solution of urea is mixed with one-fourth of its weight of diluted sulphuric acid, no effervescence takes place; but, on the application of heat, a quantity of oil appears on the surface, which concretes upon cooling; the liquid which comes over into the receiver contains acetic acid, and a quantity of sulphat of ammonia. In the former, chemists disengage in the distillation. By repeated distillations, the whole of the urea is converted into acetic acid and ammonia.

When nitric acid is poured upon crystalized urea, a violent effervescence takes place, the mixture froths, assuming the form of a dark-red liquid, containing quantities of nitrous gas, azotic acid, and carbontic acid, are disengaged. When the effervescence is over, there remains only a concrete white matter, with some drops of reddish liquid. When heat is applied to this residuum, it detaches like nitrat of ammonia. Into a solution of urea, formed by its attracting moisture from the atmosphere, an equal quantity of nitric acid, of the specific gravity 1.460, diluted with twice its weight of water, was added; a gentle effervescence ensued:—a very small heat was applied, which supported the effervescence for two days. There was disengaged the first day a great quantity of carbontic acid gas, and the second day, carbontic acid gas; and last nitrous gas. At the same time with the nitrous gas the smell of the oxypurassic acid of Berthollet was perceptible. At the end of the second day, the matter in the retort, which became thick, took fire, and burnt with a violent explosion. The residuum contained traces of prussic acid and ammonia. The receiver contained a yellowish acid liquor, on the surface of which some drops of oil swam.

Muriatic acid dissolves urea, but does not alter it. Oxymuriatic acid is gas absorbed very rapidly by a diluted solution of urea; small whitish flakes appear, which become brown, and adhere to the sides of the vessel like a concrete oil. After a considerable quantity of oxymuriatic acid had been absorbed, the solution, left, continued to effervescence exceedingly slowly, and to emit carbontic acid and azotic gas. After this effervescence was over, the liquid contained muriat and carbont of ammonia.

Urea is dissolved very rapidly by a solution of potass or soda, and at the same time a quantity of ammonia is disengaged; the same
substance is digested when urea is treated with barytes, lime, or even magnesia. Hence it is evident, that this appearance must be ascribed to the muriate of ammonia, with which it is constantly mixed. When pure solid potash is triturated with urea, heat is produced, a great quantity of ammonia is digested, the mixture becomes brown, and a substance is deposited, having the appearance of an empyreumatic oil. One part of urea and two of potash, dissolved in four times its weight of water, when distilled, gives out a great quantity of ammoniacal water; the residue contains acetan and carbonate of potash.

When muriat of soda is dissolved in a solution of urea in water, it is obtained by evaporation, not in cubic crystals, its usual form, but in regular octahedrons. Muriat of ammonia, on the contrary, which crystallizes naturally in octahedrons, is converted into cubes by dissolving and crystallizing it in the solution of urea.

URELA, a genus of the monadelphia polyanthaceae comprising the corolla wherein consists of five oval, obtuse, coniculate petals, broader than the apex, and narrower at the base; the fruit is a round echinated capsule, with five angles, consisting of five cells, and five united valves; the seeds are solitary, roundish, and compressed. There are eight species.

URETERS. See Anatomy.

URETHRA. See Anatomy.

UREIC ACID. Uric or lithic acid was discovered by Scheele in 1776. It is the common constituent of urinary calculi, and exists also in human urine. That species of calculus which resembles wood in its color and appearance is composed entirely of this substance. It was called at first lithic acid; but this name, in consequence of the remarks made by Dr. Pearson on its impropriety, has been laid aside, and that of uric acid substituted in its place.

Uric acid in this state has a brown colour; it is hard, and crystallized in small scales. It has a bitter taste nor smell, is insoluble in cold water, but soluble in boiling water. The solution reddens vegetable liquids, especially the tincture of turmeric. A great part of the acid precipitates as the water cools. It combines readily with alkalies and earths; but the compound thus formed is altered by every other acid. Muratic acid has no action on it, neither has sulphuric acid while cold, but when assisted by heat it decomposes it entirely.

When triturated with potash or soda, it forms a saponaceous paste very soluble in water when there is an excess of alkali, but sparingly when the alkali is neutralized. The urt of potash or of soda is nearly tasteless.

The last is found crystallized, constituting gouty concretions. Ammonia does not dissolve uric acid, but it combines with it, and forms a salt not more soluble than the pure acid, and resembling it in its external characters. Neither does uric acid dissolve in liquefied water; the ammoniacal salts have not action whatever on it.

Nitric acid dissolves it readily; the solution is of a pink-colour, and has the property of tingling animal substances, the skin for instance, of the same colour. When this solution is boiled, a quantity of azotic gas, car-bonic acid gas, and of prussic acid, is digested. When oxymuratic acid gas is made to pass into water containing this acid suspended in it, the acid assumes a gelatinous appearance, then dissolves; carbonic acid gas is emitted, and the solution yields by evaporation muriat of ammonia, superoxal of ammnia, muriatic acid, and malic acid.

When uric acid is distilled, about a fourth of the acid passes over with a little altered, and is found in the receiver crystalized in plates; a few drops of thick oil make their appearance; 8/9 of the acid of concrete carbonat of ammonia, some prussiat of ammonia, some water, and carbonic acid, pass over, and the remainder in the retort charcoal, amounting to about 36/9 of the weight of the acid distilled.

These facts are sufficient to show us that uric acid is composed of carbon, azote, hydrogen, and oxygen; and that the proportion of the two last ingredients is much smaller than of the other two.

URINE. No animal substance has attracted more attention than this, both on account of its supposed connection with various diseases and its account of the singular products obtained from it. Human urine, when fresh, is a transparent liquid of a light amber-colour, an aromatic smell, and a disagreeable bitter taste. Its specific gravity varies, according to Mr. Cruikshank, from 1.005 to 1.033. When it cools, the aromatic smell leaves it, and is succeeded by another, well known by the name of urinous smell. This smell is succeeded in two or three days by another, which has a considerable resemblance to that of sour milk. This smell gradually disappears in its turn, and is succeeded by a flat alkaline colour.

Urine reddens paper stained with tannine, and with the juice of radishes, and therefore contains an acid.

If a solution of ammonia is poured into fresh urine, a white powder precipitates, which has the properties of phospat of lime.

The presence of a white substance in urine was first discovered by Scheele. If lime-water is poured into urine, phospat of lime precipitates in greater abundance than when ammonis is used; consequently urine contains phospat of lime. Thus we see that the phospat of lime is kept dissolved in urine by an excess of an acid, or it is in the state of super-phospat. This also was first discovered by Scheele. This substance is most abundant in the urine of the sick. Berchtollet has observed, that the urine of gouty people is less acid than that of people in perfect health. The average quantity of phospat of lime in healthy urine is, as Cruikshank has ascertained, about 30/90 of the weight of the urine.

If the phospat of lime precipitated from urine is examined, a little magnesia will be found mixed with it. Fourcroy and Vaquez have ascertained that this is owing to a little phospat of magnesium which urine contains, and which is decomposed by the alkali or lime employed to precipitate the phospat of lime.

Proust informs us that carbonic acid exists in urine, and that it is kept dissolved, giving rise to the deposition of carbonic acid. If the urine is evaporated, the carbonic acid is precipitated, forming a crystalline carbonate of lime. However, we must conclude that urine contains carbonate of lime; a very extraordinary fact, to which we reflect that super-phospat of lime is also present.

When fresh urine cools, it often lets fall a brick-coloured precipitate, which Scheele first ascertained to be crystals of uric acid. All urine contains this acid; even when it is perfectly acid, and precipitated again by acetic acid. It exhibits all the properties of uric acid. The fact is, that the precipitate which usually falls when urine cools consists chiefly of phospat of lime and uric acid. It may be dissolved in water, and then evaporated to dryness. If the solution is heated and evaporated to dryness, it is a crystalline carbonate of lime if uric acid is present. The proportion of uric acid varies considerably in urine. It crystallizes in small red prisms, partly on the surface of urine mixed with some nitric acid, and left exposed to the air.

During intermittent fevers, and especially during diseases of the liver, a copious secretion of a brick-red colour is deposited from urine. This sediment is the rosic acid of Proust. Scheele considered this sediment as uric acid mixed with some phospat of lime; and the same opinion has been entertained by other chemists; but Proust affirms that it consists chiefly of a different substance, to which he has given the name of rosic acid from its colour, mixed with a certain proportion of uric acid and phospat of lime. This rosic acid, he informs us, is distinguished from the uric by the facility with which it dissolves in water; by the green or blue precipitate which it occasion in medicines or urine; and by the little tendency which it has to crystallize it.

If fresh urine is evaporated to the consistence of a syrup, and uric acid is then precipitated into it, a precipitate appears which possesses the properties of uric acid. Scheele first discovered the presence of benzoic acid in urine. He evaporated it to dryness, separated the saline part, and applied heat to the residuum. The benzoic acid was sublimed, and found crystallized in the receiver. Considerable quantities of benzoic acid may thus be obtained from the urine of horses and cows, where it is much more abundant than in human urine. In human urine it varies from 330 to 350 of the whole. Proust affirms that the acid obtained by Scheele's process is not the benzoic, but another possessed of similar properties; but differing in this circumstance, that nitric acid decomposes it, whereas only whitens benzoic acid.

When an infusion of tan is dropped into urine, a white precipitate appears, having the properties of the combination of tan and albuminum, or an acid. This character of urine, therefore, contains albumen or gelatine. These substances have been suspected to be in urine, but their presence...
If urine is slowly evaporated to the constancy of a syrup, a number of crystals make their appearance on its surface; these possess the properties of murat of soda. Urine therefore contains urat of soda. It is well known that murat of soda crystallizes in cubic form; but when obtained from urine it has the form of octahedrons. This singular modification of its form is owing to the action of urea. It has been long known that urine saturated with murat of soda deposits that salt in regular octahedrons.

The saline residuum which remains after the separation of urine from crystallized urine by means of alcohol has been long known under the name of fusible salt of urine and microsomic salt. Various methods of obtaining it have been given by chemists; from Boerhaave, who first published a process, to Rouelle and Chaulnes, who gave the method just mentioned. If the urine mass is dissolved in a sufficient quantity of hot water, and allowed to crystallize spontaneously in a closed vessel, two sets of crystals are gradually deposited. The lowest set has the figure of flat rhomboidal prisms; the uppermost, on the contrary, has the form of rectangular tablets. These two may be easily separated by exposing them for some time to a dry atmosphere. The rectangular tablets effloresce and fall to powder, but the rhomboidal prisms remain unaltered.

When these salts are examined, they are found to have the properties of phosphates. The rhomboidal prisms consist of phosphate of ammonia united to a little phosphat of soda; the rectangular tablets, on the contrary, are phosphat of soda and phosphate of ammonia. Urine, then, contains phosphate of soda and phosphate of ammonia.

When urine is cautiously evaporated, a few cubic crystals are often deposited among the other salts; these crystals have the properties of phosphat of ammonia. Now the usual form of the crystals of murat of calcium is the octahedron. The change of its form in urine is produced also by urea. This salt is obtained in greater abundance when the crystals of urea obtained from the alcohol solution are dissolved.

When urine is boiled in a silver basin it blackens the basin; and if the quantity of urine is large, small crusts of sulphuret of silver may be detached. Hence we see that urine contains sulphur. This sulphuret exhalés, along with the carbonic acid when the urine putrefies; for the fumes which separate from urine in that state blacken paper stained with acetate of lead.

Urine, then, contains the following substances:

1. Water,
2. Phosphoric acid,
3. Phosphat of ammonia,
4. Phosphat of magnesium,
5. Carboxic acid,
6. Carbonat of lime,
7. Uric acid,
8. Rosic acid,
9. Benzoic acid,
10. Gelatine and albumen,
11. Urca,
12. Resin,
13. Murat of soda,
14. Phosphat of soda,
15. Phosphat of ammonia,
16. Murat of ammonia,
17. Sulphur.

These are the only substances which are constantly found in healthy urine; but it contains also occasionally other substances. Very often murat of potass may be distinguished through the crystals which form during its evaporation. The presence of this is always detected by dropping cautiously some tartaric acid into urine. If it contains murat of potass, there will precipitate a little tartar, which may easily be recognized by its properties.

Urine sometimes also contains sulphat of soda, and even sulphat of lime. The presence of these salts may be ascertained by pouring into urine a solution of murat of barytes; a copious white precipitate appears, consisting of the barytes-combined with phosphoric acid, and with sulphuric acid if any is present. This precipitate must be treated with a sufficient quantity of muriatic acid. The phosphat of barytes is dissolved, but the sulphat of barytes remains unchanged.

No substance putrefies sooner, or exhalés a more detestable odour during its spontaneous decomposition, than urine; but there is a very great difference in this respect in different urines. In some, putrefaction takes place almost instantaneously as soon as it is voided; in others, scarcely any change appears for a number of days. Fourcroy and Vaquelin have ascertained that this difference depends on the quantity of gelatine and albumin which urine contains. When there is very little of these substances present, urine remains long unchanged; on the contrary, the greater the quantity of gelatine or albumen, the sooner does putrefaction commence. The putrefaction of urine, therefore, is in some degree the test of the health of the person who has voided it; for a superabundance of gelatine in urine always indicates some defect in the power of digestion.

The rapid putrefaction of urine, then, is owing to the action of gelatine on urea. We have seen already the facility with which that singular substance is decomposed; and that the new products into which it is changed are: ammonia, carboenic acid, and acetic acid accordingly, the putrefaction of urine is announced by an ammoniacal smell. Muclulaginous flakes are deposited, consisting of part of the gelatinous matter. The phosphoric acid is saturated with ammonia; and the phosphat of lime, in consequence, is precipitated. Ammonia combines with the phosphat of magnesia; and forms with it a triple salt, which crystallizes upon the sides of the vessel in the form of white crystals, composed of six-sided prisms, terminated by six-sided pyramids. The uric and benzoic acids are saturated with ammonia; the acetic acid, and the carbonic acid, which are the products of the decomposition of the area, are also saturated with ammonia; and notwithstanding the quantity which exhalés, the production of this substance is so abundant, that there is a quantity of unsaturated alkali in the liquid. Untertreated urine, therefore, contains chiefly the following substances, most of which are the products of putrefaction:
Ammonia, Carbonat of ammonia, Phosphat of ammonia, Phosphat of magnesium and ammonia, Urat of ammonia, Acetat of ammonia, Benzet of ammonia, Muriat of soda, Muriat of ammonia;

besides the precipitated gelatine, and phosphat of lime.

The distillation of urine produces almost the same changes: for the heat of boiling water is sufficient to decompose urea, and to convert it into ammonia, carbonic, and acetic acids. Accordingly, when urine is distilled, there comes over water, containing ammonia dissolved in it, and carbonat of ammonia in crystals; the acids contained in urine are saturated with ammonia, and the gelatine and phosphat of lime precipitate.

Such are the properties of human urine in a state of health: but this excretion is singularly modified by disease; and the changes to which it is liable have attracted the attention of physicians in all ages, because they serve in some measure to indicate the state of the patient and the progress of the disease under which he labours. The following are the most remarkable of these changes that have been observed:

1. In inflammatory diseases the urine is of a red colour, and peculiarly acid; it deposits no sediment on standing, but with oxymuriat of mercury it yields a copious precipitate.

2. During jaundice the urine has an orange-yellow colour, and communicates the same tint to linen. Muriatic acid renders this urine green, and thus detects the presence of a little bile.

3. About the end of inflammatory diseases the urine becomes abundant, and deposits a copious pink-coloured sediment, composed of roasic acid, a little phosphat of lime, and uric acid.

4. During hysterical paroxysms, the urine usually flows abundantly. It is limpid and colourless, containing much salt, but scarcely any urea or gelatine.

5. Mr. Berthollet observed that the urine of gouty persons contains usually much less phosphoric acid than healthy urine. But during a gouty paroxysm it contains much more phosphoric acid than usual; though not more than constantly exists in healthy urine.

6. In general dropsy, the urine is loaded with albumen, and becomes milky, or even coagulates, when heated, or at least when acids are mixed with it. In dropsy from diseased liver, no albumen is present, the urine is scantly, high-coloured, and deposits the pink-coloured sediment.

7. In dyspepsia, the urine always yields a copious precipitate with tan, and putsrefy rapidly.

8. The urine of rickety patients is said to be loaded with phosphat of lime, or, according to others, with oxalat of lime.

9. In diabetes, the urine is sweet-tasted and often loaded with saccharine matter. In one case, the urine emitted daily by a diabetic patient, according to the experiments of Cruikshank, contained 20 ounces of sugar.

The urine of other animals differs considerably from that of man. For the analyses of the urine of quadrupeds hitherto made, we are chiefly indebted to Rouelle junior. The following facts are true, though named by that chemist, and by the late experiments of Fourcroy and Vauquelin:

1. The urine of the horse has a peculiar smell: after exercise it is emitted thick and milky; at other times it is more permanent, but becomes milky soon after its emission. When exposed to the air, its surface becomes covered with a crust of carbonat of lime. It gives a green colour to syrup of violets, and has the consistence of mucilage. The following are its constituents as estimated by Fourcroy and Vauquelin from their experiments:

- Carbonat of lime: 0.111
- Carbonat of soda: 0.009
- Benzet of soda: 0.024
- Muriat of potas: 0.009
- Urea: 0.007
- Water and mucilage: 0.940

1.000

From the late experiments of Mr. Giese, we learn that the quantity of benzet of soda varies considerably in the urine of horses. In some specimens he found it in abundance and easily precipitated by muriatic acid. In others there was little or none. He could detect no benzoic acid in the food of horses. Hence he considers it as formed within the animal, and he thinks that it appears only in cases of disease.

II. The urine of the cow has a strong resemblance to that of the horse; it has nearly the same colour, and the same mucilaginous consistence. It tinges syrup of violets green, and deposits a gelatineous matter. On standing, small crystals are formed on its surface.

It contains, according to Rouelle,

1. Carbonat of potas, 4. Benzoic acid,
2. Sulphat of potas, 5. Urea,
3. Muriat of Potas,

III. The urine of the camel was also examined by Rouelle. Its colour resembles that of the urine of the cow; its colour is that of brown, but it is not brown, and does not deposit carbonat of lime. It gives a green colour to syrup of violets, and effervesces with acids like the urine of the horse and cow. Rouelle obtained from it,

1. Carbonat of potas,
2. Sulphat of potas,
3. Muriat of potas,
4. Urea.

IV. The urine of the rabbit has been lately analysed by Vauquelin. When exposed to the air, it becomes milky, and deposites carbonat of lime. It gives a green colour to syrup of violets, and effervesces with acids. That chemist detected in it the following substances:

1. Carbonat of lime,
2. Carbonat of magnesia,
3. Carbonat of potas,
4. Sulphat of potas,
5. Sulphat of lime,
6. Muriat of potas,
7. Urea,
8. Gelatine,

V. Vauquelin has also made some experiments on the urine of the guinea-pig, from which it appears that it resembles the urine of the other quadrupeds. It deposits carbonat of lime, gives a green colour to syrup of violets, and contains carbonat and muriat of potas, but no phosphat zor uric acid.

Thus it appears that the urine of the granivorous quadrupeds agrees with that of man in containing urea, but differs from it materially in being destitute of phosphoric acid, phos- phate, and uric acid. Whether the urine of the granivorous quadrupeds contains those last substances has not been ascertained, but it is probable that it does.

URSA, the bear, in astronomy, a name common to two constellations of the northern hemisphere, near the pole, distinguished by no peculiar character. The ura major, or the great bear, according to Ptolemy's catalogue, consists of twenty-five stars: according to Tycho's, of sixty-six: but in the British catalogue we have two hundred and fifteen.

The ura minor, or little bear called also Charles's vain, and the Greeks cynoura, by its neighbourhood to the pole, gives the denomination 8 Perseus, bear, thereta. Ptolemy and Tycho make it of eight stars, but Flamsteed of fourteen.

URUS, bear, a genus of quadrupeds of the order Carniva, in which the generic character is, from teeth six both above and below: the two lateral ones of the lower jaw longer than the rest and lobed; with smaller or secondary teeth at their internal bases; canine teeth solitary or double in each side, the first or second being proximated to the canine teeth; tongue smooth; snout prominent; eyes furnished with a nictitating membrane. There are four species.

1. Ursus arctos. The common bear, with a coat of fur as to size and colour, is a native of almost all the northern parts of Europe and Asia, and is even said to be found in some of the Indian islands, as Ceylon, &c. It is a large animal, and frequents woods and unoccupied places, and feeds chiefly on roots, fruits, and every vegetable substance, but occasionally preys on animals. In the Alpine regions the bear is brown; in some other parts of Europe, black; and in some parts of Norway it is white, or nearly so. It is almost entirely vegetable food; the brown, the black, the grey, and the white bears are, therefore, to be considered as the same species; yet it is observed that the brown and black varieties differ somewhat in their manner of life; the black confining itself to a certain species of fish, and avoiding other animals, and destroying lambs, kids, and even sometimes cattle, and sucking the blood in the manner of the cat and weasel tribes. Linnæus adds, that the bear has a habit of blowing up his prey, and of hiding or burning a part of it. Bears are reported to particularly love honey, in search of which they will climb trees, in order to get at nests of wild bees; for the bear, notwithstanding his awkward form, is expert in climbing and sometimes takes up his residence in a hollow of a very large tree. The bear also catches and devours fish, occasionally in quest of the banks of rivers for that purpose.

The bear passes a considerable part of
winter in a state of repose and abstinence; emerging only at distant intervals from his den, and again concealing himself in his retreat till the opening of the vernal season. The females are said to continue their isolation much longer than the males, and it is during this period that they bring forth their young, which are commonly two in number. These animals, when imagined to be but shapeless masses, gradually located and fashioned into regular form by the parent; an opinion now sufficiently exploded. The young, however, though not shapeless, have a different aspect from the grown animal; the soot being much sharper, and their colour yellowness: their ears are said to be blind for nearly the space of a month.

2. Ursus Americana, American bear. This, which is now considered as a distinct species, and not to be confounded with the black bear of Europe, has a long, pointed nose and narrow forehead: the cheeks and throat of a yellow-brown colour; the hair on the whole body and limbs of a glossy black, and smoother and paler than that of the European kind. It is also said to be in general smaller than the European bear, though instances have been known in which its size, at least, equalled the European, since Mr. Harlan from an island in the Pacific killed a bear weighed in Florida which weighed forty-seven pounds.

This animal inhabits all the northern parts of America, migrating occasionally from the northern to the more southerly parts in quest of food, which is said to be entirely vegetable; and it is even affirmed, that, when pressed by extreme want, they will still neglect all animal food whenever they can obtain an supply of roots and grain. They, however, sometimes destroy fish, and particularly herring, when these fish happen to come up into the creeks in shoals. They are said to continue in their winter retreats, either in dens beneath the snow under ground, or in the hollows of old trees, for the space of five or six weeks without food.

3. Ursus maritimus, polar bear. This is a far larger species than the common bear, and is said to have been sometimes found of the length of twelve feet. The head and neck are of a more lengthened form than in the common bear, and of much more in proportion. The whole animal is white, except the tip of the nose and the claws, which are jet-black: the ears are small and rounded; the eyes small; the teeth of an extraordinary magnitude; the hair is of a great length, and the limbs are extremely large and strong. See Plate Nat. fig. 415. It seems confined to the very coldest parts of the globe; being found within 80 degrees of north latitudes, as far as any navigators have yet penetrated. The shores of Hudson's-bay, Greenland, and Spitsbergen, are its principal places of residence; but it is said to have been accidentally carried on floating ice as far south as Newfoundland. This species seems to have often come in this state among the white variety of the common bear, which is occasionally found in the northern regions.

The polar bear is an animal of tremendous strength and ferocity. Barentz, in his voyage in search of an ocean passage to China, and the proof of the ferocity of these animals, in the island of Nova Zembla, where they at

lacked his teamen, seizing them in their mouths, carrying them off with the utmost ease, and devouring them in the sight of their comrades. It is said that they will attack and tear to pieces an old cow, a great distance from shore; and have sometimes been with much difficulty repelled. Their usual food consists of seals, fish, and the carcasses of whales; but, when on land, they prey on deer, and other animals, as bears, young birds, &c. They also eat various kinds of berries which they happen to find. They are said to be frequently seen in Greenland in great droves, alarmed by the scent of the flesh of seals; and will sometimes surround the habitations of the natives, and attempt to break in; and it is added, that the most successful method of repelling them is by the smell of burnt feathers. They grow extremely fat, a hundred pounds of fat having been taken from a single beast. The flesh is said to be coarse, but the skin is valuable for coverings of various kinds, and the Greenlanders often wear it as a clothing. The split tendons are said to form an excellent thread; and the summer they reside chiefly on the ice-islands, and are frequently from one to another; being extremely expert swimmers. They have been seen on these ice-islands at the distance of more than eighty miles from the shore, and feeding as they float along. They winter in dens formed in the vast masses of ice, which are piled in a stupendous manner, leaving great caverns beneath: heretofore, breed, and bring one or two young at a time, and sometimes, but very rarely, three. The affection between parent and young is so great, that they will sooner die than desert each other. They follow their dams a very long time, and grow to a large size before they quit them.

During winter they retire, and bed themselves deep beneath the snow, or else beneath the fixed ice of some eminence, where they pass in a state of torpidity the long and dismal Arctic night, appearing only with the return of the sun.

The skins of the polar bear, says Mr. Pennant, were formerly offered by the hunters in the arctic regions to the high altars of cathedrals and other churches, for the priest to stand on during the celebration of mass in winter.

4. Ursus gulo, glutton. This animal is a native of the most northern parts of Europe and Asia, occurring in Sweden, Norway, Lapland, and Siberia, as well as in some of the Alpine regions, and in the forests of Poland and Courland. It is also found in the northern parts of America, being not uncommon about Hudson's Bay.

The glutton is considerably larger than a badger, measuring a yard from nose to tail, and the tail about a foot; but it seems to vary in size, and is often less than this. The muzzle, as far as beyond the eyes, is blackish brown, and covered with hard shining hair: over the forehead, down the sides of the head, between the eyes and ears, runs a whitish or ash-coloured band or fillet: the top of the head and whole length of the back are blackish, the rump widening somewhat over the sides as it passes on, and again lessening or contracting towards the tail. In the American variety a whitish or ash-coloured band or border runs across the body, in the European kind as the ferruginous one in the European kind.

The glutton, as its name imports, has the character of a very voracious animal, preying indiscriminately both on fresh prey and carrion. One of which was kept at Dresden, and fed on flesh of a day, without being satisfied. It attacked dog, field-mice, &c. and even sometimes the larger cattle; and it is said to sit on the branches of trees, and suddenly to spring down on such animals as happen to pass beneath; tearing them, and sucking the blood, till they fall down through faintness, when it begins to devour the spoil. In winter it seeks out and catches ptarmigan under the snow. What it cannot devour at once, it is said to hide under ground, or in the cavity of some tree. It is said to be an animal of uncommon fierceness and strength; and will sometimes dispute the prey both with the wolf and bear. It is also extremely fed. It breeds once a year, and brings from two to four young at a litter. The fur is much used for muffs, linings, &c. Those skins are said to be preferred which have least of the ferruginous patch, and for this reason the Siberian variety, which is blacker than the European, is esteemed. The ursus luscus, or wolverine, appears to be a variety of this animal.

5. Ursus lotor, the raccoon. This is a native of the new world, and is principally inhabited of the northern parts of America. It is also found in some of the West Indian islands. Its colour is grey; the face white; the eyes each imbedded in a large patch of black, which forms a kind of band across the forehead. It is frequently found running down the nose. The visage is shaped like that of a fox, the forehead being broad and the snout short; the eyes are large and greenish; the ears short and slightly rounded; and the upper jaw is longer than the lower: the tail, which is covered with bushy hair, tapers to the end, and is annulated with several black bars; the body is broad, the back arched, the limbs rather short, and the fore legs shorter than the hinder; the animal is covered with thick and long hair, which has a somewhat upright growth: the feet are dasy, and have five toes with very sharp claws. The colour of the raccoon is generally a dark brown, mixed with black, as sugar-canes, various sorts of fruit, as apples, cheremuts, &c. It is also supplied to devour birds and their eggs, and is, therefore, considered as an enemy to poultry. It avidly feeds by night, and by day keeps in its hole, except in dull weather. In winter, and in very bad weather, it keeps altogether within; and is popularly believed to live like the bear, by sucking its paws. The raccoon, however, is an active and sprightly animal when taken into a state of domestication. It has a kind of oblique gait in walking, can leap and climb with great ease, and is very frequently seen on trees. It is easily tamed, and will eat the food of the Americans, and will live on bread, milk, fish, eggs, &c. It is particularly delighted with sweets of every kind, and has as great a dislike to acids. In eating, it commonly sits on its hind legs, and uses its fore feet in the manner of hands. It has a way of dipping
all manner of dry food that is given it into water, it eats it; as well as of rolling it between its paws for some time. When it kills birds, it proceeds exactly in the manner of a polecat; first biting off the head, and then skeling the body. It eats but little, and is a very cleanly animal. It is extremely expert in opening oysters, on which, as well as on crabs and various other kinds of shell-fish, it frequently feeds in its wild state. It is, when tamed, extremely active and playful: but it is of a capricious disposition, and not easily reconciled when offended. When angry, its voice is like a hoarse bark, and at other times soft and sharp. In its wild state it generally inhabits the hollows of trees; but in a domestic state shows no particular inclination for warmth; nor is it observed to be desirous of lying on straw, or any other substance, in preference to the bare ground. It sleeps from about midnight to noon, at which time it comes out for food and exercise. According to Linneus, the raccoon has a wonderful antipathy to hogs' bristles, and is much disturbed at the sight of a brush. It produces three young at a birth; a fact which, says Linneus, it commonly takes place in the month of May. The fur of the raccoon is used by the hatters, and is considered as next in merit for this purpose to that of the beaver.

In meadow, fields, or woods, the badger is an inhabitant of all the temperate parts of Europe and Asia. Its usual length is about two feet from the nose to the tail, which measures six inches. It is an animal of very clumsy make, being thick-necked and thick-bodied, with very short legs. It体制机制ly nests in a hole or den under ground, out of which it emerges by night in quest of food; feeding chiefly on roots and fruits; but it will also devour frogs, worms, &c. The badger is of an uniform grey colour on the upper parts, and the throat, breast, belly, and legs, are black: the face is white, and along each side of the head runs a long and somewhat triangular or pyramidal band of black, including the eyes and very short ears. It is commonly met with in holes or cellars, under houses, or in the ground. Authors have sometimes made a distinction between what they call the sow badger and the dog badger; but this is supposed to be perfectly untenable, and if there is any perceptible variation, it is probably no other than a mere sexual difference. The hair of the female, both on the body, limbs, and tail, is very thick; and the teeth, legs, and claws, are very strong; so that he makes a very vigorous enemy. When taken young, the badger may be easily tamed, and generally prefers raw flesh to every other food in a state of captivity. It is a very cleanly animal, and is observed to keep its subterraneous chamber extremely neat. The female produces about three or four young: this happens in summer; and, according to the count de Buffon, the parent seizes on young rabbits, which she claws out of their burrows, birds, eggs, snakes, and any other animals, in order to feed her young. Like the bear, this animal is also fond of honey, and will attack hives in order to obtain it. The badger sleeps a great deal, especially during winter, when he imitates the practice of the bear, confining himself to his den in a state of semi-torpor.

7. Ursus labradorius, American badger. In its general appearance this extremely resembles the common badger, and might almost be taken for the same animal, except in the under parts which are somewhat smaller, and the black bands on the face are much narrower and do not include the eyes, but commence behind them, and run along the top of the neck: the ears are surronded with black: the upper parts of the body are of the same colour as in the common badger, but rather paler, and with a slight yellowish cast; and the breast and belly are of a light ash-colour, instead of black: the legs are of a dusky brown: the claws are at least as long and strong as in the European badger, if not more so. This species is rather scarce in America. It is found in the neighbourhood of Hudson's-bay, and in Terra de Ladrador, and as Mr. Pennant suspects, as low as Pennsylvania, where it is called the ground-bog.

URTICA, a genus of plants of the class monoeccia, and order tetrameridia; and in the natural system classed under the 33rd or 83rd order, s. abride. The male flower has a calyx of four leaves, and a pistil; a monoeccia, central, un-furnished. The female has a bivalve calyx; and a single, oval, glossy seed. There are 59 species, three of which are British plants: 1. The planiflora, Roman nettle, has a stalk branched, two or three feet high. Leaves opposite, oval, serrated, stinging. Fruit globose. 2. The uren, less stinging nettle, has a stem a foot high. Leaves roundish, deeply serrated, opposite. The stings are very very curious microscopic objects: they consist of an exceedingly fine-pointed, tapering, hollow substance, with a perforation at the point, and a bag at the base. When the spring is pressed upon, it readily perforates the skin, and at the same time forces up some of the acrimonious liquor contained in the bag into the wound. 3. The donnca, common nettle, has a square firm stem, three or four feet high. Leaves heart-shaped, long-pointed, serrated at the edges, with wings. Flowers in long catkins. The aculei, or stings of the nettle, have a small bladder at their base full of a burning corrosive liquor: when touched, they excite a bluster, attended with a violent itching, the stings appear to be tubular, or perforated at the top, nor any visible liquor to be infused into the puncture made by it in the flesh. It seems certain, however, that some of this liquor is imnizated into the wound, though invisibly, since the stings of the dried plant excite no pain.

Nettle-tops in the spring are often boiled and eaten by the common people instead of cabbage-greens. In Arran, and other islands, a remnant is made of a strong decoction of nettles: a quart of salt is put to three pints of the decoction, and boiled up for the common spoonful of this liquor will coagulate a large bowl of milk very readily and agreeably. The stalks of nettles are so like in quality to hemp, that in some parts of Europe and Siberia they are cultivated in cloth, and paper has been made of them. The whole plant, particularly the root, is esteemed to be diuretic, and has been recommended in the jaundice and nephritic complaints. The roots boiled will dye yarn of a yellow colour. The larvae, or caterpillars, of many species of butterflies, feed on the green plant; and sheep and oxen will readily eat dried.

USAGE, in law, differs from custom and usage, denoting a usual practice, custom, or other inheritance, by usage, though he may by prescription. B. Co. 65.

USANCE, in commerce. See INTEREST.

USE, is a trust and confidence reposed in another who is tenant of the land, that he is to dispose of the land according to the intention of cestue que se, or him in whose use it was granted, and suffer him to take the profits. 2 Black. 328.

By st. 27 H. VIII. c. 10, commonly called the statute of uses, or the statute for transferring uses into possession, the cestue que se is considered as the real owner of the estate; whereby it is enacted that, when any person is seized of lands to the use of another, the person mulitified to the use in simple fee, life, for life, or years, or otherwise, shall grant the possession, in the like estate, as he has of the use, trust, or confidence; and thereby the act makes cestue que se to be the person who yields any possession under law and equity. 2 Black. 302.

USES, superadditions. See Mortmain.

Uses and customs of the sea, are certain maxims or rules which form the basis of the maritime jurisprudence, by which the policy of navigation, and the commerce of the sea, are regulated.

These uses and customs consist of three kinds of regulations, the first called the laws or judgments of Oleron; the second, regulations made by the merchants of Wisby, a city in the island of Gotland, in the Baltic, antiently much famed for commerce; and the third, a set of regulations made at Lubeck, by the Hanseatic League.

USQUEBERA, a strong compound liquor, chiefly taken by way of draught.

There are several different methods of making this liquor; but the following is esteemed one of the best: To two gallons of grappa, or other spirit, put a pound of Spanish liqueur, half a pound of raisins of the sun, four ounces of currants, and three of sliced dates; 10 pounds of sugar, 1 pound of honey, 1 pound of the flowers of rosemary, of each two ounces; cinamon and mace, well bruised, nutmegs, aniseed, and coriander-seeds, bruised likewise, of each four ounces; citron, or lemon and orange peel, scraped, of each an ounce; let all these infuse forty-eight hours in a warm place, often shaking them together: then let them stand in a cool place for a week: after which the clear liquor is to be decanted off, and to it are to be put an equal quantity of new white port, and a gallon of canary: after which, it is to be sweetened with a sufficient quantity of double-refined sugar.

USTERIA, a genus of plants of the class and order monoecia monogynia. The calyx is four-toothed; corolla funnel-form, four-lipped; capsule one-seeded, two-celled. There is one species, a shrub of North Guinea.

USURY, in a strict sense, is a contract upon the loan of money, to give the lender a certain profit for the use of it, upon all events;
whether the borrower made any advantage of it, or the lender suffered any prejudice for want of it, or whether, it shall be repaid on the appointed time or not; and in a large sense, it seems undue advantage taken by a lender against a borrower, came under the notion of usury. Haw. 243.

The statute 12 Anne, c. 16, enacts that no person, upon any contract which shall be made, shall take for loan of any money, wares, &c., which shall value 5s. or more in the year, the rent of 100l. for a year; and all bonds and assurances for the payment of any money to be lent upon usury, whereupon or whereby there shall be reserved or taken above five pounds in the hundred, shall be null, and every person who shall receive, by means of any corrupt bargain, loan, exchange, shift, or interest, of any wares or other things, or by any deceitful way, for forbearing or giving day of payment for one year, for their money or other things, shall be st. for 100l. for a year, &c.; shall forfeit treble the value of the moneys or other things lent.

But if a contract, which carries interest, is made in a foreign country, our courts will direct the payment of interest according to the law of that country. Thus, Irish, American, Turkish, and Indian interest, have been allowed in our courts, to the amount of 12l. per cent. For the moderation or exorbitance of interest depends upon local circumstances; and the refusal to enforce such contracts would put a stop to all foreign trade. 2 Black. 463.

In an action brought for usury, the statute made against it must be pleaded; and in pleading an usurious contract as a bar to an action, the whole matter is to be set forth specially, because it lies within the party's own privity; yet, on an information on the statute for making such contract, it is sufficient to mention the corrupt bargain generally, because matters of this kind are supposed to be privily transacted; and such information may be brought by a stranger. 1 Hawk. P. C. 238. Likewise upon an information on the statute against usury, he that borrows the money may be a witness, after he has paid the same.

UTENSILS, in a military sense, are necessaries due to every soldier, and to be furnished by his host where he is in quarters, viz. bed with sheets, a pot, a glass or cup to drink out of, a dish, a place at the fire, and a candle.

Utensils, &c. directed to be provided for the use of regimental hospitals:

In page 19, of the Regulations for the Sick, it is stated, that each hospital ought to be furnished with a slip-bath, or bathing-tub, two water-buckets, one dozen of Osnaburg towels, one dozen of flannel, half a dozen of large sponges, combs, razors, and soap; two large kettles, capable of making soup for 30 men, two large tea-kettles, two large tea-pots, two saucepans, 40 tin cups of one spoon, two spoons, a dozen of knives and forks, two close-stools, two bed-pans, and two earthern vessels.

A regiment consisting of 1000 men, and provided with three medical persons, ought to be furnished with hospital necessaries and utensils for at least 40 patients. It should be provided with 40 cotton night-caps; 40 sets of bedding, in the proportion of four for every hundred men; each set consisting of one pallasse, one straw matress, one bolster, three sheets, two blankets, and one rug.

For regiments of smaller number, the quantity of which are able to dry the necessaries will of course be proportionally reduced.

UTENSILS, BAKERY. The following list of bakery utensils, being the proportion requisite for an army of 36,000 men, has been extracted from the British Commissary, to which we are indebted to refer the military reader for a specific description of field ovens, &c. and field bakery, page 16, &c.

12 double iron ovens, 11 feet long, 9 feet diameter, and 3 feet high; 28 troughs and their covers, 10 feet long, 3 feet wide, and 3 feet deep, to kindle the dough.

12 large double tents (having double coverings), 32 feet long, and 24 feet wide, to make the bread in.

4 ditto, to cool and deposit the bread in.

2 ditto, to deposit the meal and empty sacks in.

2000 boards, 8 feet long, and 14 inch wide, to carry the bread to the oven, and back again.

24 small scales to weigh the dough, with weights from half an ounce to 6lb.; 24 small lamps for night work; 24 small hatchets; 24 scrapers, to scrape the dough from the troughs; 12 copper kettles, containing each from ten to twelve pails of water; 12 trevets for ditto; 12 barrels with handles, to carry water, containing each from 5 to 7 pails.

12 pails, to draw water; 24 yokes and hooks, to carry the barrels by hand; 24 iron peles, to slove and draw the bread from the ovens; 24 iron pitchforks, to turn and move the firewood and coals in the ovens; 24 spare handles, 14 feet long, for the peles and pitchforks; 24 rakes, with handles of the same lengths, to clear away the coals and cinders from the ovens; 4 large scales, to weigh the sacks and barrels of meal, and capable of weighing 500lb.; 4 triangles for the said scales; to each must be added 500lb. of weights, 3 of 100lb. each, 2 of 50lb. each, and downwards to half a pound.

UTERUS. See Anatomy.

UTLAMAGO capicudo quando utulagaw in uno conscribe et postea fugit in alium. A wit for the taking of an outlawed person in one county, who afterwaods flies into another.

UTRICULARIA, a genus of plants of the class diurana, and order monogynia; and in the natural system arranged under the 24th order, corollas of the flowers are entire, with a nectarium resembling a spur; the corolla diphyllous and equal; the capsule unicorial. There are 13 species, two of which are natives of Britain. They have been applied for ornamental use.

UVARIA, a genus of plants of the class dicotyledon, and order papilionac; the calyx is three-leafed; petals six; berries numerous, pendent, four-seeded. There are eleven species, shrubs and trees of the East Indies.

VULGAR, a genus of birds belonging to the order of accipiters. The beak is straight, and crooked at the base; the head has no feathers, on the fore part there being only naked skin, and the tongue generally biled. There are twenty-one species. The most remarkable are,

1. Grypus, the condor, which is not only the largest of this genus, but perhaps of all birds, and is said to weigh between 20 and 25 years of age. It is very nearly, if not precisely, the truth, which states the extent of wing at about 11 feet. The bill is strong, moderately hooked, and blunt at the tip, which is white, the rest of it being of a dusky colour. On the top of the head runs a kind of carunculated substance, standing up like the comb of a cock. The head and neck are slightly covered with brown down, in some parts nearly bare, and here and there a carunculated part, as in the neck of a turkey. The lower part of the neck is surrounded with a cluster of dull white and hairy kind of feathers. The upper parts of the body, wing, and tail, are black, except that the middle wing-coverts have whitish ends, and the greater coverts half black half white. The nine or ten first quills are yellow, the rest white, with the tips only black; and when the wings are closed, producing the appearance of the bird having the back white. The under parts of the body are rather slightly covered with feathers; but those of the thighs are pretty long. The legs are stout and brown; claws black and white.

These birds are said to make their nests among the inaccessible rocks, and to lay two white eggs, larger than those of a turkey; are very destructive to sheep, and will in troops often attempt calves; in which case, some of them first pick out the eyes, whilst others attack the poor animal on all sides, and soon tear him to pieces. This gives rise to the following song, used by the natives of Chili: One of them wraps himself up in the hide of a fresh-killed sheep or ox, and lies still on the ground; the condor, supposing it to be lawful prey, flies down to secure it, when the person concealed lays hold of the legs of the bird, his hands being well covered with gloves; and immediately his comrades, who are concealed at a distance, run in, and assist to secure the depredator, by falling on him with sticks till they have killed him.

2. The perorniters, or Egyptian vulture. The appearance of this bird is so horrid as well be imagined, viz. the face is naked and wrinkled; the eyes are large and black; the beak black and hooked; the talons large, and extending ready for prey; and the whole body polluted with filth: these are qualities enough to make the beholder shudder with horror. Notwithstanding this, the inhabitants of Egypt cannot be thankful enough to Providence for this bird. All the places round Cairo are filled with the dead bodies of these birds, and thousands of these birds fly about, and devour the carcasses before they putrefy and fill the air with noxious exhalations. The inhabitants of Egypt, and after them Maitet in Description of Egypt, say, that they yearly follow the caravan to Mecca, and devour the
A few of the slaughtered beasts, and the carcasses of the camels which die on the journey. They do not fly high, nor are they afraid of men. If one is killed, all the rest surround him in the same manner as do the Royton crows; they do not quit the places they frequent, though frightened by the explosion of a gun, but immediately return thither.

3. The aura, or carrion vulture, according to Latham, is about the size of a turkey, though it varies in size in different parts. The bill is white; the end black; ridges bluish saffron-colour. The head, and part of the neck, are bare of feathers; end of a red, or rather rufous colour. The sides of the head warted, not unlike that of a turkey. The whole plumage is brown-black, with a purple and green gloss in different reflections; but in some birds, especially young ones, greatly verging to dirty-brown. The feathers of the quills and tail are blacker than the rest of the body. The legs are flesh-colour; the claws black.

4. The sagittarius, or secretary, is a most singular species, being particularly remarkable from the great length of its legs; which at first sight would induce one to think it belonged to the gralle, or waders; but the characters of the vulture are so strongly marked, as to leave no doubt as to which class it belongs. The bird, when standing erect, is full three feet from the top of the head to the ground. The bill is black, sharp, and crooked, like that of an eagle; the head, neck, breast, and upper parts of the body, are of a bluish ash-colour; the legs are very long; 'twixt those of a heron, and of a brown colour; claws shortish, but crooked, not very sharp, and of a black colour; from the hind-head springs a number of long feathers, which hang loose behind like a pendant crest; these feathers arise by pairs, and are longer as they are lower down on the neck; this crest the bird can erect or depress at pleasure; it is of a dark colour, almost black; the webs are equal on both sides, and rather cedled; and the feathers, when erected, somewhat inclined towards the neck; the two middle feathers of the tail are twice as long as any of the rest. This singular species inhabits the internal parts of Africa, and is frequently seen at the Cape of Good Hope. It is also met with in the Philippine islands.

As to the manners of this bird, it is on all hands allowed that it principally feeds on rats, lizards, snakes, and the like; and that it will become familiar: whence Somner is of opinion that it might be made useful in some of our colonies, if encouraged, towards the destruction of those pests. They call it at the Cape of Good Hope stagneater, i.e. snake eater. A great peculiarity belongs to it, perhaps observed in nother; which is, the faculty of striking forwards with its legs, never backwards. Dr. Solander saw one of these birds take up a snake, small toroise, or suchlike, in its claws; when dashing it thence against the ground with great violence, if the victim was not killed at first, it repeated the operation till the end was answered; after which it ate it up quietly. Dr. J. R. Forster mentioned a similar instance, which he says was supposed to be peculiar to this bird; that is, that it might by any accident break the leg, the bone would never unite again.

The Editor of this work saw a secretary some years ago at Exeter-exchange. The dexterity with which it struck ends, &c. with its hard feel was surprising. How far it might have been tutored to this exercise is impossible to say.

2. The apex, or king vulture, inhabits South America; is the size of a bun turkeys; feeds on serpents, lizards, frogs, rats and carrion; flies high. See Plate Nat. Hist, fig. 420.

VULVA. See Anatomy.

VULVARIA, a genus of the hexandra monogynia class of plants, the flower of which consists of six very long lancedolate petals; and its fruit an ovate-oblong trilocular capsule, containing several roundish and compressed seeds. There are six species.

W.

W, or w, is the twenty-first letter of our alphabet.

WACHENDORFIA, a genus of plants of the class tracheides, or order monogynia; and arranged in Linnæus's natural method of classification under the 6th order, esnata. The corolla is hexapetalous, unequal, and situated below the germen; the capsule trilocular and superior. There are five species, none of which are natives of Britain.

WACKEN, a mineral that occurs in mass; sometimes it forms strata, but more frequently it runs in veins. Colour dark greenish-grey, which often passes to mountian-green, or blackish-green. Specific gravity from 2.6 to 3.0. Easily melts before the blowpipe. Liable to spontaneous decomposition.

WAD, or Wadding, in gunnery, a stopper of paper, hay, straw, old rope, yarn, or tow, rolled firmly up like a ball, or a short cylinder, and forced into a gun upon the powder to keep it close in the chamber; or, but up close to the shot, to keep it from rolling out, as well as, according to some, to prevent the inflamed powder from diluting round the sides of the ball, by its ignition, as it passes along the cluse, which it was thought would much diminish the effort of the powder. But, from the accurate experiments lately made at Woolwich, it has not been found to have any such effect.

WAGERS, or Sealing-Wagers, are made thus: Take very fine flour, mix it with white of eggs, isinglass, and a little yeast; mingle the materials; beat them well together; spread, the batter being made thin with gum-water, on even tin plates, and dry them in a stove; then cut them out for use.

You may make them of what colours you please, by ting the paste with brazil or vermilion for red; indigo or verditer, &c. for blue; saffron, tumeric, or gamboge, &c. for yellow.

WAGER OF LAW, is a particular mode of proceeding, whereby in an action of debt brought upon a simple contract between the parties, without any deed or record, the defendant may discharge himself by swearing in court in the presence of compurgators, that he owes the plaintiff nothing, in manner and form as he has declared, and his compurgators swear that they believe what he says is true. And this waving his law, is sometimes called making his law. 5 Bac. Abr. 428.

It being at length considered, that this waving of law offered too great a temptation to perjury, by degrees new remedies were devised, and new forms of action introduced, wherein no defendant is at liberty to wave his law.

Instead of an action of debt upon a simple contract, an action is now brought for the breach of a promise, or assumpsit; wherein though the specific debt cannot be recovered, yet damages may, equivalent to the specific debt; and this being an action of trespass, no law can be waged therein. So instead of an action of delinit to recover the very thing detained, an action of trespass upon the case, in trover and conversion, is usually brought, wherein though the specific thing cannot be had, yet the defendant shall pay damages for the conversion equal to the value thereof; and for this trespass also no wager of law is allowed. In the place of accounts, a bill in equity is usually filed, wherein, though the defendant answers upon his oath, yet such oath is not conclusive to the plaintiff, but he may prove every article, by other evidence, in contradiction to what the defendant has sworn. So that wager of law is now quite out of use, being avoided by the mode of bringing the action, but still is not out of force. And therefore when a new statute inflicts a penalty, and gives an action of debt, it is usual to add that no wager of law will be allowed.

WAGERS. In general a wager may be considered as legal, if it is not an incitement to a breach of the peace, or to immorality; or if it does not affect the feelings or interest of a third person, or expose him to ridicule: or if it is not against sound policy. 2 Durnel, & East, 610. See Insurance.

WAGES, what is agreed upon by a master to be paid to a servant, or any other per-
son that he hires to do his business for him.

2 Lid. Abr. 677. See Master and Servant.

WAGTAIL, in ornithology. See Motacilla.

WAIFS, are goods which are stolen and wavel by a felon in his flight from those who pursue him, which are forfeited; and though wavel is generally spoken of goods stolen, yet if a man is pursued with hue and cry as a felon, and he flees and leaves his own goods, these will be forfeited as stolen goods; but they are properly fugitive's goods, and not forfeited till the contrary is proved, and otherwise of record, that he fled for the felony.

2 Law. 430. See Estrays.

WAINAGE. The reasonableness of fines or amencements having been regulated by Magna Charta, that no person shall have a larger amencement imposed upon him than his circumstances or personal estate will bear, it is added, saving to the freethread his contem- ent or land; to the trader his merchandise; and to the countryman, wainage, or team and instruments of husbandry. 4 Black. 379.

WAIVER, in law, signifies the passing by of a thing, or a refusal to accept it; sometimes it is applied to an estate, or something conveyed to a man, and sometimes to a gift, &c. And a waiver or disagreement as to goods and chattels, in case of a gift, will be effectual.

Lit. 710.

WAKE, of a ship, is the smooth water asters when she is under sail: this shews the way she has gone in the sea, whereby the mariners judge what way she makes. For if the wake is right astern, they conclude she makes her way forwards; but if the wake is to leeward a point or two, then they conclude she fails to the leeward of her course. When one ship, giving chase to another, is got as far into the wind as she, and sails directly after her, they say she has got into her wake. A ship is said to stay to the weather of her wake, when in her staying she is so quick, that she does not fall to leeward upon a tack; but that when she is tacked, her wake is to the leeward; and it is a sign she feels her helm very little, and the steering of the ship.

WALE, or WARE, in a ship, those outermost timbers in a ship's side on which the sailors set their feet in climbing up. They are reckoned from the water, and are called her first, second, and third wale, or bend. See Ship.

WALES. By stat. 27 H. VIII. c. 26, and other subsequent statutes, the dominion of Wales shall be incorporated with, and be part of, the realm of England; and all persons born in Wales shall enjoy all liberties and privileges as the subjects in England do. And the lands in Wales shall be inheritable after the English tenure, and not after any Welsh laws or customs. And the proceedings in all the law-courts shall be in the English tongue. A session is also to be held twice a year in every county, by judges appointed by the king, to be held on the great sessions of the several counties in Wales; in which all pleas of real and personal actions shall be held, with the same form of process, and in as ample manner, as in the court of common-pleas at Westminster; and all the errors, unless otherwise directed by the court of king's-bench at Westminster. But the ordinary original writs, or process of the king's courts, do not run into the principality of Wales, though process of execution does, as also all prerogative writs, as writs of certiorari, quo warranto, mandamus, and the like, 3 Blac. 99.

Murders and felonies in any part of Wales may be tried in the next adjoining English county; the judges of assize having a concur- rent jurisdiction throughout all Wales, with the justice of the great sessions. Str. 255.

All local matters arising in Wales, capable of being tried in the king's-bench, are by the common law to be tried by a jury returned from the next adjoining county in England. Burt. 859. Where a man or master in Wales shall, upon any process out of the courts at Westminster, hold any person to special bail, unless the cause of action is twenty pounds or upwards. 11 and 12 W. c. 25.

WALK. See Gardening.

WALKERIA, a genus of plants of the class and order pentandria monogynia. The calyx is five-parted, inferior; corolla five-petalled; drupes five, one-seeded; nut ripe in a tree of the East Indies.

WALL, in gardening. Of all materials for building walls for fruit-trees, brick is the best, it being not only the handsomest, but the most lasting, and the most sanitory; and affording the best convenience for nailing, as smaller nails will serve in brick than will in stone walls, where the joints are larger; and if the walls are capped with fine-stone, and stone piles or columns at proper dis- tances, to separate the trees, and break off the force of the winds; they are very beau- tiful, and the most profitable walls of any others. In some parts of England there are walls built both of brick and stone, which are found very commodious. The bricks of some places are not of themselves substantial enough for walls; and therefore some persons, that they might have walls both substantial and wholesome, have built these double, the outside being of stone, and the inside of brick; but there must be great care taken to bond the bricks well into the stone, otherwise they are very apt to separate one from the other, especially when frost comes after much wet.

There have been several trials made of walls built in different forms; some of them having been built side by side in angles or variously projecting more towards the north, to screen off the cold winds; but there has not as yet been any method which has succeeded near so well as that of making the walls straight, and building them upright. Where persons are willing to be at the expense in the building of their walls substantial, they will find it answer much better than those which are slightly built, not only in cost, but in warmth; therefore a wall two bricks thick will be found to answer better than that of one brick and a half. The best aspect for ripen- ing fruit is south, with a point to the east; and the next best is south-west. It is a great improvement to have a trellis of wood against the wall, to train the trees to, as it prevents the wall being spoiled by nails, &c.

WALLENIA, a genus of plants of the class and order penicillaria monogynia. The calyx is four-leaved, the corolla has four pe- rsids, and the capsule is linear and birot- rated. There are four species, none of which are natives of Britain.

WAPENTAKE. See Judg. 777.

WAPENTAKE, from the Saxons, the same with what we call a hundred, and more especially used in the northern counties be- yond the river Trent. There have been several conjectures as to the original of the word, one of which is, that antitypically musters were made of the armour and weapons of the inhabitants of every hundred; and from those that could not find sufficient they deprived their good behaviour, their weapons were taken away, and given to others: whence it is said this word is derived. See Hundred.

WAR. The too frequent recurrence of this great and detestable calamity, unfortu- nately renders a definition of the word unnecessary. If we were called upon to define it, we should say, it is the wanton destruction, the cold-blooded slaughter, of the human race; we should call it the fruit of every sin that degrades and villifies mankind: we should mark it as a practice that diffuses misery and perpetuates vice: we should say, that if there is a barlesque upon the boasted reason of man it is this: when millions meet to murder each other for a quarrel in which, in general, they have not individually the smallest interest. The poet who wrote,

"One murder makes a villain, millions a hero," &c.

deserves a statue of gold; and the writer of that verse may sit high upon his chair, and profess to reduce the civilized world under one system of general despotism, and to plunder the property of unoffending nations and individuals, in the same manner as the highwayman, who by the laws of every well regulated community, for such an offence destined to the rope. We leave our readers to make the application to the present cir- cumstances of Europe, and we think they cannot long be at a loss.

In this view, as a means of defence, and as useful to the understanding of history, and not as giving our sanction to an irrational and antichristian practice, we insert the following article.

WAR, art of. As war, on the one hand, in respect to its effects, is intimately connected with the propriety and independence of nations; so, on the other, it requires infinite skill, combination, and management, when
considered as an art. Its principles, founded on the sciences themselves, are fixed and certain; but these branch out into such a prodigious variety of ramifications, that men of extraordinary talents and genius only have been able to excel in it.

As two different elements constitute the theatre of its operations, war is naturally divided into naval and military arrangements.

Of naval warfare.

The art of arranging squadrons or fleets in order of battle, and regulating their movements in such a manner as may be deemed best calculated for attacking, defending, or retreating, to the greatest possible advantage, is termed naval tactics.

The ancients seem to have excelled rather in land, than in sea engagements. On re-turning to the history of remote periods, we are perpetually reminded of the state of savage nations at the present day; the canoes indeed of the Trojans would have availed but little; yet the war-boats of Odysseus might not then have appeared contemptible. The Mediterranean was the early scene of naval exploits; and galleys were the vessels originally employed in these campaigns. These were propelled by the force of oars; and the combats being made to approach, and sometimes to board each other by means of flying bridges, a battle at sea differed but little from a battle on land. But as progress of time, a superiority was attempted to be obtained by means of skill and management. The prows were armed with brazen spigot, or tridents, which were so contrived as to pierce the enemy's vessel under water, and by letting in the sea, expose them to the danger of sinking. Turrets were also erected between the poop and the forecastle, for the purpose of overlooking the foe, and annoying him by means of darts and slings. In process of time, other improvements took place, which we shall here endeavour briefly to enumerate.

The dolphin, which was a huge and massive piece of lead, formed into the shape of the fish from which it had derived its name. This being perfectly water-proof by blackening, and ropes from the mast-head or yard-arm, was allowed to drop, whenever an opportunity presented itself; and penetrating through the keel of a vessel slightly constructed, it of course, by its own specific gravity, made a passage for the entering waves; and thus sometimes rendered even a retreat impossible.

2. Another engine in use, consisted of a scythe of iron, fixed at the top of a long pole; and was employed for the purpose of cutting asunder the slings of the sail-yards, so as to incommode them during action, and prevent escape from the decks.

3. Spears, or maces, of an extraordinary length, were constructed so as to annoy at a considerable distance; and thus, although stationary, to serve the purpose of a missile weapon.

4. The naval battering-ram, mentioned by Vergilus, consisted of a long beam, armed with a head of iron; and being suspended to the main-mast, was employed to good effect against the galleys.

5. A grappling-iron, which seized hold of any part of the opposing vessel, and facilitated the boarding of her.

6. The last, and most formidable of all their machines, was the balista; by which large stones could be thrown to a great distance, with a considerable degree of certainty, and the most terrible effects.

Having thus mentioned the engines made use of by the ancients, we come next to the disposition of their fleets. It was then, as now, considered a great advantage to obtain the weather-gage; and it was at the same time endeavoured to contrive so as to have the gun behind themselves, while it shone directly in the faces of their enemies. Instead of manoeuvring by means of their sails, these were always lowered previously to action; and the prows being presented to the enemy, they advanced against each other by force of oars, and amidst the sound of trumpets. After expending their arrows and javelins, recorse was at length had to the sword, so that courage alone decided the combat.

The code of signals, like the symbol by which they were regulated, was simple in the extreme. It consisted sometimes of a gilded shield, and sometimes of a red garment, or banner. During the elevation of this, the battle commenced without ceremony. During one memorable sea-fight, the galleys of the Romans were ranged so as to represent a wedge in front, while the Carthaginians drew up their fleet in such a manner as to form a rectangle on two sides of a square, to derive the purpose of annoying and inclosing the flank of the enemy; the former was the figure best calculated for attack, the latter for defence.

Notwithstanding the boasted greatness of the Roman people, yet when this country was invaded by Cesar, they appear to have obtained but little eminence in respect to naval affairs. A fleet on that occasion was not brought from the mouth of the Tiber, and the vessels built by Scipio exhibited nothing formidable or ingenious either in their management or construction. They must have been small and contemptible, in point of size, for they were drawn up on the beach, near to the town of Lucca, now vanished, and fortified like the camp, by means of a ditch and rampart.

On the departure of these invaders, who, as usual, at once conquered and civilized the barbarous tribes among whom they settled, the situation of the Britons must have been truly distressing. Reduced perhaps to the use of the coracles, or boats made of skins stretched on oisters, they were able to derive little or no benefit from the ocean that surrounded them.

On the neighbouring continent, however, the boats had made a greater progress, or at least left a deeper impression; for, doubtless, the keels of the Saxons must have appeared formidable to men whose vessels were ribbed with two or three timbers.

The wars with the Danes rendered some attention to maritime affairs necessary; and Alfred is represented as having encouraged and employed foreign artificers and masons, by means of bonds or constructed vessels of a superior size. With these he secured many of the northern coasts, which were then infested by pirates, freebooters, and enemies of all sorts: and this prince appears to have rescued his subjects from the incursions of pirates.

At length the depredations of the northern states became so formidable, from being occasional visitors, for the sake of plunder, the Danes, and other nations bordering on the Baltic, began to think of settling in Britain, and in consequence of their power and numbers, they were finally enabled to place one of their own sovereigns on the throne. After this, either by land or sea, all contention necessarily ceased.

William the Norman obtained the crown by the gross management of Harold, in respect to both naval and military affairs; for on one hand he had detached his squadron to the northern parts of the kingdom, instead of keeping it on the southern shore to oppose the enemy, while on the other he put his whole stake to hazard on a single battle. The fleet conducted by the Conqueror to the coast of Sussex, (Sept. 28, 1066) consisted of no less than three hundred vessels; but they appear to have been contemptible in point of size, and to have been but ill calculated to cope with an enemy.

A long interval succeeded before any great progress, in respect to maritime affairs, occurred; and when the Seine were between the kings and the bishops, the acquisition of Ireland, and the incorporation of Wales, all took place before the foundation of a national navy was laid. But commerce, the true nurse of sailors and of a fleet, began to be attended to; trade was no longer carried on solely by foreigners; while the wool of England, after being woven and spun where it had grown, was exported to distant countries, and brought back profitable returns. The ships of the cinque-parts now became formidable; they were regularly wont out, when required, to the kings of England; and assisted not only in their wars, but in the conveyance of their troops to the continent.

In 1217, Hubert de Burgh, governor of Dover-castle, after obtaining the weather-gage, defeated the French, in the first seafight that ever took place between the English and the Continent.

It was not until the time of Edward I., however, that any great expeditions seem to have taken place. That prince fitted out three squadrons at the same time.

In 1340, the English fleet appears to have been drawn up in the straight lines, the larger ships being placed in the front, and the smaller in the rear, whence they were enabled to send fresh supplies of men, or otherwise grant their assistance, as occasion might serve. In this battle, which took place on the coast of Flanders, the French lost two hundred and thirty ships, and had two of their admirals slain. During the contest for the crown of France, the arms of England were eminently triumphant both by sea and land; but the wars between the rival houses of York and Lancaster so completely occupied the hands and the hearts of the nation, as to prevent any attention to foreign affairs.

At length HEN VIII. a wise and able prince, began to build ships of war, one of which cost him upwards of 14000L. His son, Henry VIII. notwithstanding those odious vices and follies before mentioned, seems to have conceived a just notion of the true interests of the nation, in respect to maritime
affairs. He accordingly instituted the navy-office, appointed commissioners, constructed several large ships, and laid the foundations for naval discipline and drill, in the time of his daughter, preserved the independence, and added not a little to the glory, of England.

Nor were the French at this period inactive to their navy. During an engagement with the English in the Channel, their fleet appears to have assumed a regular and systematical arrangement. It consisted of three divisions, that in the centre being composed of thirty-six ships, and the van and rear of thirty each. The galleys, which had come from the Mediterranean, were considered in the same point of view as frigates are at the present day, and never entered the line of battle.

Meanwhile, the introduction of gunpowder had created an entire change in the weapons of war; and at this day the sword and the boarding-pike are perhaps the only ones that have been in use, both by the ancients and moderns. The Spaniards, who had become a great maritime nation, said to have gone even to sea mainly to procure cannon, during a sea-fight with the English and their allies, off Rochelle, in 1372: yet it has been asserted, that this instrument of destruction was actually recurved to by our ancestors in 1350. The galleys then, which had been threatened by a heavy invasion, means of an armada, which, whether we consider the size of the vessels, or the manner in which they were manned and equipped, must be considered as formidable. They entered the Channel in the form of a crescent, the horns of which extended to a prodigious distance, and were assuredly more than a match for any force that could be brought to oppose them. But lord Howard of Effingham, assisted by Drake, Hawkins, and Froebisher, (all of whom, but himself alone, had been bred in the merchant-service), so managed an inferior squadron, as to obtain a complete victory.

A competent idea may be formed of the fleet of England in those days, by observing, that on the demise of Elizabeth, it consisted of forty small ships only, of which number four did not exceed forty guns, but two of those were mere frigates. They were commanded by twenty-two commodores, or twenty-three others were below-five hundred; of the rest, some did not exceed fifty, and some not even twenty, while the whole number of guns amounted to no more than 774.

But the long and bloody contest that afterwards took place with Holland for naval superiority, finally fixed the character of the English nation, in respect to maritime affairs. During three dreadful wars, there were no less than nineteen general engagements, in one of which Nelson was victorious. Every resolution had its effect, and the English were never defeated. Their navy was renewed for three years in succession, in another for two days, and in a third for one; making in all no less than twenty-five days of general actions. What is still more remarkable, during the whole period, the enemy's fleet, D. W. Van. 5.

At the battle of the Nile, Charles II. the royal navy amounted in all to 113 sail. James II. while a subject, had commanded a fleet, and insti-

WAR.

tuted, or rather improved and enlarged, the system of signals. At his abdication, England possessed 173 vessels of different descriptions. During the time of William and Mary, these were increased to 320; but their success was not proportionable to the public expense, and it was not till the reign of Anne, however, that the naval power of France received a deadly blow at Vigo, having lost no less than seventeen ships of war.

On the accession of the house of Brunswick, the fleet increased rapidly; and during the present reign, it has obtained an unprecedented degree of prosperity: for towards the middle of the year 1806, it consisted of 132 sail of the line, 17 forty-four and fifty gun ships, 190 frigates, 160 sloops, &c. and 242 gunboats, forming a total of 753 in commission.

After these observations on the rise and progress of the British navy, it may be necessary to make some remarks on the manner in which it is conducted during action. As the skill and bravery of our seamen have always been eminent by comparison in close engagements between single ships, it necessarily follows, that the adoption of any system which would place the crews of all the vessels in the same condition, could not fail to be attended with the most beneficial advantages. It was a long while, however, before this could be effected; for the opposite squadrons being usually disposed in right lines parallel to each other, every ship had to suc-ceed to a wind on the same tack, it necessarily fol-

lowed, that the action in general, provided equal numbers were brought into contact, could neither be long nor decisive. Thus it frequently happened, that nothing decisive occurred, not so much as a single ship being lost or won on either side.

A great and sudden change was however effected. This occurred on the 12th of April 1782, when admiral sir George Rodney, instead of following the old system, pierced the French line, formed by the count De Grasse, and gained a complete victory. The same occurred under lord Howe, June 1, 1794.

A similar principle, viz. "the directing the principal share of the force of a fleet against a few ships," was put in practice by sir John Jervis, now earl St. Vincent, on the 13th of February, 1797.

At the battle of the Nile admiral sir Horatio, afterwards lord viscount Nelson, contrived to double down on the enemy, and place part of their fleet between two fires: while during that of Trafalgar he advanced in two lines, and effected a junction with this similar effect, but by different means. The latter, indeed, was exactly the same in all: that of bringing fleets into the same position as single ships, so that the sailors might be enabled to fight hand to hand, with the additional advantage, that the many would thus be enabled to attack the few.

It has already been observed, that some of our gallant naval commanders, during the civil wars, had been bred in the army; and it is not a little remarkable, that the great change which has taken place in the line of late years, in respect to the management of fleets, appears to have originated with a landsman, who, according to his own account, had attained ten years of age, before he had ever seen a ship. The gentleman to whom we now allude is Mr. Clerk, or Elsin, author of an "Essay on Naval Tactics, Systematical and Historical, in four parts." The first edition of the first part appeared in 1789, and the second edition in 1794; and it is the last in that language that we shall here take some notice of it.

During the American war, the action between amphibial Keppe and the French fleet, on the 27th of July, 1779, engaged Mr. Clerc's particular attention. The idea of the line of battle was in some parts novel, as it was an attack from the leeward; and he remarked, with surprise, that in the course of the two long trials which followed this indecisive fight, as well as that of admiral Matthews, in 1744, and of admiral Byng, in 1756, not a single hint escaped, "that it was possible any thing defective could be attributed to the system of the attack itself, or that any kind of improvement should be attempted," such as the scheme since put in practice, "the cutting the enemy's line asunder; the directing the greater part of the force of a fleet against a few ships, either in the van or rear of the enemy, in the same manner as by a hawking, or a plover-sailing or crippled ships of the enemy."

During the engagement of admiral Byron off the island of Grenada, on the 7th of July, 1779, the attack, like those made by Matthews and Byng, was from the windward; and from a consideration of all these cases, Mr. Clerk became induced to think, that the want of success was not to be attributed either to any abatement in the spirit of the seamen, or by any fault in the ship-building; but solely to the unskilful manner in which the general attacks were conducted.

Impressed with these ideas, he mentioned his suspicions, in January 1780, to a friend of sir George Rodney, to whom he at the same time communicated his theories of attack, from both windward and leeward, and explained his doctrine of cutting the enemy's line. The propriety of these plans was not fully exemplified however, until two years after, (April 12, 1782;) when a victory, far more decisive and important than any which had been gained by our fleets during the last century, was obtained; for, on this occasion, the attack was from the windward; and from the author considers as more rare, ingenious, and effectual, than an attack from the windward; in addition to which, the enemy's line was at the same time cut in two.

In the Essay on Naval Tactics, the importance of a single ship to windward bearing down directly on an enemy to leeward, is pointed out by a diagram, accompanied with a demonstration, we are here presented with a complete and effectual way of cutting directly against the rigging of a ship, with its result when employed against the bull. In respect to fleets, an attack from the windward is supposed to be attended with a disadvantage in the ratio of twenty to one, as the fire of the whole line to leeward can be applied, on such an occasion, against the van of the assaulting; a manoeuvre which the French were well acquainted with, and put constant in practice, until the new mode of combat was introduced.

These positions are illustrated by:

1. Admiral Matthews' engagement with the combined fleets of France and Spain, off Toulon, February 11, 1744.
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2. Admiral Byron's action with the French fleet off Minorca, May 20, 1756.
4. Admiral Byron's off Grenada, July 6, 1779.
5. Admiral Barrington's, at St. Lucia.
6. Sir George Bridges Rodney's, off Cape Finisterre and St. Vincent.

The art of arranging armies in order of battle, and of regulating their movements in such a manner, as may be deemed most proper for attacking, defending, or retreating, to the greatest possible advantage, is termed military tactics. It has been generally recognized, and at length received as an axiom, that there is no branch of human knowledge more difficult than that of which we are now about to treat; and both ancient and modern have been well convinced of this fact, that it has been regularly taught in public schools, erected expressly for that purpose.

Two celebrated nations, the Greeks and the Romans, were particularly anxious to attain perfection in the science of war; and this account, in order to describe their extraordinary success, when combating against enemies who, content with a blind obedience to a custom, placed their chief confidence not in the discipline, but in the multitude of their combatants, the circumstances on the contrary were conspicuous that the strength of armies consists principally in the art with which they are managed, and the principles by which they are regulated; that multitudes are often more embarrassed than system, and that a small body of troops, well regulated, and ably directed, is capable of overcoming a large one, deficient in respect to those advantages. Therefore, they deduced a theory relative to the disposition of their soldiers, the order of battle, the manner of encamping, the best and most regular mode of marching, of forming, and of acting, in such a way, as to oppose the strong to the weak, while they at the same time anticipate all the stratagems, and prevented all the deceptions, of the enemy. On the other hand, they did not forget to regulate the different species of arms, and to adapt the army to the nature and exigencies of the moment, and to adopt the most advantageous method of using them, whether offensively or defensively.

War, accordingly, was regarded as an art, of which it was necessary to become acquainted with the principles anterior to the practice. It is but little wonder, therefore, that so many great men were produced, and such wonderful effects ensured; more especially in Greece, where infinite pains were taken to attain a perfect knowledge of the art, and the Romans too directed their attention to military affairs; and the order of the legion was supposed to be placed on the whole to be superior to that of the phalanx. Vegetius, indeed, after examining its formation, explains that none but a God could have contrived such a powerful and admirable assemblage.

That wonderful nation too, laying prejudice aside, was examined, studied, and adopted, those practices of war they were excelled by their enemies. A defeat was never lost on them; for after every reverse, they obtained an increase of their military knowledge. Thus the sharp-edged weapons of the Gauls, and the elephants of Pyrrhus, never surprised them but once; and they had not sooner become acquainted with the Spanish sword, than they immediately abancon their own. At the same time, they did not omit to employ Numidian horses, Cretan archers, slingers from the Balearic islands, and ships belonging to Rhodes. In fine, no people ever exercised with such prudence in their preparations for a campaign, or carried on hostilities with such extraordinary ability. We are the less inclined to wonder, therefore, at the observation of Josephus, who remarks, that with them was a meditation, and pace an exercise.

We accordingly find that they abound with great commanders; and what is still more extraordinary, that many of these commanders proved victorious without the benefit of experience. Some, at the age of twenty-seven, knew how to repair the faults committed by his father and his uncle, in consequence of previous study. When Lucullus marched into Asia for the purpose of attack, he instructed himself, according to Cicero, and read into the works of the best authors; while at a later period, Nurse, who had never before commanded, nor even served, replaced Belisarius, over and over, and successfully concluded the struggle with the Goths.

It is evident, therefore, that war is to be regulated according to certain rules and principles; and that on the knowledge and application of these, depends the fate of a campaign, and perhaps of a nation. It necessarily follows, that a general ought to possess extraordinary talents and attainments. According to a celebrated author, "some qualities should be born with, and others acquired by him." In addition to these, he should also possess a quick eye, so as to enable him to judge of an advantageous position for his troops, decide on a manoeuvre to be made or to be avoided, of a country suitable or unsuitable to his army, and, above all, of a field of battle where he should give the greatest number of possible advantages at the least possible risk or inconvenience.

He should at the same time exhibit a sound and solid judgment; for the choice of officers to be put at any particular exigency, depends in a great measure upon him, and therefore the best dispositions would prove fruitless if not ably seconded. As his orders too cannot, from the nature of things, be precise, it is expected therefore of those who command under him, to know how to take advantage of a wrong movement on the part of the enemy, to commence an attack themselves, or only to sustain the troops engaged, and to vary their conduct according to the varying nature of circumstances.

But these qualities in the chief without subordination on the part of those who are subject to his command would be of little avail, if order and discipline were not duly maintained. Without these, the most numerous and best-composed army would soon become little better than a horde of Tartars, who, being united only by the hope of booty, separate as soon as that motive ceases to operate. Great as it is necessary, however, in enforcing discipline, and in any mean ought to be adopted. Too much severity disgusts the soldier, and not unfrequently
PRODUCES ANTIQUITY; TOO MUCH INDULGENCE ON THE OTHER-HAND SINKS HIM INTO IDIOLATRY, AND INDUCES HIM TO NEGLECT HIS DUTY; LICENCIATENESS MAKES GOOD ORDER APPEAR BASHERFUL; AND GOOD GOVERNMENT LIBERATES HIS SOUL FROM ALL CONSIDERATION, IN HIS SUPERIOR OFFICER, SO THAT THE MOST FATAL RESULTS ARE AT LENGTH UNAVOIDABLE.

BEHIND THE ABOVE QUALITIES, WHICH ARE SO ESSENTIAL, AND EVEN NECESSARY, IN A COMMANDER, A GENERAL WHO WOULD ASSUME THE TITLE OF A HERO, OUGHT TO UNITE IN HIMSELF, NOT ONLY ALL MILITARY, BUT ALL CIVIL AND POLITICAL EXCELLENCE. IT IS A KNOWLEDGE OF THE LAWS, CUSTOMS, CONSTITUTIONS, PRODUCE, AND NATURE OF DIFFERENT STATES, THAT HE IS TO REGULATE HIS OPERATIONS, AND MAKE WAR WITH SUCCESS. NOTHING WILL ESCAPE HIM, BECAUSE EVERY THING IS ESSENTIAL TO HIS PROJECTS; THE GENIUS OF THE COUNTRY POINTS OUT THE MANNER OF HIS MARCHES AND HIS MOVEMENTS, AND THE KNOWLEDGE OF THE INHABITANTS WILL LEAD HIM TO ANTICIPATE WHATEVER MAY BE EXPECTED ON THEIR PART. ONE NATION IS VENEREABLE, FIERCE, AND FORMIDABLE, AT THE FIRST ONSET; ANOTHER IS NOT SO HERETICALLY; THE ONE STANDS SOLELY WITH THE FEMALE, THE OTHER WITH THE FEMALE, A SINGLE INSTANT DETERMINES SUCCESS; WITH THE LATTER, THE ACTION IS NOT SO RAPID, BUT THE EVENT IS LESS DOUBTFUL.

IN FORMER TIMES, THE ART OF WAR WAS DIFFERENT FROM WHAT IT IS AT PRESENT; THE GENERAL PRINCIPLES ARE ALIKE. AFTER THE DARTS, JAVELINS, AND ARROWS HAD BEEN EXPENDED, THE COMBAT TOOK PLACE BETWEEN OPPONENTS WHO ENGAGED HAND TO HAND; AND THEY DID NOT DIFFER FROM ONE ANOTHER, THE CROSS-BOWS HAVING ALL OPERATING BY MEANS OF THE IMPETUS, THE ACTION WAS GENERALLY LONG AND BLOODY. SOME OF THE PLANS OF BATTLE WERE EXACTLY THE SAME AS THEY ARE NOW; AND IT IS NOT A LITTLE REMARKABLE, THAT Cesar, At Pharsalia, DREW UP HIS TROPS ACCORDING TO THE OBVIOUS ORDER, WHILE EPIANONIADAS AT LEUCRA ADAPTED THAT WHICH, ON ACCOUNT OF ITS PARTICULAR FORM, IS CALLED AN ECHELON ATTACK.

IN THE MIDDLE AGES, WAR APPEARS TO HAVE DEGENERATED INTO A SYSTEM OF MARAUDING, BEING CARRIED ON NEARLY IN THE SAME MANNER AS AMONG THE MAHRATTAS AT THE PRESENT DAY. THE TROOPS, IF THEY WERE NOT ARMED, WERE MOUNTED ON HORSEBACK; AND THE MEN WERE CARRIED IN ARMOUR, PLACED THEIR GLORY IN STANDING ERCENT IN THEIR SIRUPPS, SO AS TO RESIST THE SHOCK OF AN ADVERSARY. AT LENGTH, DURING THE CRUSADES, A MORE REGULAR SYSTEM BEGAN TO PREVAIL; AND THE CHRISTIANS ON THE PLAINS OF PONTUS, MET WITH A MASTER IN THE ART OF WAR, IN THE PERSON OF SALADIN.

AT THE BATTLE OF HASTINGS, THE NORMAN CROSS-BOWS UPON TO HAVE GAINED AND EVEN TO HAVE SURPASSED THE ENGLISH, WHOSE RANKS WERE CLOSE, AND WHOSE LINE COULD NOT BE PIERCED. ON PERCEIVING THIS, WILLIAM HAD RE COURSE TO STRATEGEM, AND CONQUERED BY PRETENDING TO FLY, FOR HE KNEW THAT REGULAR ORDER COULDN'T NOT BE PRESERVED IN A PERSUASION; AND HE WAS THUS ENABLED TO OVERCOME AN ENEMY WHICH HAD BEEN THROWN INTO DISORDER.


THE INTRODUCTION OF GUNPOWDER HAS MADE A GREAT CHANGE IN THE ART, WITHOUT ALTURING; HOWEVER, ANY OF ITS GENERAL PRINCIPLES, WHICH WERE EXACTLY THE SAME AT THE BATTLES OF CANNE AND OF AUSTRIA. THIS INVENTION, HOWEVER, HAS MADE MODERN WARS INFINITELY MORE EXPENSIVE, AND MORE DIFFICULT, IN RESPECT TO THEIR MANAGEMENT. AN IMMENSE QUANTITY OF BAGGAGE, AMMUNITION, AND ARTILLERY, HAS NOW BECOME NECESSARY, AND THE SPECIFIC NUMBER RATHER THAN THE INTEGRAL ALLOWS THE ROYAL ARMS TO THE SOLDIER, IS ATTENDED TO. AS MUCH DEPENDS ON THE SYSTEM, ON THE REGULAR SUPPLY OF PROVISIONS, FOR MEN AND HORSES, A PLAN OF THE CAMPAIGN IS FORMED IN ADVANCE; FORTRESSES ARE CONSIDERED AS SO MANY FACTORIES, AND THE MAGAZINES ARE MAINTAINED UNDER THEIR PROTECTION, AS THEY ARE THE BASIS WHERE THE LINES OF OPERATION ARE TO BE TRACED. IT IS, THEREFORE, THAT STRONG PLACES SUCE TO EQUALLY PROTECT RETREATS, AND TO ADVANCE HAVENS.

IN ANCIENT TIMES, IT WAS USUAL TO ASSAULT THE ENEMY IN FRONT, BUT IT IS NOW CUSTOMARY TO ACT ON THE FLANKS AND THE REAR, TO CUT OFF CONVOYS, AND TO ANNihilate SUPPLIES, TO DESTROY THE RESOURCES ON WHICH HE DEPENDS. IT IS USUAL, THEREFORE, INSTEAD OF ASSUMING A POSITION DIRECTLY IN FRONT, TO OCCUPY A CAMP EITHER TO THE RIGHT OR TO THE LEFT; FOR THE CENTRE, WHICH IS THE STRONGEST PART OF THE LINE, IS ALMOST HAPPLY ELUDED. WHILE ON THE CONTRARY, THE ARMS WHICH ARE NECESSARY IN THE WEAK PORTION, THEN BECAME EXPOSED TO INFLICT.


IT WAS ABOUT THIS PERIOD, THAT IN CONSEQUENCE OF THE FREQUENCY OF SIEGES, THE PIGE BECAME ESSENTIAL TO THE ADVANCE OF THE ARMY; THE BAYONET ADOPTED. THE PRINCE DE Dessaoue SOON AFTER INTRODUCED THREE IMPORTANT CHANGES, TO TWO OF WHICH THE PRUSSIANS WERE INDUCED FOR THE BATTLE OF MOSVITZ. THE FIRST OF THESE, THAT OF BEARING, THE SECOND NOT TO REND THE FIRE OF MUSQUETERY MORE FATAL, AND THUS SERVE TO EXHIBIT IT FROM THE CONTEMPT IN WHICH IT WAS HELD BY THE CHEVALIER POLARD AND MARSHAL SACE. THE SECOND WAS THE EQUAL STEEP, WHICH ENABLED THE WHOLE LINE IN REGULAR MOVEMENTS TO PERFORM A CHARGE IN THE ORDER OF BATTLE, WHICH WAS ALTERED TO CONSIDER THREE INSTEAD OF FOUR LINES.

IT WAS ON THESE FOUNDATIONS THAT FREDERICK II. ERECTED A GRAND SUPERSTRUCTURE. IT WAS HE WHO, IN ADDITION TO THE PRACTICE OF THESE IMPROVEMENTS, INTRODUCED ORDER INTO THE MOVEMENTS OF THE INFANTRY, AND EFFECTED AN ENTIRE CHANGE IN THE CHARGE OF THE CAVALRY; BEFORE HIS TIME THE TROOPES NEVER ADVANCED WITH A QUICKER PACE THAN A TROT, AND HAD RECURS TO FIRE-ARMS INSTEAD OF THE SABRE.


AFTER ALL, ALTHOUGH WAR AS A SCIENCE HAS LATELY BEEN CERTAINLY CARRIED TO A GREAT DEGREE OF PERFECTION, YET IT HAS VARIED BUT LITTLE IN ITS PRINCIPLES; ON THE CONTRARY, THE MAXIMUM OF THE ART SEEMS NOW TO BE TO BRING TROOPS TO ATTACK WITH THE BAYONET, AND TO KEEP THE WAR OF THE SUCCESSION, WHICH BECAME TO DO WITH THE PIGE SOME CENTURIES AGO; AND THE ENGLISH BY THEIR CONDUCT IN FLANDERS, EGYPT, AND CALABRIA HAVE PROVED THAT TANG TO HAND THEY STILL PRESERVE THEIR ANTIENT REPUTATION AND NOVAE OF OLD, ARE UNQUEALED BY A CHARGE.
Meanwhile, military seminaries for the instruction of those destined to become officers have been established, able masters have been also provided, and the arts and sciences connected with war, are now publicly taught. By the institution of the volunteers, the genius of the nation has been of late years directed in an eminent degree to military affairs; and it seems now to be established as a principle, that an army has become to the full as necessary as a fleet, for the defence of our own islands, as well as the annoyance of the dominions of our enemies.

Before we conclude this subject, it may be necessary to enumerate a few of the principal events, laid down by those who have treated of the art of modern warfare; observing at the same time, that they apply rather to a continent than an island.

1. It is necessary to have magazines for the supply of an army, and fortresses for the protection of these supplies.

2. There should be a range of fortresses on the same line, to serve as a base for future operations.

3. To undertake with safety an offensive operation against the enemy, it is necessary that the two fortresses at the extremities of the line, should be separate at such a distance from each other, that the two lines of operations proceeding from them may meet at the given object, and form an angle of at least 90 degrees.

4. It is easier to stop the progress of an enemy by occupying a frontier on his flank, than in his front.

5. The best way of opposing an offensive operation, is to act offensively.

6. The subsistence of the enemy's army, rather than the army itself, ought to be the chief object against which operations are to be directed.

7. It is always possible to avoid a combat, by preventing the enemy from approaching too near.

8. A general ought never to wait an attack, but to put himself in movement to act offensively, even if in possession of a strong position.

9. The enemy can never be drawn up so as to prevent his flank from being turned.

10. The front opposed to the enemy ought to be extended so as to envelop him, and he may be enveloped by an inferior number, provided it is posted on his flanks.

11. The infantry ought to be constantly supported by the cavalry, and the best way of achieving this, is to draw up the latter in the rear.

12. A column is the best defensive figure that can be assumed against cavalry.

WARS. The following are the most remarkable wars in which this country has been engaged, since the

War with Scotland, 1068.

War with France, 1249.

Civil War, 1262—ended, 1267.

War with France, 1297—ended, 1327.

War with France, 1339.

War with France, 1358—ended, 1360.

War with France, 1378—ended, 1389.

War with France, 1400—ended, 1402.

War with France, 1403—ended, 1409.

War with France, 1410—ended, 1415.

War with France, 1422—ended, 1423.

War with France, 1427—ended, 1429.

War with France, 1462—ended, 1477.

War with France, 1486—ended, 1489.

War with France, 1502—ended, 1509.

War with France, 1527—ended, 1529.

War with France, 1532—ended, 1535.

War with France, 1557—ended, 1559.

War with France, 1564—ended, 1566.

War with France, 1576—ended, 1579.

War with France, 1597—ended, 1600.

War with France, 1607—ended, 1609.

War with France, 1629—ended, 1635.

War with France, 1648—ended, 1650.

War with France, 1667—ended, 1668.

War with France, 1677—ended, 1679.

War with France, 1689—ended, 1690.

War with France, 1697—ended, 1700.

War with France, 1702—ended, 1703.

War with France, 1713—ended, 1714.

War with France, 1726—ended, 1727.

War with France, 1727—ended, 1728.

War with France, 1733—ended, 1734.

War with France, 1735—ended, 1736.

War with France, 1737—ended, 1738.

War with France, 1739—ended, 1740.

War with France, 1741—ended, 1742.

War with France, 1743—ended, 1744.

War with France, 1745—ended, 1746.

War with France, 1747—ended, 1748.

War with France, 1749—ended, 1750.

War with France, 1751—ended, 1752.

War with France, 1753—ended, 1754.

War with France, 1755—ended, 1756.

War with France, 1757—ended, 1758.

War with France, 1759—ended, 1760.

War with France, 1761—ended, 1762.

War with France, 1763—ended, 1764.

War with France, 1765—ended, 1766.

War with France, 1767—ended, 1768.

War with France, 1769—ended, 1770.

War with France, 1771—ended, 1772.

War with France, 1773—ended, 1774.
The general, therefore, who is chosen for the command of an offensive army, should have wisdom, penetration, and foresight; wisdom, to preserve a proper discipline in his corps, that the allied prince may have no cause to complain of him; foresight and prudence, to prevent his troops from suffering for want of subsistence, or being exposed to the perils of war, but in proportion to their numbers with those of the allied prince; and finally, that nothing shall pass without his knowledge, which may be prejudicial to his master.

War, council of, is an assembly of great officers, called by a general, or commander, to deliberate with him on enterprises and attempts to be made. On some occasions, the quarter ports,under the governor of an assembly of officers, sitting in judgment on delinquent soldiers, deserters, coward officers, &c.

WARD, in law-books, a word of divers significations; thus, a ward in London, is a description of the charge of one of the aldermen of the city. There are twenty-six wards in London, which are as hundreds, and the parishes thereof as towns. A forest is divided into wards, and so are most of our hospitals.

WARDEN, one who has the charge or keeping of any person, or thing, by office. Such is the warden of the Fleet, the keeper of the Fleet-prison, who has the charge of the prisoners there, especially such as are committed from the court of chancery for contempt.

Warden, in an university, is the head of a college, answering to what in other colleges we call the master. Warden, or lord-warden, is the governor of these noted havens, who has the authority of an admiral, and sends out writs in his own name. Warden of the mint, is an officer whose business it is to receive the gold and silver bullion brought by the merchants to pay for them, and oversee the other officers. He is called keeper of the exchange and mint.

Warden, church. See Church-Warden.

WARDMOTE, in London, is a court so-called which is kept in every ward of the city, answering to the curates comitata in ancient Rome.

WARDS was a county first erected in the reign of Henry VIII, and afterwards augmented by him with the issue of livery; whence it was styled the court of wards and livery, but dissolved by 12 Car. II.

WARDSHIP. In our ancient customs, when the tenant died, and his heir was under the age of twenty-one being a male, or fourteen being a female, the lord was entitled to the wardship of the heir, and was called the guardian in chivalry. This wardship consisted in having the custody of the body and lands of such heir, without any account of the profits, till the age of twenty-one in males, and fourteen (which was afterwards advanced to sixteen) in females. For the fine supposed the heir male unable to perform knight's service till twenty-one; but as for the female, she was supposed capable at fourteen to marry, and then her husband might perform the office. 3 Black, 67. This privilege of the lord's was abolished under the Commonwealth, and the abolition confirmed by act; 12 C. 2. c. 24.

WARNING-WHEEL, in a clock, is the third or fourth, according to its distance from the first wheel. See Clockwork.

WARP, in the manufacture of threads, whether of silk, wool, linen, hemp, &c. that are extended lengthwise on the weaver's loom; and across which the workman by means of his shuttle passes the threads of the wool, to form a cloth, ribband, festoon, or other stuff.

For a woolen stuff to have the necessary qualities, it is required that the threads of the warp should be of the same kind of wool, and of the same fineness, throughout; that they are sized with Flanders or parchement-sizing, well prepared; and that they should be in sufficient number with regard to the breadth of the stuff to be wrought. To warp a ship is to shift her from one place to another, when the wind and tide will permit it without danger.

WARRANT, a prerequisite under seal and sign to some officer, to bring any offender before the person giving it. Warrants of commitment are issued by the privy council, a secretary of state, or justice of the peace, &c. where there has been a private information, or a witness has deposed against an offender. Wool's Inst. 614.

Any one under the degree of nobility may be arrested for a misdemeanor, or any thing done against the peace of the kingdom, by warrant from a justice of the peace; but if the person is a peer of the realm, he must be apprehended for a breach of the peace by warrant out of B. R. Dalt. Just. 203.

A constable ought not to execute a justice's warrant, where the warrant is unlawful, or the justice has no jurisdiction; if he does he may be punished. Ploed. 294.

But if any person abuses it, by throwing it in the dirt, &c. or refuses to execute a lawful warrant, it is a contempt of the king's process, and the offender may be indicted and fined. Crompt. 149.

A general warrant to apprehend all persons suspected, without naming or particularly describing any person in special, is illegal and void. As the duty of the magistrate, and ought not to be left to the officer, to judge of the ground of the suspicion. Also a warrant to apprehend all persons guilty of such a crime, is no legal warrant; for the point upon which its authority rests, is a fact to be decided on a subsequent trial; namely, whether the person apprehended (thereupon is guilty or not guilty. 4 Black, 29.)

A warrant may be lawfully granted by any justice for treason, felony, or praemunire, or any other offence against the peace; and it seems clear, that where a statute gives one justice a jurisdiction over any offence, or a power to require any person to do any thing ordained by such a statute, it implies gives a power to every such justice to make out a warrant to bring before him any one accused of such offence, or compelled to do any thing ordained by law; so it cannot but be intended, that a statute which gives a person jurisdiction over an offence, means also to give him the power incident to all courts, of compelling the party to come before him. 2 Hare, 84.
But in cases where the king is not a party, or where the corporal punishment is appointed, as in cases for servants' debts and the like, it seems that a summons is the more proper process; and for default of appearance, the justice may proceed; and so in actions for debt, the sheriff is often directed by special statutes.

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WATCH.

which is the small spring in new pocket-watches, underneath the balance. 5. The balance, whose parts are the verge, pallets, cocks, and the bob. 6. The wheels, which are the crown-wheel in pocket-pieces, and swing-wheel in pendulums, and the balance-wheel, etc. 7. The contrate-wheel, which is that next the crown-wheel, &c. and whose teeth and hoop lie contrary to those of other wheels, whence the name. 8. The great or first wheel, which is that of the fusee, &c. immediately drives; after which are the second wheel, third wheel, &c. 9. Lastly, between the frame and dial-plate, is the pinion of report, which is that fixed on the arbor of the great wheel, and serves to drive the dial-wheel, as that serves to carry the hand.

Spring or pendulum watches are pretty much upon the same principle with pendulum clocks, whence their denomination. If a pendulum describing little arches of a circle makes vibrations of unequal lengths in equal times, it is evident that it describes the greater with a greater velocity. For the same reason a spring put in motion, and making greater or less vibrations, as it is more or less stiff, and as it has a greater or less degree of elasticity, gives them nearly in equal times. Hence, as the vibrations of the pendulum had been applied to large clocks, to rectify the inequality of their motions, so to correct the unequal motions of the balance of watches, a spring is added, by the isochronism of whose vibrations the correction is to be effected.

The spring is usually wound into a spiral, that in the little compass allotted it, it may be as long as possible, and may have strength enough not to be mattered and dragged about by the inequalities of the balance it is to regulate. The vibrations of the two parts, viz. the spring and balance, should be of some length, only so adjusted as that the spring being more regular in the length of its vibrations than the balance, may on occasion communicate its regularity thereto.

The invention of spring or pocket watches is owing to the artists of the present age. It is true, we find mentions of a kind of a watch called the "Pendulum" by Galen in the history of that prince; but this in all probability was no more than a kind of clock to be set on a table, some resemblance whereof we have still remaining in the ancient pieces made before the year 1070.

In effect, it is between Dr. Hooke and Mr. Huygens, that the glory of this excellent invention bels, to which of them it properly belongs, is greatly disputed; the English ascribing it to Huygens, and that the French, Dutch, &c. to the latter. Mr. Derham, in his Artificial Clock-maker, says plainly that Dr. Hooke was the inventor; and adds, that he contrived various ways of regulation. One way was with a loadstone. Another with a tenderer straight spring, one end whereof played backwards and forwards with the balance, so that the balance was to the spring as the bob to a pendulum, and the spring as the rod of it. This was with the balance, of which there were divers sorts, some having a spiral spring to the balance for a regulator, and others without. But the way that prevailed and continued in mode, was with one balance, and one spring running round the upper parts of the verge; though this has a disadvantage which those of two springs, &c. are free from, in that a sudden jerk or confused shake will alter its vibrations, and put it in an unusual hurry.

We shall conclude this article with an account of the mechanism of a common pocket-watch.

The Plate Watch-work, explains the construction of a common pocket-watch. The moving power is a spiral steel spring (fig. 3), which is coiled up close by a tool used for the purpose, and put into a brass box (fig. 2) called the barrel: the spring has a hook at its outer end which is put through a hole in the side of the barrel and riveted; the inner end has an oblong opening cut through it, to receive a hook upon the barrel arbor (fig. 6); this arbor goes through the bottom of the barrel, and is square to hold a worm-wheel d, (fig. 5) which is turned round by a worm b; the ends of the arbor project below this, and it is pivoted into the lower plate A (fig. 8) of the watch: the top of the barrel has a square hole through which the pivot of the arbor projects, and works in a socket in the upper plate D.

The barrel thus mounted has a steel chain a, (figs. 1 and 8) hooked to its upper end, and that of the barrel, the chain is hooked to the lower part of the fusee E (figs. 1 and 8). It is evident that when the fusee is turned by the watch-key, it will wind the chain of the barrel on itself; and as one of the springs is fastened to the barrel, and the other is hooked to the arbor (which is prevented from turning by the worm-wheel beneath), the spring will be coiled up into a smaller compass than it was before, and by its re-action will, when the watch-key is taken off, turn the fusee and keep the watch going.

The fusee has a spiral groove cut round it, as shewn in fig. 4, in which the chain lies: this groove is cut by an engine, so that the chain shall pull from the smallest part of the fusee, when the spring is wound, and act with its greatest force; and gradually increases in size as the spring unwinds and acts with less power, so that the effect upon the great wheel e (figs. 1, 8, and 7) was always the same, and that when the spring is full, it round in the other direction, it may move the great wheel with it, and the other wheels of the watch.

The great wheel e has 48 teeth on its circumference, which take into a pinion of 12 teeth, fixed on the same arbor with the centre-wheel g, and fig. 9, which has 54 teeth to turn a pinion of six leaves on the arbor of the third wheel h, and fig. 10; the third wheel has 45 teeth, and turns a pinion of six on the arbor of the fusee i, and fig. 11, which has 48 teeth cut parallel to its axis, by which it turns a pinion of six leaves, fixed to the balance-wheel k, fig. 8, 12, and 14. The pinion of the arbor of this wheel turns, one in a frame F, (fig. 8, and fig. 15) called the potance, fixed to the upper plate; and the other in a small piece fixed to the upper part, called the counter-potance, so that when the two plates are put together, the balance-wheel pinion slides on the teeth of the contrate wheel. The balance wheel has 15 teeth, by which it impels the balance l, (figs. 8 and 16, and fig. 13) the arbor of the balance, which is called the verge, has two pallets projecting from it nearly at right angles to each other; these are acted upon by the balance wheel, as shewn in fig. 14, where the lower pallet is supposed to be in contact with one of the teeth of the balance wheel, which, as it turns round, pushes the pallet round and the balance with it, till the balance has made about a quarter of a turn: the tooth of the balance wheel then slips off and escapes; in this position the watch would run down if it were not for the upper pallet at that instant taking another tooth on the opposite side of the balance wheel, which, as it moves in a contrary direction, pushes the balance back again, till the tooth escapes the lower pallet, and then engages the upper pallet, as before. But for the better regulation of the time, the balance has a very fine spring m, (fig. 16), called the pendulum spring, with the inner end fixed to the verge just beneath the outer end, and the outer end pinned to a stud fixed to the top of the upper plate of the watch, so that the balance will rest only in one position, and if it is moved either way by the balance wheel, it will be instantly put to ease by the spring to the spring will have a tendency to turn back. When the lower pallet, for instance, has just liberated a tooth of the balance wheel, the pendulum spring is strained, and returns the balance to its point of rest instantaneously, the balance wheel following the upper pallet by the action of the main spring; and when the balance wheel comes to push the balance beyond its point of rest the other way, it moves slowly, because it has the elasticity of the pendulum spring to overcome.

It is evident that by strengthening or weakening this spring, the velocity of the balance can be regulated, which is done by a contrivance shewn in fig. 16, and shewn the plate of brass screwed to the top of the upper plate, close under the balance; and at one place it is hollowed out to receive a wheel or of 20 teeth, which turns a segment of a wheel p, which moves round in a circular groove: it has a projecting leaf g, with a notch in it to receive the pendulum spring; so that by turning the wheel with a key put on a square part of its arbor, the spring is lengthened or shortened, so as to give it a different power, and make the balance vibrate quicker or slower; the arbor of the wheel n, has a dial r, (fig. 16) upon it, with divisions to set by. The upper pivot of the verge runs in a cock screw to the upper plate, as shewn in fig. 8, which covers the balance and protects it from violence; and the lower pivot works in the bottom of the potance; the socket for the pivot of the balance wheel is made in a small piece, and on a side there is a groove made in the potance, as shewn in fig. 15, so that by drawing the slide in or out, the teeth of the balance wheel shall just clear one pallet before it takes the other.

The verge is thus adjusted by the pendulum spring; that the balance shall vibrate so as to
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1. Rain water, unless when near a town, or when collected in a covered place, or in a current of the rain, possesses the properties of good water in perfection, and is as free from foreign ingredients as any native water whatever. The substances which it holds in solution are air, carbonic acid, and lime, and, according to Bergman, it yields some traces of nitric acid, and a little muriate of lime. The quantity of air in good water does not exceed \( \frac{7}{9} \) of the bulk. One hundred cubic inches of water contain generally about one cubic inch of carbonic acid, and hence its presence in the water.
The substances hitherto found in mineral waters amount to about 38, and may be reduced under the four following heads: 1. Air and its constituents, and azotic gases. 2. Acids. 3. Alkalies and earths. 4. Salts.

I. Air is contained in by far the greater number of mineral waters: its proportion does not exceed 1/80th of the bulk of the water.

2. Oxygen gas was first detected in waters by Scheele. Its quantity is usually inconsiderable; and it is incompatible with the presence of sulphated hydrogen gas or iron.

3. Azotic gas was first detected in Poitou water by Dr. Pearson. Afterwards it was discovered in Harrowgate waters by Dr. Garnet, and in those of Lenington Priors by Mr. Lambe.

II. The only acids hitherto found in waters, except in combination with a base, are the four following: carbonic, sulphurous, boracic, and sulphated hydrogen gas. 1. Carbonic acid was first detected in Pyrmont water by Dr. Browning. It is the most common ingredient in mineral waters, 100 cubic inches of the water generally containing from six to 40 cubic inches of this acid gas. According to Westrum, 100 cubic inches of Pyrmont water contain 187 cubic inches of it, or almost double its own bulk. 2. Sulphurous acid has been observed in several of the hot mineral waters in Italy, which are in the neighbourhood of volcanoes. 3. The boracic acid has also been observed in some lakes in Italy. 4. Sulphated hydrogen gas constitutes the most conspicuous ingredient in those waters which are distinguished by the name of hepatic or sulphaurous.

III. The only alkali which has been observed in mineral waters, uncombined, is soda; and the only earthy bodies are silica and lime. 1. Dr. Black detected soda in the hot minerals of Geyser and Rykum in Iceland; but in most other cases the soda is combined with carbonic acid. 2. Silica was first observed in waters by Bergman. It was afterwards detected in those of Geyser and Rykum by Dr. Black, and in those of Carlsbad by Kahlmann. It has been observed in the waters of Pongues, and Breez in those of Pu. It has been found also in many other mineral waters. 3. Lime is said to have been found uncombined in some mineral waters; but it has not been proved in a satisfactory manner.

IV. The only salts hitherto found in mineral waters, are the following sulphates, nitrates, muriates, carbonates, and hydroxylsures:

1. Sulphate of soda
2. Ammonia
3. Lime
4. Magnesia
5. Alumina
6. Iron
7. Copper
8. Nitrate of potash
9. Lime
10. Magnesia
11. Muriate of potash
12. Soda
13. Ammonia
14. Barytes
15. Lime
16. Magnesia
17. Alumina
18. Magnesite

19. Carbonate of potash
20. Ammonia
21. Lime
22. Magnesia
23. Alumina
24. Carbonate of lime
25. Hydrosulphuret of lime
26. Potass
27. And likewise borax.

Of these genera the carbonates and muriates occur by far most commonly, and the nitrates most rarely. 1. Sulphate of soda is not uncommon, especially in those mineral waters which are distinguished by the epithet saline. 2. Sulphate of ammonia is found in mineral waters near volcanoes. 3. Sulphate of lime is exceedingly common in water. Its presence seems to have been first detected by Dr. Lister in 1832. 4. Sulphate of magnesia is almost constantly an ingredient in those mineral waters which have purgative properties. It was detected in Epsom waters in 1610, and in 1690 Dr. Grew published a treatise on it. 5. Alum has sometimes been found in mineral waters, but is exceedingly rare. 6. Sulphate of iron occurs sometimes in Pyrmont mineral waters, and has been observed in other places. But sulphate of copper is only found in the waters which issue from copper mines. 7. Nitrate of lime has been observed in some springs in Hungary; but it is exceedingly uncommon. 8. Nitrate of lime was first detected in water by Dr. Home of Edinburgh, in 1756. It is said to occur in some springs in the sandy deserts of Arabia. 9. Nitrate of magnesia is said to have been found in some springs. 10. Muriate of potash is uncommon; but it has lately been observed in the mineral springs of Ulinsburg in Sweden, by Julius. 11. Muriate of soda is so exceedingly common in mineral waters, that hardly a single spring has been analyzed without detecting some of it. 12. Muriate of ammonia is uncommon; but it has been found in some mineral springs in Italy, and in Siberia. 13. Muriate of barytes is still more uncommon; but its presence in mineral waters has been announced by Bergman. 14. Muriate of lime and magnesia are common ingredients. 15. Muriate of alumina has been observed in water by Mr. Withering, but it is exceedingly rare. 16. Muriate of manganese was mentioned by Bergman as sometimes occurring in mineral waters. It has lately been detected by Lambe in the waters of Lenington Priors, but in an extremely limited proportion. 17. The presence of carbonate of potash in mineral waters has been mentioned by several chemists; if it does occur, it must be in a very small proportion. 18. But carbonate of soda is, perhaps, the most common ingredient of these liquids, if we except common salt and carbonate of lime. 19. Carbonate of ammonia has been discovered in waters; but it is uncommon. 20. Carbonate of lime is found in all mineral waters, and is usually held in solution by an excess of acid. It appears from the different experiments of chemists, as stated by Mr. Kirwan, and especially from those of Berthold, that water saturated with carbonic acid contains 9.002 of carbonate of lime. When the proportion of water is increased, it is capable of holding the carbonate of lime in solution, even when the proportion of carbonic acid united with it is diminished. Thus 24,000 parts of water are capable of holding two parts of carbonate of lime in solution, even when they contain only one part of carbonic acid. The greater the proportion of water, the smaller a proportion of carbonic acid is necessary to keep the lime in solution; and when the water is increased to a certain proportion, no sensible excess of carbonic acid is necessary. It ought to be remarked also, that water, how small a quantity soever of carbonic acid it contains, is capable of holding carbonate of lime in solution, provided the weight of the carbonic acid present exceeds that of the lime. These observations apply equally to the other earthy carbonates, held in solution by mineral waters.

21. Carbonate of magnesia is also very common in mineral waters, and is almost always accompanied by carbonate of lime. 22. Carbonate of alumina is said to have been found in waters; but its presence has not been ascertained. 23. But carbonate of iron is by no means uncommon; indeed it forms the most remarkable ingredient in those waters which are distinguished by the epithet chalybeate. 24. The presence of lime and soda have been frequently detected in those waters which are called sulphurous or hepatic. 25. Borax exists in some lakes in Persia and Thibet; but the nature of these waters has not been ascertained.

Besides these substances, certain vegetable and animal matters have been occasionally observed in mineral waters. But in most cases they are rather to be considered in the light of accidental mixtures than of real component parts of the waters in which they occur.

From the above enumeration, we are enabled to form a pretty accurate idea of the nature of mineral waters which occur in this kingdom; but this is by no means sufficient to make us acquainted with these liquids. No mineral water contains all of these substances. Several are there more than five or six of them present together, and rarely exceed the number of eight or ten. The proportion too in which they enter into mineral waters is generally small, and in many cases extremely so. Now in order to understand the nature of mineral waters, it is necessary to know the substances which most usually associate together, and the proportion in which they commonly associate. In the greater part of mineral waters there is usually some substance present which, from its greater proportion or its greater activity, stamps, in a manner, the character of the water, and gives it those properties by which it is most readily distinguished. This substance of course claims the greatest attention; while the other bodies which enter in a smaller proportion may vary or even be absent altogether, without producing any sensible change in the nature of the water. This circumstance enables us to divide mineral waters into classes, distinguished by the pre-
cular substance which predominates in each. Accordingly they have been divided into four classes, namely:

1. Acidulous.
2. Chalybeate.
3. Hepatic.
4. Saline.

1. The acidulous waters contain a considerable proportion of carbonic acid. They are easily distinguished by their acid taste, and by the sparkling like champagne wine when poured into a glass. They contain almost constantly some common salt, and in general also a greater or smaller proportion of the earthy carbonates.

2. The chalybeate waters contain a portion of iron, and are easily distinguished by the property which they have of striking a black with the tincture of nattails even after being boiled and filtered; whereas boiling decomposes the carbonate of iron, and causes its base to precipitate.

3. The hepatic or sulphureous waters are those which contain sulphurated hydrogen gas. These waters are easily distinguished by the colour of the aseinated hydrogen gas which they exhale, and by the property which they have of blackening silver and lead. The nature of the waters belonging to this class long puzzled chemists. Though they often deposit sulphur spontaneously, yet no sulphur could be artificially separated from them. The secret was at last discovered by Bergman. These waters are of two kinds: in the first the sulphurated hydrogen is uncombined; in the second it is united to lime or an alkali. They are frequently also impregnated with carbonate of iron, and usually contain some muriates or sulphats.

4. Saline waters are those which contain only salts in solution, without iron or carbonate of iron in excess. They may be distinguished into four different orders. The waters belonging to the first order contain salts whose base is lime, and generally either the carbonate or the sulphat. They are known by the name of hard waters, and have but a slight disagreeable taste. The waters belonging to the second order are those in which common salt predominates. They are readily recognized by their salt taste, and like sea water usually contain some magnesium and sulphate of soda. The waters of the third order contain sulphat of magnesia. They have a bitter taste and are purgative.

Finally, the waters of the fourth order are alkaline containing carbonate of soda. They are easily distinguished by the property which they have of tinging vegetable juices green.

The following table exhibits a synoptical view of the component parts of a considerable number of mineral waters as analysed by different chemists. See Dr. Saunders's Treatise on the Chemical History and Medical Powers of the most celebrated Mineral Waters.

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One pint of the Bath water contains (according to the laborious and delicate analysis of Mr. Phillips),

- Carbonic acid
- Muriat of soda
- Sulphat of soda
- Sulphat of lime
- Carbonat of lime
- Silica
- Oxide of iron

Waters, the method of analysing. The analysis of waters, or the art of ascertaining the different substances which they hold in solution, and of determining the proportion of these substances, is one of the most difficult branches of chemistry. The difficulty arises, not only from the diversity of the bodies which occur in waters, but from the very minute quantities of some of the ingredients.

Though many attempts have been made to analyse particular waters, and several of these were remarkably well conducted, no general mode of analysis was known till Bergman published his Treatise on Mineral Waters in 1778. This admirable treatise carried the subject all at once to a very high degree of perfection. The Bergmannian method has been followed by succeeding chemists, to whom we are indebted not only for a great number of very accurate analyses of mineral waters, but likewise for several improvements in the mode of conducting the analysis.

Mr. Kirwan has in 1799 published an essay on the general analysis of waters, no less valuable than that of Bergman; containing all that has hitherto been done on the subject, and enriched by the numerous experiments of Mr. Kirwan himself, which are equally important and well conducted. Mr. Kirwan has given a new method of analysis, which will probably be adopted hereafter; not only because it is shorter and easier than the Bergmannian, but because it is susceptible of a greater degree of accuracy.

The method of analysing consists in two different branches: 1. The method of ascertaining the different substances contained in the water which we are examining. 2. The method of determining the exact proportion of each of these ingredients.

The different bodies which are dissolved and combined in water, are discovered by the addition of certain substances to the water, which is subjected to examination. The consequence of the addition is some change in the appearance of the water; and this change indicates the presence or the absence of the bodies suspected. The substances thus employed are distinguished by the name of tests, and are the instruments by means of which the analysis of water is accomplished. They were first introduced into chemistry by Boyle, and were gradually increased by succeeding chemists; but Bergman was the first who ascertained with precision the degree of confidence which can be placed in the different tests. They still continued rather uncertain and precarious, till Mr. Kirwan showed how they might be combined and arranged in such a manner as to give certain and precise indications whether or not any particular substance constitutes a component part of the water. Let us consider by what means the preceifce or the absence of all the different substances which occur in waters may be ascertained.

1. The gaseous bodies contained in water are obtained by boiling it, and by retort luted to
a pneumatic apparatus. The method of separating alkalis containing these different bodies shall be described hereafter.

II. The presence of carbonic acid, not combined with a base, or combined in excess, may be detected by the following tests: 1. Lime-water occasions a precipitate soluble with effervescence in muriatic acid. 2. The infusion of litmus is reddened; but the red colour gradually disappears, and may be again restored by the addition of more of the mineral water. When boiled it loses the property of reddening the infusion of litmus.

III. The mineral acids when present, uncombined in water, give the infusion of litmus a permanent red, even though the water has been boiled. Bergman has shown that paper, stained with litmus, is reddened when dipped into water containing 1-321 of sulphuric acid.

IV. Water containing sulphuretted hydrogen gas is distinguished by the following properties: 1. A peculiar odour of sulphuretted hydrogen gas. 2. It reddens the infusion of litmus fugaciously. 3. It blackens paper dip into a solution of lead, and precipitates the nitrate of silver black or lead. V. Alkali and earthy carbones are distinguished by the following tests: 1. The infusion of turmeric, or paper stained with turmeric, is rendered brown by alkali, or reddish-brown if the quantity is minute. This change is produced when the soda in water amounts only to 1-29177th part. 2. Paper stained with Brazil wood, or the infusion of Brazil wood, is rendered blue; but this change is produced also by the alkaline and earthy carbones. It can be ascertained that water containing 1-9945th part of carbonat of soda renders paper stained with Brazil wood blue. 3. Litmus paper reddened by vinegar is restored to its original blue colour. This change is produced by the alkaline and earthy carbones also. 4. When these changes are fugacious, we may conclude that the alkali is ammonium.

VI. Fixed alkalis exist in water which occasions a precipitate with water, which after being evaporated is formed. Volatile alkali may be distinguished by the smell, or it may be obtained in the receiver by distilling a portion of the water gently, and then it may be distinguished by the above tests.

VII. Earthy and metallic carbones are precipitated by boiling the water containing them; except carbont of magnesia, which is only precipitated imperfectly.

VIII. Iron is detected by the following tests: 1. The addition of tincture of nuts galls gives water containing iron a purple or black colour. This test indicates the presence of a very minute portion of iron. If the tincture has no effect upon the water after boiling, though it colours before, the iron is in the state of a carbonat. The following observations of Weatrun on the colours which iron gives to nuts galls, as modified by other bodies, deserve attention:—A violet indicates an alkaline carbonat or earthy salt. Dark purple indicates other alkaline salts. Purplish red indicates sulphuretted hydrogen gas. Whithis and then black indicates sulphat of lime.

IX. The prussian alkali occasion a blue precipitate in water containing iron. If an alkalii is present, the blue precipitate does not appear unless the alkali is saturated with an acid.

X. Sulphuric acid exists in waters which form a precipitate with the following saline solutions: 1. Muriat, nitrat, or acetat of barytes 2. - - - - - - strontian 3. - - - - - - line 4. Nitrat or acetat of lead.

If of these the most powerful is far is muriatic of barytes, which is capable of detecting the presence of sulphuric acid uncombined, when it does not exceed the millionth part of the water. Acetat of lead is next in point of power. The muriatic is more powerful than the nitrat. The calcareous salts are least powerful. All these tests are capable of indicating a much smaller proportion of uncombined sulphuric acid than when it is combined with a base. To render muriat of barytes a certain test of sulphuric acid, the following precautions must be observed: 1. The muriat must be diluted. 2. The alkali, or carbonate of alkali, if the water contains any, must be previously saturated with muriatic acid. The precipitate must be insoluble in muriatic acid. 4. If boracic acid is suspended, muriat of strontian must be tried, which is not precipitated by boracic acid. 5. The hydrosulphurates precipitate barytic solutions, but their presence is easily discovered by the smell.

XI. Muriatic acid is detected by nitrat of silver, which occasions a white precipitate, or a cloud in water containing a minute portion of this acid. To render this test certain, the following precautions are necessary: 1. The alkali or carbonat must be previously saturated with nitric acid. 2. Sulphuric acid, if any should be present, must be previously removed by means of nitrat of barytes. 3. The precipitate must be insoluble in nitric acid.

XII. Boracic acid is detected by means of acetat of lead, with which it forms a precipitate insoluble in nitric acid. To render this test certain, the alkalies and earths must be previously saturated with acetic acid, and the sulphuric and muriatic acids removed by means of acetat of strontian and acetat of silver.

XIII. Barytes is detected by the insoluble white precipitate which it forms with dilute sulphuric acid.

XIV. Lime is detected by means of oxalic acid, which occasions a white precipitate in water containing a very minute proportion of this earth. To render this test decisive, the following precautions are necessary: 1. The mineral acids, if any should be present, must be previously separated with an alkali. 2. Barytes, if any should be present, must be previously removed by means of sulphuric acid. 3. Oxalic acid precipitates magnesia but very slowly, whereas it precipitates lime instantly.

XV. Magnesia and alumina. The presence of these earths is ascertained by the following tests: 1. Pure ammonia precipitates them both, and no other earth, provided the carbonic acid has been previously separated by a mineral alkali and boiling. 2. Lime-water precipitates only these two earths, provided the carbonic acid is previously removed, and the sulphuric acid also, by means of nitrat of barytes.
WATERS.


Besides the substances above described, there is sometimes found in water a quantity of bitumen combined with alkalii, and in the state of soap. In some instances this occurs as a coagulation; and the coagulum collected on a filter discovers its bituminous nature by its combustibility.

Water also sometimes contains extractive matter; the presence of which may be detected by means of nitrat of silver. The water suspected to contain it must be freed from sulphatic and niterous acid by means of nitrat of lead. After this, it is given a brown precipitate with nitrat of silver, we may conclude that extractive matter is present.

The proportion of saline ingredients, held in solution by any water, may be in some measure determined from its specific gravity. The lighter a water is, the more saline it contains; and, on the other hand, the heavier it is, the greater is the proportion of saline contents. 

Mr. Kirwan has pointed out a very ingenious method of estimating the saline contents of a mineral water whose specific gravity is known; so that the error does not exceed one or two parts in the hundred. The method is this: Subtract the specific gravity of pure water from the specific gravity of the mineral water examined (both expressed in whole numbers), and multiply the remainder by 1.4. The product is the saline contents, in a quantity of the water denoted by the number employed to indicate the specific gravity of distilled water. Thus let the water be of the specific gravity 1.072, or in whole numbers 1075, then the specific gravity of distilled water will be 1.000. And 1075 — 1000 = 14 = 0.014 = saline contents in 1000 parts of the water in question; or 1075.0014 = 14.00 = 100 parts of the same water. The formula will often be of considerable use, as it serves as a kind of standard to which we may con
Waters.

The saline contents indicated by it are supposed to be freed from their water of crystallization; in which state only they ought to be used. The tests, in the last section, determined the particular substances which exist in it, let us now proceed to ascertain the proportion of each of these ingredients.

I. The different aerial fluids ought to be first separated and estimated. For this purpose a retort ought to be filled two-thirds with the water, and connected with a jar full of mercury, standing over a mercurial trough. Let the water be made to boil for a quarter of an hour. The aerial fluids will pass over into the jar. When the apparatus is cool, the quantity of air expelled from the water may be determined either by bringing the mercury within and without the jar to a level; or it that cannot be done, by reducing the air to the proportion of eight. The air of the gas is ought to be carefully subtracted, and the jar must be divided into cubic inches and tenths.

The only gaseous bodies in water are common air, oxygen gas, carbonic acid, sulphurated hydrogen gas, and sulphurous acid. The last two never exist in water together. The presence of either of them must be ascertained previously by the application of the proper tests. If sulphurated hydrogen gas be present, it will be mixed with the air contained in the glass jar, and must be separated before air is examined. For this purpose, the jar must be carried into a tube of warm water, and nitric acid introduced, which will absorb the sulphurated hydrogen.

The residuum is then to be again put into a mercurial jar and examined.

If the water contains sulphurous acid, this previous step is not necessary. Introduce the air again into a redness vessel, and the reddish precipitate appears. The iron and part of the magnesia are thus separated. Dry the precipitate, and expose it to the air for some time in a heat of 200°; then treat it with acetic acid, which solution is to be added to the muriatic solution. The iron is to be redissolved in muriatic acid, precipitated by an alkaline carbonate, dried, and weighed.

Add sulphuric acid to the muriatic solution as long as any precipitate appears; then heat the solution and concentrate. Heat the sulphat of lime thus obtained to redness, and weigh it. One hundred grains of it are equivalent to 70 of carbonate of lime. Precipitate the magnesia in the same manner. Dry it and weigh it. But as part remains in solution, evaporate to dryness, and wash the residue with a sufficient quantity of distilled water to dissolve the mirror of soda and the sulphat of lime, if any should be present. What remains behind is carbonate of magnesia. Weigh it, and add its weight to the former. The sulphat of lime, if any, must also be separated and weighed.

III. Let us now consider the method of ascertaining the proportion of mineral acids or alkalies, if any should be present uncombined. The acids which may be present, omitting the gaseous, are the sulphuric, muriatic, and nitric.

1. The proportion of sulphuric acid is easily determined. Satiate it with barites and water; and ignite the precipitate. One hundred grains of sulphat of barytes thus formed indicate 23.5 of real sulphuric acid.

2. Saturate the muriatic acid with barytes-water, and then precipitate the barytes by sulphuric acid. One hundred parts of the ignited precipitate are equivalent to 21 grains of real muriatic acid.

3. Precipitate the boreatic acid by means of acatot of lead. Decompose the borate of lead by boiling it in sulphuric acid. Evaporate to dryness. Dissolve the boratic acid in alcohol, and evaporate the solution; the acid left behind may be weighed.

4. To estimate the proportion of alkaline carbonat present in a water containing it, saturate it with sulphuric acid, and note the weight of real acid necessary. Now 100 grains of real sulphuric acid saturate 121.44 potash, and 78.32 soda.

IV. Let us now consider the method of ascertaining the proportion of the different sulphats. These are six in number, viz., the sulphat of barium and those of lime, alumina, magnesia, and iron.

1. The alkaline sulphats may be estimated by precipitating their acid by means of nitrat of barytes, having previously freed the water of all other sulphats. For 170 grains of ignited sulphat of barytes indicate 100 grains of dried sulphat of soda; while 136.56 grains of sulphat of barytes indicate 100 of dry sulphat of potash.

2. Sulphat of lime is easily estimated by evaporating the liquid containing it to a few ounces (having previously saturated the earthy carbonat with nitric acid), and precipitating the sulphat of lime by means of weak alcaline. It may be then dried and weighed.

3. The quantity of alum may be estimated by precipitating the alumina by carbonat of lime or of magnesia (if no lime is present in the liquid). Twelve grains of alumina (by the heated incandescent indicate one hundred of the crystalized alum, or forty nine of the dried salt).

4. Sulphat of magnesia may be estimated, provided no other sulphat is present, by precipitating the acid by means of a barytate salt; as 100 parts of ignited sulphat of barytes indicate 52.11 of sulphat of magnesia. If sulphat of lime and no other sulphat is present, the last may be decomposed, and the lime precipitated by carbonat of magnesia. The weight of the lime thus obtained enables us to ascertain the quantity of sulphat of lime contained in the water.

5. Sulphat of soda is then to be precipitated by barytes. This gives the quantity of sulphuric acid; and subtracting the portion which belongs to the sulphat of lime, there remains that which was combined with the magnesia, from which the sulphat of magnesia may be easily estimated.

If sulphat of soda is present, no earthy nitrat or muriat can exist. Therefore, if no other earthy sulphat is present, the magnesia may be precipitated; for sulphat of lime, dried, and weighed; 30.68 grains of which indicate 100 grains of dried sulphat of magnesia. The same process succeeds when sulphat of lime accompanies these two sulphats; only in that
case the precipitate, which consists both of lime and magnesia, is to be dissolved in sulphuric acid, evaporated to dryness, and to be treated with twice its weight of cold water; which dissolves the sulphate of magnesia, and leaves the other salt. Let the sulphat of magnesia be evaporated to dryness, exposed to a heat of 400° and weighed. The same process succeeds if shum is present instead of sulphat of lime.

5. Sulphat of iron may be estimated by precipitating the iron by means of prussic alkali, having previously determined the weight of the precipitate produced by the prussat in a solution of a given weight of sulphat of iron in water. If sulphat of iron is also present, which is a very rare case, it may be separated by evaporating the water to dryness, treating the residuum with alcohol, which dissolves the murat, and leaves the sulphat. Or the sulphat may be estimated with great precision by the rules laid down by Mr. Kirwan.

VI. It now only remains to explain the method of ascertaining the proportion of the nitrats which may exist in waters.

1. When nitre accompanies sulphats and murats without any other nitrat, the sulphats are to be decomposed by acetat of barytes, and the residuum, with the nitre, is to be separated by washing, and then dissolved by a slight quantity of hydrochloric acid. The clear liquid, after evaporation, is to be treated with twice its weight of cold water, which dissolves the nitre, and leaves the nitre; the quantity of which may be easily estimated. If an alkali is present, it ought to be previously saturated with sulphat of lime or magnesia.

2. If nitre, common salt, nitrat of lime, and nitrat of magnesia are present together, the water ought to be evaporated to dryness, and the dry mass treated with alkaline, which takes up the earthy salts. From the residuum, resolved in water, the nitre may be separated, as estimated as in the last case. The alcohol solution is to be evaporated to dryness, and the residuum resolved into water.

Let us suppose it to contain nitrat of magnesia and nitrat of lime. Precipitate the muriatic acid by nitrat of silver, which gives the proportion of muriat of magnesia and of lime. Separate the muriat of magnesia by means of carbonate of lime, and note its quantity. Then subtract the quantity of muriat of magnesia. And subtracting the muriatic acid contained in that salt from the whole acid indicated by the precipitate of silver, we have the proportion of muriat of lime.

Lastly, subtract the acid which has been added to precipitate the muriat with nitric acid. Then precipitate the whole of the lime by sulphuric acid; and subtracting from the whole of the sulphat thus formed that portion formed by the carbont of lime added, and by the lime contained in the muriat, the residuum gives us the lime contained in the original nitrat; and 35 grains of lime form 100 of dry nitrat of lime.

WATER-SEA. See Sea.

WATER-COLOURS. Painting in water-colours, is an art capable of affording the highest delight to the eye, since no mode of representation can display the appearances of nature with greater splendour. It is an art which has been brought forward with unprecedented success, and may be at present to be the most perfect species of design or painting, which is in practice amongst our artists. To this the facility of the materials employed in it contributes in no small degree. It is not attended with the embarrassments to which oil-painting, or most other kinds of painting, are liable, but proceeds by ready and uninterrupted progress to the completion of its task.

The preliminary parts of study requisite for the true student in the attainment of this art, have been treated under the article of Drawing. See Drawing. We can recommend no more advantageous method for his further progress, than the careful studying and copying the various works of excellence by the best masters, until he shall be able to follow, if not to rival them, in the imitation of nature. We shall now endeavour to furnish him with the best means for this purpose, by describing the colours which are employed in washing, and giving the most approved directions for preparing and using them.

The materials and implements necessary for the practice of water-colours (or washing, as it is sometimes called) are,—gum-colours, of which we shall treat more particularly; camels' hair pencils, fitches, a palette, and penknife.

The general or simple colours, and the various species of each, fit for painting in water-colours, are as follow:

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<thead>
<tr>
<th>Whites.</th>
<th>Browns.</th>
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<tr>
<td>Ceres.</td>
<td>Spanish brown</td>
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<td>Spanish white.</td>
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<td>White of</td>
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<td>Spanish white.</td>
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<td>Flake white.</td>
<td>Burnt Terra de</td>
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<td>Spodum.</td>
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WATER COLOURS.

Blacks.  Reds.
Burnt cherry-stones  Indian red
very-black  Burnt ochre
King's black  Indian red
Lamp-black  Lead lead
Green bice  Minimum
Green verditer  Vermilion
Sap-green  Carmine
Crushed rose distilled  Indian lake
Blues.

Yellow.

Snakers blue  English ochre
Terra-calle  Gaul-stone
Blue verditer  Gamboge
Lime green  Lead white
Lithium  Ochre de luce
Smalt  Orpiment
Prussian blue  Roman ochre
Light ditto  Dutch pink
Ultramarine  Saffron-water
Ultramarine ashes  King's yellow
Blue bice  Gold yellow
French beries.

Directions for preparing the following single colours.

Whites.
The best white for painting in water-colours is white lead; some mix a white made of pearl and oyster-shells, brought to an impalpable powder, called a pearl-white, which will mix well with any colour. If you use white lead, clarify it with white-wine, the white is settled, pour off the vinegar, and wash it with water thus: Put the powder into a glass of water, stir it, and presently pour the water off, while it is white, into another clean glass; when it is settled, pour off the water, and you will have an excellent white; to which add as much gum as is necessary, to give it a gloss.

It has been often noticed, that white lead will turn black, if mixed with water that comes from iron or clay; so that, in the space of a month or two, you may perceive it: and it will also change any colour with which it is mixed.

Some therefore recommend the powder of egg-shells, of the brightest and whitest sort, well ground with gum-water, to the state of an impalpable powder, to which they add one-twentieth, or part of white lead; others esteem it most when clarified in spirit of wine, and then use it with gum-water.

It has been found, by repeated experiments, that this egg-shell powder is extremely serviceable as a white, in water-colours; and that this, and the oyster-shell powder, rectified and well bruised, will make an excellent mixture with other colours, to keep them from changing.

A fine white, for water-colours, may be made by dissolving filings of silver, or silver-leaf, in aqua-fortis, evaporating the aqua-fortis till it appears like crystal in the bottom of the glass; decant the other part of the aqua-fortis, and wash the silver four or five times in pure water, till it is entirely cleaned from the aqua-fortis, drying it for use. It must be used with the waters of gum and sugar-candy.

A good white for water-colours, proper for miniature, is made thus: Take a pound of the shreds of glove-leather, and steep them in water; boil them with twelve quarts of water, till it wastes to two; strain it through a linen cloth, into a well-glazed earthen pan; this is called glue or size, and proper to use with colours in candle-light pieces; to know if this is strong enough, try if it is stiff, and firm under your hand.

The glue being melted, reduce some white chalk to a powder, while it is hot, add such a quantity of the chalk as will bring it to the consistency of a paste, letting it steep for a quarter of an hour; stir it with a brush made of hog's bristles.

In order to make this white brighter, add more glue. Be careful to observe that every layer is dry, before you put on another. If you work upon wood, you must put on a dozen; but six or seven are sufficient if your paper is thick. Afterwards dip a soft brush in some water, draining it with your fingers; rub the work with it, in order to make it the smoother. When your brush is full of white, you must wash it again; and also change the water when it is too white. Or you may use a wet linen rag, instead of a brush.

Yellows.

In some objects there may be seen a shining, like that of gold, through colours of red, blue, or green, such as some sort of plant that the cantharides. This gold or transparency may be well imitated by laying some leaf-gold on the shaded side of the drawing, giving a little to the light side. To lay on the gold-leaf, press it smooth; or, if you have washed it with strong gum-water; but care must be taken, that in laying on the gum, you do not exceed the limits through which you would have the gold appear. In this case, the gold is only to shine through the transparent colour, which is to be laid over it.

As leaf-gold will not receive water-colours regularly, it is necessary to be provided with water of ox-gall, and with this liquor to stroke over the gold-leaf; by which it will receive any colour you are desirous of laying over it, and will also retain it.

In some manuscripts there may be seen gold letters, which seem to rise above the surface of the paper. The composition which raises them, is made of vermilion and the white of an egg, beaten to the consistence of an oil, and fixed to the paper with gum-ara-bic; on this figurative letter, wash some gum-water, then lay on the gold-leaf closely with a camel's-hair pencil; lay on the gold-leaf close with some cotton; and when dry, rub it again with cotton, and polish it with a dog's tooth, and it will appear as if it was cast in gold.

There is also another way of working in gold, which is performed by shell-gold (but then it must be pure, and not that brought from Germany, which turns green in a few days).

Cover the shady parts with vermilion, before you use the gold; and when you have rectified it with spirit of wine, lay it on; when dry, burnish it as before directed.

In laying on this gold, it is best to leave the lights without it, as it will appear to a much greater advantage than if all the objects were covered; but, provided the whole performance should chance to be covered, the best way of setting it off, is to trace over the shady parts with gall-stone, or the yellow made of French berries, (of which we shall treat hereafter), heightened with minimum.

Of yellows in general. Gamboge is, beyond doubt, one of the meellowest colours nature has produced; it is of so mild a temperament, that when it is touched with any fluid, it instantly dissolves; so that, consequently, it wants neither gumming nor grinding; it is productive of a variety of the most agreeable and pleasant yellow tints, that fancy or art could ever imagine; in it is to be found that shade itself, though sometimes it requires help.

Gall-stone is a very rich deep yellow, tending towards a brown; it is exceedingly useful in many cases, needs but little gumming or grinding, works freely, but will not show itself.

Mr. Boyle says, if you cut the roots of berberies, and put them into a strong liquid, made of pearlashes and water, from them will proceed a very agreeable yellow. This experiment has often been made, and as often attended with success.

He also gives an account of another fine transparent yellow, by boiling the root of a mulberry-tree, well cleansed, in the foregoing liquid.

Yellow ochre makes a very good pale yellow, and, being ground with gum-water, will prove extremely useful.

Another very useful yellow, is made by dissolving the resin of the tree that yields the black gum-water, gently pressing it, adding to the liquor some alum-water, letting it boil.

The virtue of the yellow extracted from French berries is so well known, that we need only give the directions for preparing it. In a quart of the preceding liquid, boil two ounces of French berries, till the liquor is of a fine yellow; strain it from the yellow berries, and when cold it is fit for use. To the berries put a pint of the same liquid, and boil it till the liquor is as strong as gall-stones; with which you may shade any yellows; this you may boil till it comes to a brown, and will, with the addition of a little ox-gall, serve to shade the gold-leaf.

You may likewise make a yellow, by infusing saffron in pure water. When this is steeped in rectified spirit of wine, there is nothing higher; but it is very apt to fly, unless it is high-gummed.

A good yellow, for the illumination of prints, may be extracted from the roots of ginger; which make a good green, when mixed with transparent verdigrise.

Those yellows called English and Dutch greens, are made with French berries, ground to a fine powder, and then boiled.

King's yellow, a fine body-colour, is much used in heightening the ochre for gold lace, &c.

Orange colour. This colour is made of a mixture of vermilion and gamboge, the latter most predominant, in which you have a servicable colour in painting flies, and all other orange-coloured flowers. Orpiment is likewise a pleasing colour.

Reds.

Red-lead, or minium, is a strong heavy colour. Mr. Boyle has given us the following directions for preparing it: Put four ounces in a glass, to a quart of rain-water, and when it has been thoroughly stirred, pour off the water: and by a frequent repetition of this, there will remain at the bottom of the glass a beautiful red, when dry, which is to be used with gum-water. When the colour has been thus prepared, you must not expect above twenty grains to remain out of four ounces.

Carmine affords the brightest and most perfect crimson, and is the most beautiful of
all reds: for with this colour and lake you may make the shades as strong as you please. This colour should never be purchased but by day-light; for if not good, it will but spoil your work.

Lake is a fine transparent colour, not much inferior to Carmine; but in painting with Carmine on that part of the print on which the light is supposed to strike, lay on the first tint as light as possible, working it stronger as it grows darker, and touch it in the darker parts with lake.

Lake may be bought at most colour-shops, ready prepared for water-colours; but if you are desirous of making it yourself, it is necessary to adhere to the following directions: Having prepared a Liquidum, made with the ashes of vine-barks, to three pints of it add a pound of the best ground brazal wood; boil it till half the Liquidum is evaporated; strain off; boil it again with the addition of four ounces of fresh brazal wood, two equal quarts of cochineal, half a minute of terramarita, and a pint of fair water; let it evaporate as before; add half an ounce of burnt alum (reduced to an impalpable powder), a quarter of a drachm of arsenic; dissolve the arsenic in it, by stirring it with a stick; when settled, strain it. To give this a body, reduce two cuttlefish bones to a powder, and putting it in, let it dry leisurely. Grind it in a quantity of fair water, in which you may let it steep; strain it through a cloth, and making it into a few cakes, set it by for use, after drying it on a piece of marble.

If you would have this lake redder, add some of the juice of a lemon; and to make it deeper, add a little oil of tartar.

Another lake: Boil the shreds of superfine scarlet cloth in a lye made of the ashes of burnt tartar; when sufficiently boiled, add some cochineal, powdered mastich, and cochine alum; boil this again; while it is quite hot, strain it through a bag several times.

The first time, the bag must be strained from top to bottom, and the remaining gross matter being taken out, let the bag be well washed; after this, strain the liquor through the bag again, and you will find a paste remaining on the sides, which divide into small cakes, and set by for use.

Another lake: Steep four ounces of the best brazal wood in a pint and a half of the finest distilled vinegar, for three weeks at least, though the longer it remains the better it is; seethe the whole in balsam maria, till it boils up three or four times; let it settle for a day or two; put it to an ounce of powdered alum, and into a clean pan with the liquor; let it remain for twenty-four hours; heat the composition, and stir it till it is cold; when it has stood about twelve hours, strain it, and add two cuttlefish bones, prepared as before.

A liquid colour of a very good crimson, is made as follows: In twelve ounces of pale stale beer, boil one ounce of ground brazal wood, till the colour is as strong as you desire; strain it through a lines cloth, and bottle it up for use. If you want to bring this colour to body, take some dry ox-blood, reduced to a powder, and mix it with the colour.

We have the following directions from Mr. Beale, for extracting a fine crimson from the berry-bearing spinach, which, being pressed, afford a very agreeable juice; to which add a fourth part of alum; boil it, and when cold it is fit for use.

Or you may extract a very beautiful red from the red beet-root, baked with a little strong vinegar and alum: when cold it is fit for use.

Another way to make a crimson: Put twenty or more grains of bruised cochinel into a gallon, with as many drops of the lye of tartar as will make it a good oil colour; add to this mixture about half a spoonful of water, or more, and you will have a very agreeable purple; reducing some alum to a very fine powder, put it to the purple liquor, and you will have a beautiful crimson; strain it through a fine cloth; use it as soon as possible; for though this is a colour which, if soon used, looks extremely well, yet by long standing it is subject to decay.

Indian lake is far superior to any other of the kind, for the deep shade of reds of all kinds, and works as free as gamboge. The best is brought from China, in pots, and has the appearance of raspberry-jam, but very bitter to taste: it requires no gum.

Purple: Take eight ounces of logwood, a pint of rain water, and an ounce of alum; ilter it well over a slow fire, in a well glazed pan or pipkin, for about twenty-four hours; and when clear, let it stand for a week: strain it through a piece of fine cloth. Keep it close, or it will mould.

Or you may make a redder purple, by adding to one ounce, four ounces of brazal wood, and a pint of stale beer, boiling it till the liquor is as strong as you desire. It may be made darker, by adding more logwood.

The richest purple is made by blending Carmine and Prussian blue, or indigo, to what shade you please.

Blues. Ultramarine is the best and brightest blue. Prepare it by heating six ounces of the lapis lazuli till it is red; cool it in strong vinegar; grind it with a stone and muller to an impalpable powder; then make a composition of bees-wax, resin, linseed oil, and turpentine, of each three ounces; in a pot put together over a slow fire, till it is near boiling; pour them into a pan well glazed. This is called the paste of ultramarine. The lapis lazuli being prepared, add to it an equal quantity of the paste, or paste, mix them together thoroughly, and let them remain twelve hours. To extirpate the ultramarine from the paste, pours clear-water upon it; on pressing the paste with your hands, the ultramarine will come out for its reception, place a glass tumulder under your hands; let it settle in this water till the ultramarine sinks to the bottom.

If the colour seems foul, cleanse it thus: Dissolve some tartar in water; add as much of it to the ultramarine as will cover it; let it stand twelve hours; wash it in warm water, and you will have your colour well charmed and perfectly clear. Let your ultramarine be of a high colour, and well ground.

Next to ultramarine in beauty, is Prussian blue; but it does not grind kindly with water, on account of its oily substance.

Blue bico is a colour of a very good body, and flows very agreeably in the pencil; wash it according to the rules laid down for ultramarine.
WATER-COLOURS.

Directions for preparing the following mixed colours.

Ash colour. Ceruse, Knapping's black, and white, shaded with cherry-stone black.

Bay. Lake and lake white, shaded with carmine; bistre and vermilion, shaded with black.

Changeable silk. Red and mastic-water, shaded with sap-green and verdigrise.

Another. Lake and yellow, shaded with lake and Prussian blue.

Cloud colour. Mastic, lake and white, shaded with blue verdigrise.

Another. Constant white and Indian ink, a little vermilion.

Another. White, with a little lake and blue verdigrise, makes a very agreeable cloud-colour, for that part next the horizon.

Crimson. Lake and white, with a little vermilion, shaded with lake and carmine.

Flame colour. Vermilion and opimient, heightened with white.

Another. Gamboge, shaded with minimum and red-smalt.

 Flesh colour. Ceruse, red lead, and lake, for a swarthy complexion, and yellow-oche.

Another. Constant white and a little carmine, shaded with Spanish liquorice, washed with carmine.

French green. Light pink and Dutch bice, shaded with green pink.

Glassy green. Ceruse, with a little blue of any kind.

Hair colour. Mastic, oche, umber, ceruse, and cherry-stone black.

Lead colour. Indigo and white.

Light blue. Blue bice, heightened with lake white.

Another. Blue verdigrise, and white of any sort, well ground.

Light green. Pink, mixed, and white.

Another. Blue verdigrise and gamboge.

Another. Gamboge and verdigrise. The chief use of this green is to lay the ground-colours for trees, fields, &c.

Lion aching. Red lead, and mastieot, shaded with umber.

McCoy. Lake and white lead.

Orange. Red lead and a little mastic, shaded with bull-stone and lake.

Orange toady. Lake, light pink, a little mastic, shaded with bull-stone and lake.

Pearl colour. Carmine, a little white, shaded with lake.

Popinjay green. Green and mastic, and pink and a little indigo, shaded with indigo.

Purple. Indigo, Spanish brown, and white; or blue lake, red and white lead; or blue bice and lake.

Raset. Cherry-stone black and white.

Scarlet. Red lead and lake, with or without vermilion.

Sax green. Bice, pink, and white, shaded with pink.

Ske colour. Light mastic and white, for the lowest and lightest parts; second, red ink and white; third, blue-bice and white; fourth, blue lake alone. These are all to be softened into one another at the edges, so as not to appear harsh.

Sky colour for drapery. Blue bice and carmine, or ultramarine and white, shaded with indigo.

Snow colour. Mastic and a very little lake, shaded with Dutch pink.

Violet colour. Indigo, white, and lake; or the Dutch bice and lake, shaded with indigo; or litmus, small, and bice, the latter most predominant.

Water. Blue and white, shaded with blue, and heightened with white.

Another. Blue verdigrise, shaded with indigo, and heightened with white.

Directions for using the colours.

Your pencils must be fast in the quills, and sharp-pointed (after you have drawn them through your mouth), not apt to part in the mixing.

Before you begin, have all your colours ready, and a palette for the convenience of mixing them; a paper to lay under your hand, as well as to try your colours upon; also a large brush, called a fitch, to wipe off the dust from them.

Being prepared according to the foregoing method, proceed in your painting; which if a landscape, lay on first dark colours freely all over your piece, leaving no part uncovered.

Having laid your dark colours, begin next with the lighter parts, as the sky, sea, ground-grounds, &c.; then the yellowish beams, with mastic and white; next the blueness of the sky, with blue verdigrise alone; for purple clouds, white, with the best indigo; for the sea, with your colours deeper as they go upwards from the horizon, except in tempestuous skies. The tops of distant mountains must be worked so faint, that they may seem to lose themselves in the air.

Bring your colours forward as your distance decreases; painting your first ground next the horizon, downwards, of a bluish sea-green; and as you advance forward, of a darker green, till you come to the fore-ground itself; which, as it is the darkest part of all, with dark green, worked in such a manner as to give the appearance of shrubbery, &c.

In painting trees, having first loaded a verdigrise green for a dead color, proceed with working it so as to give a leafy appearance. Bring some of your leaves forward with mastic and white, for the trunk, work the brown with sap-green; if you should introduce them, lay on some touches to express leaves of ivy turned also about it.

All distinct objects are to be made imperfect, as they appear to the eye.

In painting flesh, the following are the best directions for preparing your work so as afterwards more readily to produce the effects of colours seen in nature:

Take flesh-white and a little lake, blend them together, and with that lay the ground-colour; then shade with red-ochre, cherry-stone black, and a little lake, mixed together, touching the lips, cheeks, &c., with a tint of carmine, and heighten the flesh with white and a little carmine. Remember that you can never heighten it with pure white, which will always give it a cold appearance.

The peculiar management of tints in the representation of other various kinds of objects, such as animals, flowers, fruits, &c., will require some attention from the student, but is unnecessary to be given here in detail, as practice will soon instruct him in all that is requisite on this head.

It may be recommended to the student in general, whatever is the subject of his drawing, not to finish any one object first, but to work up every part gradually alike, and be-
From C. Squire, Watermen. A water-course does not begin by prescription, nor assent, but begins by nature, having this course naturally, and cannot be diverted.

3 Bulst. 340.

WATERMEN. In London the lord mayor and court of aldermen have much power in licensing the company of watermen, and appointing the fares for plying on the river Thames; and justices for Middlesex, and other adjoining counties, have also power to hear and determine offences, &c. 10 G. L. II. c. 31.

WATER-SPOUT, an extraordinary aqueous meteor, most frequently observed at sea. It is a truly formidable phenomenon, and is indeed capable of causing great ravages. It commonly begins by a cloud, which appears very small, and which mariners call the squall; which augments in a little time into an enormous cloud of a cylindrical form, or that of a reversed cone, and produces a noise like that of a brisk sea, sometimes emitting thunder and lightning, and also large quantities of rain or hail, sufficient to inundate large vessels, overcast trees and houses, and every thing which opposes its violent impetuosity. These water-spouts are most frequent at sea than by land; and sailors are so convinced of their dangerous consequences, that when they perceive their approach, they frequently endeavour to break them by firing a cannon before the ship. They have also been known to commit great devastations by land; though, where there is no water near, they generally assume the form of a tornado. To enable the reader to understand their nature, we shall preface the different theories by a short description of one of these wonderful appearances, as given by the celebrated M. Tonnet, in安全隐患的Voyant:

"The first of these," says this traveller, "that we saw, was about a musket-shot from our ship. There we perceived the water began to boil, and to rise about a foot above its level. The water was agitated, and fluctuated; and at least there seemed sufficient to stand a smoke, such as might be imagined to come from wet straw before it begins to blaze. It made a sort of murmuring sound, like that of a torrent heard at a distance, moved, at the same time, with a lashing noise, like that of a serpent: shortly after we perceived a column of this smoke rise up to the clouds, at the same time whirling about with great rapidity. It appeared to be as thick as one's finger, and the latter sound still continued. When this disappeared, lasting for about eight minutes, upon turning the opposite quarter of the sky, we perceived another, which began in the manner of the former, and indeed in the same manner rose to the west; and instantly beside it still another arose. The most distant of these three could not be above a musket-shot from the ship. They all continued thus for many hours, and yet continued to move and to make the same noise as before. We soon perceived each, with its respective canal, mounting up in the clouds; and spreading, where it touched the cloud, like a trumpet, filling a figure, to exhibit in a manner press intelligibly, as if the tail of an animal was pulled at one end by a weight. The canals were of a whitish colour, and so tinged as I suppose, by the water which was contained in them; for, previous to this, they were apparently empty; and of the colour of transparent glass. These canals were not straight, but bent in some parts, and far from being perpendicular, but rising in their clouds with an inclination; but what is very particular, the cloud to which one of them was pointed happening to be driven by the wind, the spout still continued to follow its motion without being broken; and passing behind one of the others, the spouts crossed each other, in the form of a St. Andrew's cross.

In the beginning they were all about as thin as a man's finger, except at the top, where they were broader, and two of them disappeared, but shortly after the last of the three increased considerably, and its canal, which was at first so small, soon became as thick as a man's arm, then as his leg, and at last thicker than the whole body. We saw distinctly through this transparent body, the water, which rose up with a kind of spiral motion; and it sometimes diminished a little of its thickness, and again resumed the same; sometimes widening at top, and sometimes at bottom; exactly resembling a gut filled with water, pressed with the fingers, to make the fluid rise or fall. And I am well convinced that this alteration in the spout was caused by the wind, which pressed the cloud, and compelled it to give up its contents. After some time its body diminished no thicker than the man's arm again, and thus swelling and diminishing, it at last became very small. In the end I observed the sea which was raised.
WAT

This is a page from a book discussing the phenomenon of whirlwinds and water-sprouts. The text describes how these phenomena are observed and the interactions between the whirlwinds and water bodies, leading to the production of electricity. The author, Mr. Oliver, who is referenced in the text, has developed a theory that explains the phenomenon. The text is a part of a larger experiment conducted by Capt. Bostock, which was assisted by Dr. Pearson and has been verified by Dr. Bouck. The water-sprout is a natural process that occurs under various conditions, and the wax produced is a byproduct of the process. The wax is described as being insoluble in water and having a specific gravity of 0.9609. Wax is also mentioned as a possible ingredient in the composition of beeswax.

The text concludes with a discussion on the effect of heat on wax, where it is stated that wax is not affected by heat. The wax produced in this manner is considered useful for making candles.

The text is a part of a larger work on natural phenomena and their interactions with the environment, particularly focusing on the production of electricity and the formation of water-sprouts.
which is known by the name of cerate, is much employed by surgeons. The volatile oils also dissolve it when heated. This is well known, at least, to be the case with oil of turpentine. A part of the wax precipitates usually as the solution cools, but of a much softer consistence than usual, and therefore containing oil.

The fixed alkalies combine with it, and form a compound which possesses all the properties of common soap. When boiled with a solution of fixed alkalies in water, the liquid becomes turbid, and after some time the soap separates and swims on the surface. It is precipitated from the alkali by acids in the state of flake, which are the wax very little altered in its properties. Punic wax, which the antients employed in painting in encaustic, is a soap composed of 20 parts of wax and one of soda. Its composition was ascertained by Mr. Lorgna.

When boiled with liquid ammonia, it forms a kind of soapy emulsion. As the mixture cools, the greatest part of the compound rises to the surface in the state of white flakes. This soap is a perfectly soluble in water.

The acids have but little action on wax; even oxycurric acid, which acts so violently on most bodies, produces no other change on it than that of rendering it white. This property which wax possesses, of resisting the action of acids, renders it very useful, as a lute, to confine acids properly in vessels, or to prevent them from injuring a common cork.

Mr. Lavoisier, by means of the apparatus which he employed in the analysis of alcohol and coal, could burn wax in oxygen gas. The quantity of wax consumed was 21.9 grams. The oxygen gas employed in consuming that quantity amounted to 66.55 grams. Consequently the substances consumed amounted to 88.45 grams. After the combustion, there were found in the glass vessel 62.58 grams of carbonic acid, and a quantity of water which was supposed to amount to 21.97 grams. These were the only products.

Now 62.58 grams of carbonic acid gas contain 44.56 of oxygen, and 18.02 of carbon; and 21.97 grams of water contain 21.99 of oxygen, and 3.88 of hydrogen.

Consequently 21.9 parts of wax are composed of 18.02 of carbon and 3.88 of hydrogen. And 100 parts of wax are composed of 82.28 carbon and 17.72 hydrogen.

But this analysis can only be considered as an approximation to the truth; the quantity of water being only estimated, and that of the gas being liable to uncertainty. There can be no doubt, from the little action of acids on wax, that it contains oxygen as an ingredient. We must therefore consider it as a triple compound of carbon, hydrogen, and oxygen; but the proportions are unknown.

WAX.

If wax is distilled with a heat greater than 212°, there comes over a little water, some acid, and a little smoke. From this oil, as the distillation advances, becomes thicker and thicker, till at last it is of the consistence of butter, and for this reason has been called butter of wax. There remains in the retort a fixed oil which is not easily reduced to ashes. When the butter of wax is repeatedly distilled, it becomes very fluid, and assumes the properties of volatile oil.

Wax possesses all the essential properties of fixed oil. We must therefore consider it as a fixed oil rendered concrete. Now that species of fixed oils, distinguished by the epitaph fat, have the property of becoming concrete, and assuming the appearance of wax when exposed long to the air; in consequence, it is supposed, of the absorption of oxygen. Hence probably the difference between wax and fixed oils consists in the oxygen which it contains as a component part. The wax at first from the state of a fixed oil; but by the absorption of oxygen it gradually concretes into wax. Wax, then, may be considered as a fixed oil saturated with oxygen.

It is natural to suppose, if this theory is just, that fixed oils occur in plants in various states of hardness: and this accordingly is the case. Sometimes it is of the consistency of butter, and this is denominated a butter; thus we have the butter of cacao, the butter of coco, the butter of galam. Sometimes it is of a greater consistency, and then is denominated tallow; than we have the tallow of the croton, extracted by boiling water from the fruit of the croton seiblera. When its consistency is as great as possible, it then takes the appellation of wax. Thus we have the myrtle wax of America extracted from the berries of the myrica cerifrera, and the pears of the Chinese. The species of wax, then, which exist in the vegetable kingdom, may possibly be as numerous as the fixed oils. Let us take a view of some of the most remarkable.

Bees' wax is the species whose properties have been most studied in the foregoing article. It is supposed that the bees collect it from plants; but it has been very well ascertained, that in many cases at least they manufacture it from honey, and even from sugar: for bees confused and fed solely upon these substances produce wax. Its consistence is said to be less when the bees are confined to sugar than when they are allowed honey.

The myrtle wax of North America is obtained from the myrica cerifrera. We are indebted to Dr. Bostock and Mr. Cadet for a very exact account of its properties and extraction. The myrica cerifrera is a shrub which grows abundantly in Louisiana and other parts of America. It bears a berry about the size of a pepper-corn. A very fertile shrub yields nearly seven pounds. The berries are picked off, thrown into a kettle, and covered with water to the depth of half a foot. The kettle is then boiled, and the berries stirred and squeezed against the sides of the vessel. The wax which they contain is melted out and swims on the surface. It is skimmed off, passed through a cloth, dried, melted again, and cast into cakes. From the observations of Cadet we learn that the wax forms the outer covering of the bee, and that thus obtained is a pale green colour. Its specific gravity is 1.0150. It melts at the temperature of 109°; when strongly heated it burns with a white flame, produces little smoke, and during the process emits a disagreeable aromatic colour. Water does not act upon it. Alcohol, when hot, dissolves 9/10th of its weight but leaves most of it fall again on cooling.

Wax Crayons. The art of painting in wax crayons is a late discovery, and when first employed of producing the most pleasing effect. It is, however, to be considered as an adjunct to the art of water-colours, than as a distinct branch of the art of design or painting, as will appear from the nature of the materials employed in it. Instead of the substances used in conjunction with the respective colours, to form the body of common crayons, such as plasters of Paris, pipe-clay, calcined albaaster, &c. all the coherents used in this mode of painting are to be incorporated with wax. This mixture gives them the superior advantage of being particularly calculated for the execution of minute works in crayons, as they are not liable to mould or adhere, or to be rubbed off from the paper; but works thus executed require the assistance of various washes in water-colours to improve and perfect their effect, as from the nature of wax, the frequent works of these crayons would produce an excessive smoothness, or glassiness, which would prevent the colours from attaching or taking proper hold of the surface of the work in the heightenings and last finishings, and would disappoint the artist in his endeavours to produce the greatest requisite strength of effect.

It is to be observed, therefore, that water-colours are to be used in beginning your picture, and in finishing it. When the crayons are judiciously worked over the water-colours, they will produce the appearance of an elegantly finished stippled engraving, coloured in the plate; the grain of the paper catching the crayons in dots, (when gradually laid on with the finger, and with a light hand) in a wonderfully pleasing manner.

We shall comprise the instructions requisite for the student’s practice under the following heads, namely:

1. The kind of wax to be used in making the crayons;
2. The colours fit to be incorporated with it;
3. The choice of proper paper;
4. The method of using the crayons.

Wax. The wax proper to be used in making crayons, must be bleached bees’ wax, entirely free from adulteration. It must likewise be of the hardest kind, of which the Russian wax is the best, although in colour not quite so fine as either the American or English wax; but its hardness gives a firmness to the crayons, and prevents a greasiness which other waxes would create.

Colours. The colours proper for mixing into crayons, are the following, viz. for yellows, king’s yellow or yellow ocher; for blues, Antwerp or Prussian; for reds, cinnabar; and Chinese vermilion; for browns, tobacco, burnt and unburnt; for blacks, lampblack.
only. As to compound tints, they are to be produced by a judicious management of the water-colours over the crayons; and this rule with respect to the colours proper to be used for crayons, as to their being carefully observed, that none are fit for the purpose, but such as, in their dry unmixed state, will mark on paper fairly well: for the reader may easily judge, that the tenacity of the wax would completely prevent any kind of colour from working that was incorporated with it.

Having procured the kind of wax already mentioned, you are to have a nice glued white paper, perfectly clean and free from any greasy particles; and having previously ground your colours on a flag with your mallet, perfectly fine, in fair water, and dried, put a small quantity of wax into the paper, which you are to place over a very slow fire; when the wax is entirely dissolved by the gentle heat (for if it bubbles it is spoiled), gradually work in your colour, stirring it with an ivory pencil-handle, until you find it perfectly mixed; at the same time observing that you do not overload the wax with colour, as it will make your surface too thick for you to work in; and you are to put in too little colour, as it will make it faint and work greasy; so a medium is to be observed, to ascertain which practice only will conduce. There are some colours, such as vermilion, which, if they receive too great a heat, turn black, and that must be very cautiously observed, in this kind of painting, as a highly useful colour: as is also lamp-black, a harder kind from which it must be used, as it may be made by mixing some of it, in its raw state, with strong glue, letting it harden, and then burning it in a crucible (as directed in calcining colours for miniature painting); then pulverizing it on your flag, and mixing it with your wax, as before mentioned. This kind of black crayon is most excellent for giving sharp touches in dark parts, as it is well adapted for making sketches to refresh the memory: is much superior to black chalk, as nothing will cause it to rub or spoil, it remaining as immovable as writing-ink, and working extremely pleasant.

Paper. The paper fit to be used in wax-crayon painting, must be of the wove or velum kind, but as there are several that are too fine, the grain will catch the crayons in dots so remote from each other, as to make your work look unpleasant; and if the paper is too fine it will not catch the crayons as it ought, but clog your painting without producing any effect. The only rule therefore for choosing your paper is to go to the stationer's, and taking a small bit of soft black crayon, by gently rubbing the crayon on a few sheets of different kinds of wove paper, you will become a judge of what is the best for your purpose, at a trifling expense. Having procured this necessary article to your satisfaction, you are to work on it at your leisure.

Method. The desk you are to work on must be much larger than the one mentioned for miniature painting, (see Miniature,) this kind of work being often used for larger sizes than the style of painting here mentioned, where the effects are more delicate; hence you are to place it in the same manner as pointed out in the article on Miniature Painting, with a soft piece of charcoal sketch faintly the distances and forms of the features; then touch in them more strongly with your crimson or black crayon, still altering until you are perfectly certain you have a correct outline. Inasmuch as the kind of painting is absolutely necessary; for in your fair drawing you commit an error in your outline, you never can alter it, the crayons being in their nature so adhesive, that nothing will remove them. Having, on your first sheet, made your outline correct, rub the back of the face part with crimson crayon, the hair part with a suitable-coloured one, and the drapery, if white, with black; then laying the paper on a fair sheet go over the outlines of your sketch with a tracer, when you will transfer, in a very neat manner, your outline ready to colour in.

You are then to mark in the features of your sitter more strongly with crimson or water-colour, and a fine pencil; ever observing, when you use it, to work over with a suitable-coloured crayon, as it is that which will give the beautiful dotted appearance so much to be admired.

Having marked in the features sufficiently strong to put the likeness out of danger of being spoiled, make a wash of yellow or entire over the flesh parts, deepening its tint according to your subject; wash-in the colour of the lips, hair, and black being dry, work with your different-coloured crayons on the parts, until you produce the effects required; filling up any interstices of the crayons with dots of water-colours and a fine wash. As to the tint of your lime shades, the black crayon will produce that in every degree, the paper answering for the lights of any-coloured drapery; for then you are to wash-in and shadow it with the crayons. Your paper is to be perfectly dry, otherwise the work will appear glazy; but even should that be the case, hold it before the fire, and the shining appearance will instantly vanish.

With respect to your back grounds, as this style of painting is intended to be light and sketchy, and back grounds are to be preferred; to manage which, the best way is to stumpl in them with dry colour, to what extent you find pleasing, and in a proper state, to add a proper value to the appearances of your wax crayons. Your drawing, either of portrait or landscape, being finished, have ready a large flat board, on which you are to stretch a sheet of royal paper; and having pasted the back of your drawing with some flour paste mixed with sizing, lay it on the royal paper, and carefully press it in all directions with a soft towel or handkerchief, when your work is completed.

WAY. A way may be by prescription, as if the owners and occupiers of such a farm have immemorially used to cross another's ground; for this immemorial usage supplies an original grant. A right of way may also arise by act and operation of law; for if a man grants to another a piece of ground in the middle of his field, he at the same time tacitly gives him a way to come at it, for where the law gives any thing to any person, it gives implied whatever is necessary for enjoying the same. 2 Black 33.

WAY of a ship, is sometimes used for her wake or track. But more commonly the term, way, is used to denote the progress, or the impression to which she makes on the water under sail; thus when she begins her motion, she is said 5 X 2 to be under way; when that motion increases, she is said to have fresh way through the water; when she goes space, they say she has a good way; and the account of having the ship lying by the log, they call, keeping an account of her way. And because most ships are apt to fall a little to the leeward of their true course, it is customary, in casting up the log-board, to allow something for her leeward way, or lee way. Hence also a ship is said to have head-way, and stern-way.

WAYFITES, or WAITS. This noun formerly signified halloo boys; and, which is remarkable, has no singular number. From the instruments its signification was, after a time, transferred to the performers themselves; who being in the habit of parading the streets by night with their music, occasioned the name to be applied generally to all musicians who followed a similar practice. Hence those persons who annually, at the approach of Christmas, salute us, with their nocturnal concerts, were, and are to this day, called wayfites.

WAY WISER, an instrument for measuring the road, or distance travelled; called also PERAMBULATOR, and PEDOMETER. See those two articles.
It appears from the construction of this machine, that it operates like circular compasses; and does not, like the common wheel way-wiser, measure the surface of every stone and round bush, but passes over most of the obstacles it meets with, and measures the chords only, instead of the arcs of any curved surfaces upon which it rolls.

WEASEL. See VITERRA.

WEATHER. See Meterology.

Weather-glasses, are instruments constructed to indicate the state or disposition of the atmosphere, and the various alterations in the weather: such as barometers, thermometers, hygrometers, &c.

WEAVERS. The wages of journeymen weavers in London are to be settled by the lord mayor, recorder, and aldermen. Masters giving more wages than is appointed, to forfeit 50l. and journeymen demanding, or combining to demand more, to forfeit 40s. or be imprisoned three months.

WEAVING-LOOM. See LOOM.

WEB, a tissue, or texture, formed of threads with each other: some whereby are extended in length, and called the warp; and others drawn across, and called the woof. See WARP, &c.

WEBER, See Trachinus.

WEIGELLA, a genus of plants of the class and order pentandria monogynia. It is cultivated; the single, two-celled, cells; stigma club-shaped; calyx five-cleft. There are three species, shrubs of the East Indies.

WEEVER. See Trachinus.

WEIGHT, WAY, or WEG, unga, a weight of cheese, wool, &c. containing 256 pounds avoirdupois. Of corn, the weight contains forty bushels; of barley or malt six quarters. In some places, as Essex, the weight of cheese is 300 pounds.

WEIGHT, gravity, in physics, a quality in all bodies whereby they tend downwards, towards the centre of the earth. Or weight may be defined in a less limited manner, to be a power inherent in all bodies whereby they tend to some common point, called the centre of gravity; and that with a greater or less velocity, as they are more or less dense, or as the medium they pass through is more or less rare.

In the common use of language, weight and gravity are considered as one and the same thing. Some authors, however, make a difference between them, and hold gravity only to express a pull, or endeavour to descend, but weight an actual descent. But there is room for a better distinction. In effect, one may conceive gravity to be the quality as inherent in the body; and weight the same quality, exerting itself either against an obstacle, or otherwise. Hence, weight may be distinguished, like gravity, into absolute and specific. See Gravity.

Sir Isaac Newton demonstrates, that the weight of all bodies, at equal distances from the centre of the earth, are proportional to the quantities of matter each contains. Whence it follows, that the weights of bodies have not any dependence on their forms or textures: the spaces are not equally full of matter. Hence also it follows, that the weight of the same body is different on the surface of different parts of the earth, as its figure is not a sphere, but a spheroid.

WEIGHT, pondus, in mechanics, is any thing to be raised, sustained, or moved by a machine, or any thing that in any manner resists the motion to be produced.

WEIGHT, in commerce, denotes a body of a known weight, appointed to be put in the balance against other bodies, whose weight is required.

The security of commerce depending, in good measure, on the justness of weights, which are usually of lead, iron, or brass, most nations having taken care to prevent the falsification of them, by stamping or marking them by proper officers, after being adjusted by some original standard. Thus in England, the standard of weights is kept in the exchequer, by an officer, called the clerk of the market.

WEIGHTS and MEASURES, regulation of. This is a branch of the king's prerogative. For the public convenience, those ought to be universally the same throughout the nation, the better to reduce the prices of articles to equitable values. But as we measure things in their nature arbitrary and uncertain, it is necessary that they are reduced to some fixed rule or standard. It is, however, impossible to fix such a standard by any written law or oral proclamation; as no person can, by words only, give to another an adequate idea of a pound weight, or foot rule. It is therefore expedient to have recourse to some visible, palpable, material standard, by forming a comparison with which all weights and measures may be reduced to one uniform size. Such a standard was antiently kept at Winchester; and we find in the laws of King Edgar, near a century before the Conquest, an injunction that that measure should be observed throughout the realm.

Most nations have regulated the standard of measures of length from some part of the human body; as the palm, the hand, the span, the foot, the cubit, the ell (shut or arm), the pace, and the fathom. But as these are of different dimensions in men of different proportions, antient historians inform us, that a new standard of length was fixed by our king Henry the First; who commanded that the ell, or antient ell, which answers to the modern yard, should be made of the exact length of his own arm.

A standard of long measure being once gaining, all others are easily derived from it; those of greater length by multiplying that original standard, those of less by dividing it. Thus, by the statute called composito chartarum of tertiam, 55 yards make a perch; and the yard is subdivided into three feet, and each foot into twelve inches, and the inch is divided into thirty-two points, which are each of the length of three barleycorns. But some, on the contrary, derive all measures by composition, from the barleycorn.

Superficial measures are derived by squar-
### Weights.

#### Table of Avoirdupois Weight.

<table>
<thead>
<tr>
<th>Dram.</th>
<th>Ounce</th>
<th>Pound</th>
<th>Stone</th>
<th>Quarter</th>
<th>Shilling</th>
<th>Farthing</th>
</tr>
</thead>
<tbody>
<tr>
<td>288</td>
<td>128</td>
<td>16</td>
<td>2</td>
<td>4</td>
<td>8</td>
<td>10</td>
</tr>
</tbody>
</table>

#### Scruples.

| 3   | 12   | 16   | 24   | 48   |

#### Grains.

| 20  | 30  | 40  | 60  | 80  |

#### Apothecaries.

| 20  | 30  | 40  | 60  | 80  |

---

The Roman ounce is the English avoirdupois ounce, which they divided into seven darms, as well as eight drachms; and since they reckoned their denarius equal to the Attic drachm, this will make the Attic weights one-eighth heavier than the corresponding Roman weights.

Writhe, *Modern European. 1. English weights.* By the twenty-seventh chapter of Magna Charta, the weights all over England are to be the same; but for different commodities, there are two different sorts, viz. Troy weight and avoirdupois weight. The origin from which they are both raised, is a grain of weight gathered in the middle of the ear.

In Troy weight, twenty-four of these grains make a pennyweight sterling; twenty pennyweights make one ounce; and twelve ounces make one pound.

By this weight we weigh gold, silver, jewels, grains, and liquors. The apothecaries also use the Troy pound, ounce, and grain, but they differ from the rest in the intermediate divisions. They divide the ounce into eight drachms; the drachm into three scruples, and the scruple into twenty grains.

In avoirdupois weight, the pound contains sixteen ounces, but the ounce is less by near one-twelfth than the Troy ounce; this latter containing 490 grains, and the former only 448.

The ounce contains 16 drachms; 80 ounces avoirdupois are only equal to 73 ounces Troy; and 17 pounds Troy equal to 14 pounds avoirdupois.

By avoirdupois weight are weighed mercury, and grocery ware, base metals, wood, tallow, hemp, drugs, bread, &c.

#### Table of Troy Weight as used by the Goldsmiths.

<table>
<thead>
<tr>
<th>Pounds</th>
<th>Grains</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>15,071</td>
</tr>
<tr>
<td>2</td>
<td>30,142</td>
</tr>
<tr>
<td>3</td>
<td>45,213</td>
</tr>
<tr>
<td>4</td>
<td>60,284</td>
</tr>
<tr>
<td>5</td>
<td>75,355</td>
</tr>
<tr>
<td>6</td>
<td>90,426</td>
</tr>
<tr>
<td>7</td>
<td>105,497</td>
</tr>
<tr>
<td>8</td>
<td>120,568</td>
</tr>
<tr>
<td>9</td>
<td>135,639</td>
</tr>
<tr>
<td>10</td>
<td>150,710</td>
</tr>
</tbody>
</table>

#### Table of Troy Weight as used by the Moneyers.

<table>
<thead>
<tr>
<th>Pounds</th>
<th>Grains</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>15,071</td>
</tr>
<tr>
<td>2</td>
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<td>9</td>
<td>135,639</td>
</tr>
<tr>
<td>10</td>
<td>150,710</td>
</tr>
</tbody>
</table>

#### Table of Troy Weight as used by the Weighers.

<table>
<thead>
<tr>
<th>Pounds</th>
<th>Grains</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
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</tr>
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<td>10</td>
<td>150,710</td>
</tr>
</tbody>
</table>

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In addition to certain weights peculiar to themselves: thus, Spain has its arroba, containing 25 Spanish pounds, or one-fourth of the common quintal; its quintal macho, containing 156 pounds, or one-half common quintal, or 6 arrobas; its alhumbre, containing one-sixteenth of its ounce. And for gold, it has its castilla, or one-hundredth of a pound, and its toncini, containing 12 grains, or one-sixtieth of a castilla. The same are in use in the Spanish West Indies.

Portugal has its arroba, containing 39 Lisbon arrobas, or pounds; Savary also mentions its farżelette, containing 2 Lisbon pounds; and its rototillo, containing about 12 pounds. And for grains, its choppo, containing 4 quartos. The same are used in the Portuguese East Indies.

Italy, and particularly Venice, have their migliaro, containing four mirtres; the mirre containing 30 Venice pounds; the taglio, containing a sixth part of an ounce. Genoa has five kinds of weights, viz. large weights, whereby all merchandise are weighed at the custom-house; cash weight, for grains, other specie, the canarino, or quintal, for the coarsest commodities; the large balance for raw silks, and the small balance for the fine commodities. Sicily has its rotolo, 92 and a half pounds of Messina.
WEIGHTS.

English Weights. Troy Weight. 

<table>
<thead>
<tr>
<th>lb.</th>
<th>oz.</th>
<th>dr.</th>
<th>scr.</th>
<th>grains</th>
<th>grams</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1</td>
<td>8</td>
<td>24</td>
<td>5760</td>
<td>31.08</td>
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<tr>
<td>2</td>
<td>2</td>
<td>6</td>
<td>18</td>
<td>7383.5</td>
<td>60.95</td>
</tr>
<tr>
<td>3</td>
<td>3</td>
<td>1</td>
<td>24</td>
<td>10921.0</td>
<td>82.10</td>
</tr>
<tr>
<td>4</td>
<td>4</td>
<td>24</td>
<td>5760</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Avoirdupois Weight. 

<table>
<thead>
<tr>
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<th>oz.</th>
<th>dr.</th>
<th>scr.</th>
<th>grains</th>
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<tbody>
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<td></td>
<td></td>
</tr>
</tbody>
</table>

German.

71 lbs. or grs. English troy = 74 lbs. or gr. German apothecaries' weight.

1 oz. Nuremberg, medic. weight, = 7 dr. 2 scr. English.

1 mark Cologne, = 7 oz. 2 dwt. 4 gr. English troy.

Dutch.

1 lb. Dutch = 1 lb. 3 oz. 16 dwt. 7 gr. English troy.

78 lbs. Dutch = 1038 lbs. English troy.

Swedish Weights, used by Bergman and Scler.

The Swedish pound, which is divided like the English apothecary, or troy, pound, weighs 4808.719444 English troy grains, or is equal to 0.8203 English cubic inches; and the Swedish longitudinal inch, is equal to 1389.482 English longitudinal inches.

From these data, the following rules are deduced:

1. To reduce Swedish longitudinal inches to English, multiply by 0.8203, or divide by 1.2189.

2. To reduce Swedish to English cubic inches, multiply by 1.8, or divide by 0.5557.

3. To reduce the Swedish pound, ounce, dram, scruple, or grain, to the corresponding English Troy denomination, multiply by 1.2189, or divide by 0.8203.

4. To reduce the Swedish Kenny to English wine grains, multiply by 1.2189, or divide by 0.8203.

5. The troy, a weight sometimes used by Bergman, is the 32d part of the Swedish pound: Therefore, to reduce it to the English troy pound, multiply by 0.03577, or divide by 28.1126.

Correspondence of English Weights with those used in France before the Revolution.

The Paris pound, poids de marc of Charlemagne, contains 9216 Paris grains; it is divided into 16 ounces, each ounce into 8 gros, and each gros into 72 grains. It is equal to 7361 English troy grains.

The English troy pound of 12 ounces contains 2437.84 grains.

The English avoirdupois pound of 16 ounces contains 7000 English troy grains, and is equal to 4808.719444 English.

To reduce Paris grains to English troy grains, divide by 0.8203.

To reduce English troy grains to Paris grains, multiply by 0.8203.

Weights used in the several parts of Asia, the East Indies, China, Persia, &c. In Turkey, at Smyrna, &c. they use the batman, or battenm, containing six reises, the ounce, weighing three pounds four-fifths English. They have another battenmuch less, consisting of the former, of six oozes; but the ounce only containing fifteen English grains; 44 oozes of the first kind make the Turkish quintal. At Cairo, Alexandria, Aleppo, and Alexandria, they use the roto, rotton, or rottol; at Cairo, and other parts of Egypt, it is 144 draks, being somewhat over an English pound. At Aleppo they have three sorts of rottos; the first 720 draks, making about seven pounds English, and serving to weigh cottons, galls, and other large commodities; the second is 624 draks, used for all silks but white ones, which are weighed by the third rotto of 700 draks. At Smyrna the rotto is 600 draks.

The other parts of the Levant, not named here, use some of these weights, particularly the ooz, or occult, the rottol, and the rotto.

The Chinese weights are the piece, for large commodities; it is divided into 100 cats, or cattis, though some say into 125; the piece into 16 cats, or taels, each tael equivalent to 1 1/2 of an ounce English, or the weight of one rial and 9/10, and containing 12 mas, or masses, and each mas 10 condins. So that the Chinese piece amounts to 137 pounds English avoirdupois, and the cati to 1 pound 8 ounces. The piece for silk contains 66 cats and 2/10 the bahar, balseire, or barr, contains 300 cats.

Tonquin has also the same weights, measure, &c. as China. Japan has only one weight, viz. the seer, or seerf, which is different from that of China, as containing different numbers of taels. At Surat, Agra, and throughout the states of the Great Mogul, they use the man, or muns, wherein they have two kinds, the king's man, or man, of weight, and the man simply; the first used for the weighing of common provisions, containing 40 seers, or seers, and each seer a just Paris pound. The common man, used in the weighing of merchandise, consists likewise of 40 seers, but each seer is only estimated at 19 Paris ounces, or 2/10 of the other seer.

The man may be looked on as the common weight of the East Indies, though under some difference of name, or rather of pronunciation, it being called muzo at Cambay, and in other places meen, and maun. The seer is properly the Indian pound, and of universal use; the like may be said of the bahar, tael, and cati above-mentioned.

The weights of Siam are the piece containing two shans, or cattis; but the Siamese catti is only half the Japanese, the latter containing 20 taels; and the former only 10; though some say, that the siamese catti only 10 taels, and the Siamese 8. The tael contains 4 baats or ticals, each about a Paris ounce; the baat 4 seels, or mayors; the mayor 2
WEI

found; the foung 4 pays; the puye 2 claws; the sompaye half a foung and nine.
In Golconda, and Goa, they have the funtrule containing 1 pound 14 ounces English; the mangelus or mangolin for weighing diamonds and precious stones, weighing at Goa's grains, at Golconda. They say little about the rotole containing 144 ounces English; the metrical containing the sixth part of an ounce; the wall for piasters and ducats, containing the 73rd part of a rial.

In Persia they use two kinds of hammers or maws, the one called cali or cherary, which is the king's weight; and the other batman of Tauris. The first weighs 13 pounds 10 oz. English; the second 64 pounds, its divisions are the ratel, or a 10th; the derhem, or drachm 20 tin; the bunch, which is half the derhem; the dung, which is the 6th part of the meschal, being equivalent to six carat-grains; and, lastly, the grain, which is the fourth part of the dung. They have also a light and a heavy ounce; the salt-cherary, equal to the 1170th part of the derhem; and the toman, used to weigh out large payments of money without telling; its weight is that of 50 avoirdupois.

African and American weights. We have little to say as to the weights of America; the several European colonies there making use of the weights of the states or kingdoms of Europe they belong to. For, as to the auro of Peru, which weighs 57 pounds, it is evidently no other than the Spanish arroba, with a little difference in the name.

As to the weights of Africa, there are few places that have any, except Egypt, and the countries bordering on the Mediterranean, whose weights have been already enumerated among those of the ports of the Levant. The island of Madagascar indeed has weights, but none that exceed the drachm, nor are they used for anything but gold and silver.

WIGHTS and MEASURES of measurement are kept at Winchester, which measure was by the law of King Edgar, ordained to be observed through the kingdom.

By. stat. 35 G. III. c. 105, the justices in quarter-sessions in every county, are required to appoint persons to examine the weights and balances within their respective jurisdictions. These inspectors may seize and examine weights in shops, &c. and seize false weights, and, if the offender, being convicted before one justice, shall be fined from 5s. to 20s. Persons obstructing the inspectors to forfeit from 5s. to 40s. Inspectors to be recompensed out of the county-rate. Such buses as are purchased by the sessions out of the county-rate, and produced to all persons paying for the production thereof. Informations to be within one month.

Universal standard for weights and measures. In case the transactions of one country be to be purchased by the sessions out of the county-rate, and produced to all persons paying for the production thereof. Informations to be within one month.

Universal standard for weights and measures. In case the transactions of one country be to be purchased by the sessions out of the county-rate, and produced to all persons paying for the production thereof. Informations to be within one month.

The universal standard for weights being once established, those of weights, &c. would easily follow. For instance: a vessel, of certain dimensions contains a certain weight of distilled water, or some other homogenous matter, the weight of that may be considered as a standard for weights.

WELMENNA, a genus of plants of the class and order octandria linnaceae. The calyx is four-leaved; corolla four-petalled; caps. two-celled, two-beaked. There are six species, trees of the southern climates.

WELDING HEAT, is smithey, a degree of heat given to iron, &c. sufficient to make any two bars or pieces of iron unite by a few strokes of the hammer, and form one piece.

See IRON.

WEN. See SURGERY.

WESTRINGA, a genus of plants of the family gymnossperma class and order. The calyx is half five-cleft, five-sided; corolla reversed; four segments, longest erect; clawed, stam. distant, two shorter abortive. There is one species, a shrub of New South Wales.

WHALE. See BALENA.

WHEAT. See TRITICUM, and Hus.

BANDERY.

WHEAT-FAR. See MOTACILLA.

WHEELE, in mechanics, a simple machine, consisting of a round piece of wood, metal, or other matter, which revolves on an axis. The wheel is one of the principal mechanical powers; it has place in most engines; little of it is used in an assemblage of wheels that most of our engines are composed. See MECHANICS.

Wheels, of couches, carts, waggon, &c. With respect to wheels of carriages, the following particulars are collected from the experiments and observations of Desaguliers, Brighton, Camus, Ferguson, Jacob, &c.

1. The use of wheels in carriages is twofold, viz. that of diminishing or more easily overcoming the resistance or friction of the carriage; and that of more easily overcoming obstacles in the road. In the first case, the friction on the ground is transferred in some degree from the wheel to the axle; and in the latter, they serve easily to raise the carriage over obstacles and asperities not met with on the roads. In both these cases, the height of the wheel is of material concern. The spokes act as levers, the tops of an obstacle, being the fulcrum, their length enables the carriage more easily to surmount them; and the greater proportion of the wheel to the axle serves more easily to diminish or to overcome the friction of the axle.

2. The wheels should be exactly round; and the felices at right angles to the naves, according to the inclination of the spoke.

3. It is in the most general opinions, that the spokes are somewhat inclined to the nave, so that the wheels may be disuing or concave. Indeed if the wheels were always to roll upon smooth and level ground, it would be best to make the spokes perpendicular to the nave, so as to prevent the weight from being totally on the axle, and to diminish the friction of the axle.

4. But because the ground is commonly uneven, one wheel often falls into a cavity or rut, when the other does not, and then it bears much more of the weight than the other does;
in which case it is thought best for the wheel to be dished, because the spokes become perpendicular in the rut, and therefore have the greatest strength when the obliquity of the direction of the weight and the weight itself are perpendicular; whilst those on the high ground have less weight to bear, and therefore need not be at their full strength.

4. The axles of the wheels should be quite straight, and perpendicular to the shafts, or to the pole. When the axles are straight, the rims of the wheels will be parallel to each other, in which case they will move the easiest, because they will be at liberty to proceed straight forwards. But in the usual way of practice, the ends of the axles are bent downwards, which always keeps the sides of the wheels that are next the ground nearer to one another than their upper sides are; and this not only makes the wheels drag sideways as they go along, and gives the load a much greater power of crushing them than when they are parallel to each other, but also endangers the overturning the carriage when a wheel falls into a hole or rut, or when the carriage goes on a road that has one side lower than the other, as along the side of a hill.

Large wheels are found more advantageous for ordinary purposes than small ones, both with regard to their power as a lever longer, and to the degree of friction, and to the advantage in getting over holes, rubs, and stones, 

If we consider wheels with regard to the friction upon which they are applied, it is evident that small wheels, by turning sooner round, and swifter about the axles, than large ones, must have more friction. Again, if we consider wheels as they sink into holes or soft earth, the large wheels, by sinking less, must be more easily drawn out of them, as well as over stones and obstacles, from their greater length of lever or spokes.

It is a fact, however, that the draught ought not to be horizontal, but rather inclined: because in the horizontal draught the collar presses against the chest of the horse, instead of bearing on his shoulders, as in an inclined draught; and because in this latter circumstance, the wheels press more easily over obstacles than when the draught is horizontal.

Hence it appears, that wheels are the more advantageous as they are larger, provided they are not so high as to make the draught horizontal; and that when they are very large also, they become too heavy; or if they are made light, their strength is proportionally diminished, and the length of the spokes renders them more liable to break; besides, horse—applied to such wheels would not be capable of exerting their utmost strength, for the reasons already assigned, small wheels occasing the horses to draw upwards.

6. Carriages with four wheels, as waggons or coaches, are much more advantageous than carriages with two wheels, as carts and chaises: for with two wheels it is plain the tilter—horse carries part of the weight, in one way or other; in going down hill, the weight bears upon the horse; and in going up hill, the weight falls the other way, and hits the horse, which is still worse. Besides, as the wheels sink into the holes in the road, sometimes on one side, sometimes on the other, the tilter—horse, with the tilted sides, which destroys many horses: moreover, when one of the wheels sinks into a hole or rut, half the weight falls that way, which endangers the overturning of the carriage.

7. It would be much more advantageous to make the four wheels of a coach or waggon nearly of the same height, than to make the fore—wheels of only half the height of the hind wheels, as is used in many places. The fore—wheels have commonly been made of a less size than the hind ones, both on account of turning short, and to avoid cutting the braces. Crane—necks have also been invented for turning yet shorter; and the fore—wheels have been lowered, so as to go quite under the bend of the crane—neck.

When a horse draws hard, it is observed through the beams forward, and brings his breast near the ground, and then if the wheels are high, he is pulling the carriage against the ground. A horse tackled in a waggon will draw two or three ton, because the point of line of action is below his breast, by the lowness of the wheels. It is also common to see, when one horse is drawing a heavy load, especially up hill, his fore feet will rise from the ground; in which case it is usual to add a weight to the horse's head to keep him down, by a person mounting on his back or shoulders, which will enable him to draw that load which he could not move before.

The greatest stress, or main business of drawing, is to overcome the resistance of the air; and as the drawing is but little, and then the horse's back need be pressed but with a small weight.

8. The utility of broad wheels, in amending and preserving the roads, has been so much insisted on, that it has been recommended by many legislators to enforce their use. At the same time, the proprietors and drivers of carriages seem to be convinced by experience, that a narrow—wheeled carriage is more easily and speedily drawn by the same number of horses, than a broad—wheeled one of the same burden; probably because they are much lighter, and have less friction on the axle; and brought wheels will always be lighter than broad wheels.

WHEREAS it is evident, that there is a genus of animalculae which have an apparatus of arms for taking their prey. This apparatus has been supposed, by microscopic writers, to be a kind of wheels; and they thence named the creatures that are possessed of it, wheel—animals.

WHIRLPOOL, an eddy, vortex, or whirl, where the water is continually turning round. These in rivers are very common, from various accidents, and are usually very trivial, and of little consequence. In the sea they are more rare, but more dangerous. Sibbald has related the effects of a very remarkable strain of the whirlpool called the Orcades, which would prove very dangerous to strangers, though it is of no consequence to the people who are used to it. This is not fixed to any particular place, but appears in various parts of the coast of the sea among those islands. Wherever it appears, it is very furious; and boats, &c. would inevitably be driven in and perish with it; but the people who navigate them are prepared for it, and always carry an empty vessel, a log of wood, or large bundle of straw, or some such thing, in the boat with them; as soon as they perceive the whirlpool, they toss this within its vortex, keeping themselves out; this substance, whatever it may be, is immediately received into the centre, and carried under water; and as soon as this is done, the sur— face of the water, which was before the whirlpool, becomes smooth, and they row over it with safety; and in about an hour they see the vortex begin again in some other place, usually at about a mile distance from the first.}

WHIRLWINDS. This phenomenon is well defined by its name. Its nature may be illustrated by recurring to the same kind of motion in a denser fluid. When water is flowing through an aperture in the bottom of a vessel, we may observe that the meeting of the currents which proceed from all sides towards the opening, gives rise at length to a circular motion just over it; at first confined to a small space, but spreading by degrees, until it occupies a large portion of the surrounding water. At this time, the centrifugal force becomes greater every instant, the water absolutely quits the central space, leaving a hole through it, which, together with the whirlpool, continues to maintain the remaining time of the discharge. Now, as the water descends by its gravity, and the other effect depends on a lateral impulse, given by the most powerful of the confluence streams, and the same effect of the particular tract which appears, is due to the greater falling of the water, the whirlpool being the lateral pressure of surrounding colder and heavier air, may at any time give rise to a whirlwind of greater or less extent and force, according to the quantity of water which has been sucked up, and to a higher station, in order that the equilibrium of the atmosphere may be restored. There is wanted, for this purpose only a sudden impulse from some quarter, sufficient to disturb the uniform motion of the ascending stream. The effects of whirlwinds are sometimes tremendous; not only large quantities of hay, and other light bodies, but even the limbs of trees, the roofs of houses, and other ponderous matters, having been lifted up and carried off by them. Their effects are no where more conspicuous than in the vast plains of sand, so much dreaded by travellers; which, as they have the moving surface of the sand, are enabled to form which we have a good account in Bruce's Travels. Dr. Franklin, in whom sagacity of observation was eminently united with the power of simple and plain description, has left us the following account of the whirlwind, of which he was an eye—witness close at hand.

"Being in Maryland (says the doctor) riding with colonel Parker, and some other gentlemen, to his country—seat, we saw in the vale below us a whirlwind, beginning in the road, and swerving itself by the dust it raised and contained; it appeared in the form of a sugar—loaf, spinning on its point, moving up the hill towards us, increasing as it came forward. When it passed by us, its smaller part, near the ground, appeared no bigger than a common barrel, but widening upwards, it seemed at 40 or 50 feet high, to be 20 or 30 feet in diameter. The rest of the company stood looking after it, but my curiosity being stronger, I followed it, riding close by its side, and observed it lipping up, in its progress, all the dust that was under its smaller part. As it rose, it gained strength, and a shot fired through a water—spout will break it, I tried to break 8
this little whirlwind, by striking my whip frequently through it, but without an effect. Soon after it quitied the road, and took into the woods, growing every moment larger and stronger, raising, instead of dust, the old dry leaves, with which the ground was thick-covered, and muffled the noise with the rustling of the and the branches of trees, bending some tall trees round in a circle swiftly, and very surprizingly; though the progressive motion of the whirlwind was not swift, but that a man on foot might have kept pace with it; but the circular motion was amazingly rapid. By the leaves it was now filled with, I could plainly perceive that the current of air they were driven by, moved upwards in a spiral line; and when I saw the passing whirl which came time entire after leaving the trunks and bodies of large trees which it had enveloped, I no longer wondered that my whip had no effect on it in its smaller state. I accompanied it about 3 of a mile, till some limbs or dead trees, broken off by the whirl, flying about, falling near me, made me more apprehensive of danger; and then I stopped, looking at the top of it, as it went on, which was visible, by means of the leaves coming in it, for a very great height above the trees. Many of the leaves, as they got loose from the upper and widest part, were scattered in the wind; but so great was their height in the air, that they appeared no bigger than flies. My son, who by this time was come up with me, followed the whirlwind till it left the woods, and crossed an old tobacco field, where, finding neither dust nor leaves to take up, it gradually became invisible below, and as it went away over that field. The course of the general wind then blowing along with us as we travelled; and the progressive motion of the whirlwind was in a direction nearly opposite, though it did not keep a straight line; nor was its progressive motion uniform, it making little sallies as it went on either side, proceeding sometimes faster and sometimes slower, and seeming sometimes, for a few seconds stationary; then the other forwards pretty fast again. When we rejoined the company again, they were admiring the vast height of the leaves now brought by the common wind over our heads. These leaves as we travelled, falling now and then round about us, and some not reaching the ground till we had gone near three miles from the place where we saw the whirlwind begin.

WHISPERING-PLACES depend upon this principle: If the vibrations of the tremulous body are propagated through a long tube, they will be continually reverberated from the sides of the tube into its axis, and by that means from spreading, till they get out of it; whereby they will be exceedingly increased, and the sound rendered much louder than it would otherwise be. See Soudria.

Hence it is, that sound is conveyed from one side of a whispering-gellery to the opposite one, without being perceived by those who stand in the middle. The form of a whispering-gellery is that of a segment of a sphere, or a segment of a cylinder.

WHILST, a well-known name at cards, which requires great attention and silence; hence the name. This game is played by four persons, who cut for partners; the two highest and the two lowest are together, and the partners sit opposite to each other; the person who cuts the lowest card is to deal first, strong against none of the other persons, till he comes to the last card, which is turned up for the trump, and remains on the table till each person has played a card. The person on the left-hand side of the dealer plays first, and whoever wins the trick is to play again, the figures going on till all the cards are played out. The ace, king, queen, and knave, of trumps, are called honours; in case any three of these honours have been played between, or by either of the two partners, they reck on for two points towards the game; and if the four honours have been played between or by either of the two partners, they reckon for four points towards the game, the game consisting of ten points. The honours are reckoned after the tricks; all above six tricks reckoning also towards the game.

In Hoyle's Games may be seen the general rules for playing whist, which are too long for insertion here.

WHITING. See GADUS.

WICKLIFFISTS, or WICKLIFFITES, a religious sect which sprung up in England in the reign of Edward III. and took its name from John Wickliff, doctor and professor of divinity in the university of Oxford, who in six principal treatises made the sacramental bread and wine remained unaltered after consecration; and opposed the doctrine of purgatory, indulgences, auricular confession, the invocation of saints, and the worship of images. He maintained that children may be saved without being baptised; that priests may administer confirmation; that there ought to be only two orders in the church, that of priests, and that of deacons. He made an English version of the Bible, and composed two volumes, called Alethia, that is, Truth, from which John Husse learned most of his doctrines. In short, to this reformation we owe the first hint of the reformation which was effected about two hundred years after.

WIDOW, a woman who has lost her husband by death. In London, and throughout the province of York, the widow of a freeman is by custom entitled to her apparel, and the furniture of the bed-chamber, called the widow's chamber.

WIFE. After marriage, all the will of the wife, in judgment of law, is subject to the will of the husband, and it is commonly said a feme covert has no will. See Husband and Wife.

WILDERENCE, in gardening, a kind of grove of large trees, in a spacious garden, in which the walks are commonly made either to intersect each other in angles, or have the appearance of meanders and labyrinths.

Wilderness, says Mr. Miller, should always be proportioned to the extent of the gardens in which they are made; for it is very ridiculous to see a large wilderness planted with tall trees in a small spot of ground; and, on the other hand, nothing can be more absurd, than to see little paltry squares, or quarters of wilderness-work, in a magnificent large garden. As to the situation of wildernesses, they should never be placed too near one another, or so as to obstruct any distant prospect of the country, there being nothing so agreeable as an unconfined prospect; but where, from the situation of the place, the sight is confined within the limits of the garden, or there is any thing unsightly to be concealed, nothing can so well answer the purpose, as a well-designed scene of the various kinds of trees judiciously planted; and if it is so contrived, that the termination is planted circularly, with the concave towards the sight, it will have a much better effect, than if it ends in straight lines or angles. The plants should always be adapted to the size of the plantation; for it is very absurd for tall trees to be planted in the small squares of a little garden; and in large designs small shrubs will have a mean appearance.

As to the walks, those that have the appearance of meanders, where the eye cannot discover more than twenty or thirty yards in length, are generally preferable to all others, and these should now and then lead into an open circular piece of grass; in the centre of which may be placed either an obelisk, statue, or fountain; and, if in the middle of the wilderness there is contrived a large opening, in the centre of which may be erected a dome or banqueting-house, surrounded with a green plot of grass, it will be a considerable addition to the beauty of the whole. From the sides of the walks and openings the view should gradually rise above another above to the middle of the quarters, where should always be planted the largest-growing trees, so that the heads of all the trees may appear to view, while their stems will be hid from sight. Thus those parts which are planted with deciduous trees, roses, honey-suckles, spiras, and other kinds of low-flowering shrubs, may be planted next the walks and openings, and at their feet, near the sides of the walks, with primroses, violets, daffodils, &c., not in a straight line, but so as to appear accidental, as in a natural wood. Behind the first row of shrubs should be planted syringas, bilberries, meadowsweet, and other flowering shrubs of a middle growth; and these may be backed with many other sorts of trees, rising gradually to the middle of the quarters. The plant with evergreens may be disposed in the following manner; the first line next the great walks, may be placed the laevispinus, box, spurge-laurel, jujuber, savin, and other dwarf evergreens. Behind these may be placed larches, box, yews, cypresses, Virginia cedar, and other trees of the same growth; behind these may be planted Norway and silver firs, the true pine, and other sorts of the fir growth; and in the middle should be planted Scotch pines, pinaster, and other of the larger-growing evergreens, which will afford a most delightful prospect, if the different shades of the greens are curiously intermixed.

But beside the grand walks and openings, there should be some smaller walks through the middle of the quarters, where persons may retire for privacy; and by the sides of these private walks may also be scattered some wood flowers and plants, which, if artfully planted, will have a very good effect.

In the general design for these wilderesses, there should be an intermitting correspondence between the several parts; for the greater diversity there is in the distribution of these, the more pleasure they will afford.
WILL AND TESTAMENT, in law. Every person capable of binding himself by contract, is capable of making a will.

Also in the event of a male of 14 years and upwards, and female of 12 years and upwards, are capable of making a will respecting personal estates only.

But a married woman cannot make a will unless her spouse is reserved in her marriage settlement; but wherever personal property, however, is given to a married woman for her sole and separate use, she may dispose of it by will.

If a female sole makes her will, and afterwards marries, such marriage is a legal revocation of the will.

Wills are of two kinds, written and verbal; the former are most usual and secure. It is not absolutely necessary that a will should be witnessed; and a testament of chattels, written in the testator's own hand, though it should have neither the testator's name nor seal to it, nor witnesses present at his publication, will be good, provided sufficient circumstances can be had that it is his handwriting.

Gilb. 260.

By stat. 29 Car. II. c. 3, all devises of lands, and tenements, shall not only be in writing, but shall also be signed by the party so devising the same, or by some other person in his presence, and by his express direction, and shall be witnessed and subscribed in the presence of the person devising, by three or four credible witnesses, or else the devise will be entirely void, and the land will descend to the heir at law.

A will, even if made beyond sea, bequeathing land in England, must be attested by three witnesses. 2 P. Wms. 293.

A will, however, devising copyhold land, does not require to be witnessed; it is sufficient to declare the uses of a surrender of such copyhold land made to the use of the will. The party to whom the land is given becomes entitled to it by means of the surrender, and not by the will. 2 Atk. 37.

A codicil is a supplement to a will, or an addition made by the person making the same, annexed to, and to be taken as part of, the will, with the intention, by way of correction, to add something to, or take something from, the former disposition, and which may also be either written or verbal, under the same restrictions as regard wills.

If two wills are found, and it does not appear which was the former or latter, both will be void; but if two codicils are found, and it cannot be ascertained which was the first, but the same thing is devised to two persons, both ought to divide; but where either wills or codicils have dates, the latter is considered as valid, and revokes the former. See Administrator, Executor, and Legacy.

WILL WITH A WISP, or Jack with a lantern. See Meteor.

WILLICHA, a genus of plants of the common order triandria monogyne. The calyx is four-leaf; corolla ditto; capsule two-celled, many-seeded. There is one species, an annual of Mexico.

WILLUGHBEIA, a genus of plants of the common order triandria monogyne. The corolla is salver-shaped; stigma headed; fruit one or two celled, berry or pumpkin. There are two species, trees of Guiana.

WIND, a sensible current in the atmosphere. The motions of the atmosphere are subject, in a certain degree, to the same laws as those of water. If we remove a portion of the water in a large reservoir, we see the surrounding water flow in to restore the equilibrium. If we impel, in any direction, a certain portion, an equal quantity will move in a contrary direction from the same cause. If a portion, being rarified by heat, or condensed by cold, ascends or descends, a counter-current in another part is the necessary and certain result. It is thus in the atmosphere. No wind can blow without a counter-current in an opposite direction; or arise without a previous destruction of the equilibrium, the general causes of which are:

1. The ascent of the air over certain tracts.
2. Evaporation causing an actual increase in the volume of the atmosphere. 3. Rain, &c., causing an actual decrease in volume by the destruction of the vapour.

Currents thus produced remain general, extending over a large portion of the globe; periodical as in the Indian ocean; or variable, and as it were occasional, or at least uncertain, as the winds in temperate climates. General, permanent winds blow always nearly in the same direction. In the Atlantic and Pacific oceans, under the equator, the wind is almost always easterly; it blows, indeed, in this direction, on both sides of the equatorial line, at the latitude of 20°. More to the northward of the equator, the wind generally blows between the north and east; and the farther north we proceed, we find the wind to blow to a northwestern direction; more to the southward of the equator it blows between the south and east; and the farther towards the south, the more it comes in that direction.

Between the parallels of 28° and 40° south lat, in that tract which extends from 30° west to 100° east longitude from London, the wind is variable, but it most frequently blows from between the N. W. and S. W. so that the outward-bound East India ships generally run down their easting on the parallel of 30° south.

Navigators have given the appellation of trade-winds to these general winds.

Periodical winds. Those winds, which blow in a certain direction for a time, and at certain stated seasons change and blow for an equal space of time from the opposite point of the compass, are called monsoons. During the months of April, May, June, July, August, and September, the wind blows from the southward over the whole length of the Indian ocean, viz. between the parallels of 28° N. and 28° S. lat. and between the eastern coast of Africa and the meridian which passes through the western part of Japan; but in the other months, October, November, December, January, February, and March, the winds in all the northern parts of the Indian ocean shift round, and blow directly contrary to the course they held in the former six months. For some days before and after the change, there are calms, variable winds, and tremendous storms, with thunder, &c.

Philosophers differ in their opinions respecting the natural trade-winds; but a more probable theory of the general trade-winds is, that they are occasioned by the heat of the sun in the regions about the equator, where the air is heated to a greater degree, and consequently rarefied more than, in the more northern parts of the globe. From this expansion of the air in the tropical regions, the denser air, in higher latitudes, rushes violently towards the equator from both sides by this confluence. And in the denser air, without any other circumstances intervening, a direct northerly wind would be produced in the northern tropic, and a southern one in the other tropic; but as the earth’s rotational motion varies the direct influence of the sun on the surface of the earth, and as by that motion this influence is communicated from east to west, an easterly wind would be produced if this influence alone prevailed. On account of the cooperation of these two causes at the same time, the trade-winds blow naturally from the N. E. on the north, and from the S. E. on the south of the line, throughout the whole year; but as the sun approaches nearer to the tropics in the summer season, the point towards which these winds are directed will not be invariably the same; but they will incline more towards the north in that season, and more towards the south in our winter. The land and sea breezes in the tropical climates may be considered as partial inter- ruptions of the general trade-winds; and the cause of these is not very difficult to explain. From the heat of the earth, the water is always of a more even temperature. During the day, therefore, the land becomes considerably heated, the air rarified, and consequently in the afternoon to the west of the sea, which is less heated at that time than the land. On the other hand, during the night the earth loses its surplus heat, while the sea continues more even in its temperature. Towards morning, therefore, a breeze regularly proceeds from the land towards the ocean, where the air is warmer, and consequently more rarefied, than on shore.

The cause of the monsoons is not so well understood as that of the general trade-winds, which has been just remarked, suggests, at least, a probable theory on the subject. It is well known, that at the equator the changes of heat and cold are occasioned by the diurnal variation of the sun, and that the difference of heat between the day and the night is almost all that is perceived in those tropical regions; whereas in the polar regions the great vorticities of heat and cold are occasioned by the continual motion of the globe, which produces the sensible changes of winter and summer; consequently, if the heat of the sun was the only cause of the variation of the winds, the changes, if any, that would be produced by these means in equatorial regions, ought to be diurnal only, but the changes about the pole should be experienced only once in six months. As the effects arising from the heat of the sun upon the atmosphere cannot be greater at the equator than at the poles, the changes of the wind arising from the expansion of the air by the sun’s rays must be more steady in equatorial than in polar regions. The incontrovertible evidence of this truth, that the winds are more variable towards the pole, and more constant towards the equator. But in summer, the continual heat, even in high latitudes, comes to be sensibly felt, and produces changes on the wind, which are distinctly perceptible. In our own cold region
the effects of the sun on the wind are felt during the summer months; for while the weather in that season of the year is fine, the wind generally becomes stronger as the time of the day advances, and dies away towards the evening, and assumes that pleasing serenity so characteristic of India. But in winter, and at the different quarters of the year, the diurnal changes of the wind in northern climates. The annual revolution of the sun produces still more sensible effects. The prevalence of the western winds during summer may contribute to this cause, which is still more perceptible in France and Spain; because the continent of land to the eastward, being heated more than the waters of the Atlantic ocean, the air is drawn, during that season, towards the east, and consequently produces a western wind.

But these effects are much more perceptible in countries near the tropics than with us. For when the sun approaches the tropics of Cancer, the soil of Peria, Bengal, China, and the adjoining countries, becomes much more heated than the sea to the southward of those countries, that the current of the general trade-wind is interrupted, so as to blow from the south to the north, contrary to what it would do if no land was there. But as the high mountains of Africa, during all the year, are extremely cold, the low countries of India, to the eastward of it, become better than Africa in summer, and the air is naturally drawn thence to the eastward. From the same cause it follows, that the trade-wind in the Indian ocean, from April till October, blows in a northeast direction; but the trade-wind in open seas in the same latitude; but when the sun retires towards the tropic of Capricorn, these northern parts become colder, and the general trade-wind assumes its natural direction.

Having given the most obvious causes of the periodical monsoons in the Indian seas, it is necessary to observe, that no monsoon takes place to the southward of the equator, except the ocean around New Holland. There the same causes concur to produce a monsoon as in the northern tropic, and similar appearances take place. From October till April the monsoon sets in from the opposite side of the globe; the general course of the trade-wind on the other side of the Line; and here also the general trade-wind resumes its usual course during the other months, which constitute the winter season in these regions. It may not be improper to conclude this account of the tropical winds, by enumerating some of the principal influences of the monsoons.

Between the months of April and October, the winds blow from the S.W. wind all that part of the Indian ocean which lies between Madagascar and Cape Comorin, and in the contrary direction from October to April, with some small variation in different places; but in the bay of Bengal these winds are neither so strong nor so constant as in the Indian ocean. It must also be remarked, that the S.W. winds in those seas are more southerly on the African side, and more westerly towards India; and the variations are not so great as to be repugnant to the general theory. The cause of this variation is, as was before intimated, that the mountainous lands of Africa are colder than the flatter regions of Arabia and India; consequently the wind naturally blows from those cold mountains in the summer season, towards the warmer lands of Asia, which occasions those inflations of the wind to the eastward during the summer months. The peninsula of India, lying so much farther to the north than Arabia and Persia, adds greatly to this effect; because the wind naturally draws towards them, and produces that easterly variation of the monsoon which takes place in this part of the ocean, while the sandy deserts of Arabia draw the winds more directly northward, near the African coast. A similar chain of reasoning will serve to explain any other inflations or variations that may occur in the perusal of books of travels.

WINDS, variable. In the temperate zones the direction of the winds is by no means so regular as between the tropics. Even in the same degree of latitude we find them often blowing in different directions at the same time; while their changes are frequently so sudden and so capricious, that to account for them is hitherto been found impossible. When winds are violent, and continue long, they generally extend over a large space of land or sea, and affect the climate of regions at a distance. The case is more certainly the case when they blow from the north or east than from any other points. By the multiplication and comparison of meteorological tables, some regular connection between the changes of the atmosphere in different places may in time be observed, which will at last lead to a satisfactory theory of the winds. It is from such tables chiefly, that the following facts have been collected:

In Virginia, the prevailing winds are between the south-west, west, north, and north-west; the most frequent is the south-west, which blows more constantly in June, July, and August, than at any other season. The north-west winds blow most constantly in the month of December, January, and February, they blow from the north, north-west, and west; towards the end of February they change to the south, in which quarter they continue till near the end of March; during the last days in March and in April, they blow from the south-west, and at last from the east; and in this direction they continue during a part of May.

In the Mediterranean the wind blows nearly three-fourths of the year from the north; but there is always an easterly wind in that sea, which is generally more constant in spring than in summer. These observations do not apply to the gut of Gibraltar, where there are seldom any winds except the east and the west.

At Brest, in the island of Cornica, the prevailing wind is the south-west.

In Syria the north wind blows from the autumnal equinox to November; during December, January, and February, the winds which blow from the north-west, they blow from the north, in May from the east, and in June from the north. From this month to the autumnal equinox, the wind changes gradually as the sun approaches the equator, and continues blowing south and west, and at last to the east. At Bagdad, the most frequent winds are the south-west and north-west; at Pekin, the north and the south; at Kamtschatka, on the north-east coast of Asia, the prevailing winds blow from the north.

In Italy, the prevailing winds differ considerably according to the situation of the places where the observations have been made: at Rome and Padua, they are northerly, at Milan easterly. All that we have been able to learn concerning Spain and Portugal is, that on the west coast of these countries, the west is by far the most common wind, particularly in summer; and that at Madrid the wind is north-east for the greatest part of the summer, blowing almost constantly from the Pyrenean mountains. At Berne in Switzerland, the prevailing winds are the north and west; at St. Gothard, the north-east; at Lausanne, the north-west and south.

Father Cotte has given us the result of observations made at 86 different places of France; from which it appears, that along the whole south coast of that kingdom the wind blows most frequently from the north, north-west and north-east; on the west coast, from the west, south-west, and north-west; and on the north coast from the south-west. That in the interior parts of France, the south-west wind blows most frequently in 18 places; the west wind in 14; the north in 13; the south in 6; the north-east in 4; the south-east in 2; the east and north-west each of them one. On the west coast of the Netherlands, as far as Rotterdam, the prevailing winds are probably the south-west, at least this is the case at Dunkirk and Rotterdam. It is probable also, that along the rest of this coast, from the Hague to Hamburgh, the prevailing winds are the north-west, at least these winds are most frequently the case on the Hague and at Franeker. The prevailing wind at Delt is the south-east; and at Breda, the north and the east.

In Germany, the east wind is most frequent at Gottingen, Munich, Weimar, Nuremberg, Dresden, Sigmund, Erford, and at Buda.
WINDS.

| Years of | Winds. | Place. | Westerly. Easterly.
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<td>Liverpool</td>
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<td>9</td>
<td>Branscholm, 56 miles south-west of Berwick</td>
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<td>Camuslang</td>
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<td>8</td>
<td>Hawkhill, near Edinburgh</td>
<td>229</td>
<td>155.5</td>
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Mean: 220.3 144.7

In Ireland, the south-west and west are the grand trade-winds; blowing most in summer, autumn, and winter, and least in spring. The north-east blows most in spring, and nearly double to what it does in autumn and winter. The south-east and north-west are nearly equal, and are most frequent after the south-west and west.

At Copenhagen the prevailing winds are the east and south-east; at Stockholm, the west and north. In Russia, from an average of a register of 16 years, the winds blow from November to April in the following order:

W. N. W. E. S. W. S. N. E. S.
Days 43 26 33 22 29 19 14 12

And during the other six months,

W. N. W. E. S. W. S. N. E. S.
Days 27 27 19 24 22 15 32 18

The west wind blows during the whole year 72 days; the north-west 58; the south-west and north 46 days each. During summer it is calm for 41 days, and during winter for 21. In Norway, the most frequent winds are the south, the south-west, and south-east. The wind at Bergen is seldom directly west, but generally south-west, or south-east; a north-west, and especially a north-east wind, are but little known there.

From the whole of these facts, it appears that the most frequent winds on the coast of Europe are the north-east, north-west, and north-west and north-east; and on the western coast, the south-west: that in the interior parts which lie most contiguous to the Atlantic ocean, south-west winds are also most frequent; but that easterly winds prevail in Germany. Westerly winds are also most frequent on the north-east coast of Asia.

It is probable that the winds are more constant in the south temperate zone, which is in a great measure covered with water, than in the north temperate zone, where their direction must be frequently interrupted and altered by mountains and other causes.

M. De la Caille, who was sent thither by the French king to make astronomical observations, informs us, that at the Cape of Good Hope the main winds are the south-east and north-west; that other winds seldom last longer than a few days; and that the east and north-east winds blow very seldom. The south-east wind blows in most months of the year, but chiefly from October to April; the north-west prevails during the other six months, bringing along with it rain, and tempests. Between the Cape of Good Hope and New Holland, the winds are commonly westerly, and blow in the following order: north-west, south-west, west, north.

In the Great South Sea, from latitude 30° to 40° south, the south-east trade-wind blows most frequently, especially when the sun approaches the tropic of Capricorn; the wind next to it in frequency is the north-west, and next to that is the south-west. From south latitude 40° to 50°, the prevailing wind is the north-west, and next the south-west. From south latitude 50° to 60°, the most frequent wind is also the north-west, and next to it is the west.

Thus it appears that the trade-winds sometimes extend farther into the south temperate zone than their usual limits, particularly during summer; that beyond their influence the winds are commonly westerly, and that they blow in the following order: north-west, south-west, west.

Such is the present state of the history of the direction of the winds. In the torrid zone they blow constantly from the north-east on the north side of the equator, and from the south-east on the south side of it. In the temperate zones they blow most frequently from the south-west; in the south temperate zone from the north-west, changing, however, frequently to all points of the compass; and in the north temperate zone blowing particularly during spring, from the north-east.

As to the velocity of the wind, its variations are almost infinite; from the gentlest breeze, to the hurricane which tears up trees and blows down houses. It has been remarked, that our most violent winds take place when neither the heat nor the cold is greatest; that violent winds generally extend over a great tract of country, and that they are accompanied by sudden and great falls in the mercury of the barometer. The reason appears to be, that violent winds succeed the precipitation in rain of a large quantity of vapour, which previously constituted a part of the bulk of the atmosphere; and this precipitation cannot take place when the general temperature approaches to either extreme. The wind is sometimes very violent at a distance from the earth, while it is quite calm at its surface. On one occasion Lamarti went at the rate of 70 miles an hour, in his balloon, though it was quite calm at Edinburgh when he ascended, and continued so during his whole voyage. The same thing happened lately to Garnier and his companion in their aerostatic voyage to Colchester. This again may be illustrated by the motions of dense fluids, which are always impeded in the parts contiguous to the sides and bottom of the vessels; and the same thing happens in tide-rivers, where the boatman, when he wishes to proceed with the tide, commits himself to the middle of the stream: but when he has to strive against it, he keeps close to the shore. It is, therefore, not the upper parts of the atmosphere which are accelerated, but the lower are retarded by friction against the surface of the earth.

The following table, drawn up by Mr. Smouton, will give the reader a pretty precise idea of the velocity of the wind in different circumstances:
WINDMILL, a kind of mill, the internal parts of which are much the same with those of a water-mill; from which, however, it differs in the absence of a water-wheel and the absence of a stroke of the wind upon its vanes, or sails, which are to be considered as a wheel on the axle.

There are various kinds of windmills. We shall content ourselves with describing the horizontal windmill, the construction of which is not so generally known as that of the others.

Plate Windmill, represents a horizontal windmill erected about 50 years ago at a distillery near Battersea, for grinding malt and corn. AA (fig. 1) is the main shaft, which turns on a gudgeon working in so as to be guided by solid masonry; this shaft has several wheels, as BB, attached to its upper part, as shown in fig. 2, for carrying a great number of float-boards DD, similar to a water-wheel, except being a little conical. This wheel is included in a frame EE, composed of several circular rings, connected by upright timbers, and strengthened by transverse braces, and which has timbers across the top to support the upper part. The wheels are set by a shaft AA, supported by a socket in the frame EE, and the ends, as shown at FF, the boards turn on a centre at the edge nearest the wheel, so that they can be set open, as in fig. 2, or be shut up so as to touch one another, and to allow no air to pass between them.

When the boards FF are set, as in fig. 2, it will be evident, from inspecting the figure, that the wind blow in any direction, it will always enter the building on one side, the other being in such a position that the wind cannot enter, and striking on the floats of the wheel will turn it round. The quantity of wind which strikes the wheel can be regulated by closing or opening the boards FF, all at once, which is done by a contrivance, shown in fig. 3. IIIH represents a plan of a part of the circular sail at the bottom of the frame EE, (figs. 1 and 2); IF are the wind-boards, which move on a centre at the edge of the sail; the boards have levers, GG, nailed to their lower ends, by which they can be turned about on the centre; II are rods, joined to the levers GG, the other ends of which are joined to a circular ring, of which KK is a segment; this ring rests upon rollers fixed in the floor beneath the sails.

When this ring is turned round one way, the rods II push the ends of the levers GG, and close up the boards; on the contrary, when it is turned the other way, it opens them.

The ring K has at one part of its under side a short cast iron segment with cope, which work in a corresponding one fixed to the floor. The axis of this pinion goes through the mill and into the open air, and is connected by ropes with a handle below the ground-floor of the mill.

When the miller turns this handle, it also turns the ring K (fig. 3), and, as before described, opens or closes the boards FF, and regulates the mill's velocity.

The main shaft, AA, has a large cog-wheel, O, fixed upon it, which turns two trundles on the shafts LM, on which the wheels NN are also fixed: each of these wheels turns three pinions, only one of which is represented on the axis of the mill-stones, which are arranged round the wheels NN, at proper intervals, like those described under the article FLOUR-MILL. The shaft LL has a beveled wheel at its upper end, which turns another, m, on the shaft u; which has riggers, as P, fixed on it, and by means of straps turns the bolting-mills; for a description of which see FLOUR-MILL.

With regard to the common windmills, we must observe that a patent has lately been taken out by Mr. Sutton, of Battersea, for a circular contrivance, entitled "A Sketch of the Properties and Advantages of Sutton's Patent Gravitated Sails for Windmills." We refer the reader to the article WIND-SAILS, for a full account of these, we can with pleasure refer to a work entitled "A Sketch of the Properties and Advantages of Sutton's Patent Gravitated Sails for Windmills," by W. S. Hefleden.

WIND-SAILS, in a ship, are made of the common sail-cloth, and are usually between 25 and 30 feet long, according to the size of the ship, and are of the form of a cone when upright. When they are made use of, they are hoisted by ropes to about two-thirds or more of their height, with their basis directed circularly by hoops, and their apex hanging downwards in the hatchways of the ship; above each of these, one of the common parts of the air rushing against it is directed into the wind-sail, and conveyed, as through a funnel, into the upper parts of the body of the ship.

Two-Ton-knife, a windlass, in a ship, are the main double blocks, which, being made fast to the end of a small cable, serve for hoisting goods into the ship, &c.

To WIND, or WEND, a ship, signifies to bring her head about. How wind or winds a ship is a question asked by mariners concerning a ship under sail; signifying as much as, upon what point of the compass does she lie with her head.

WINDWARD, in the sea language, denotes any thing towards that point from which the wind blows in respect of a ship: thus windward is the tide which runs against the wind.

Large Wind. In the sea language, to sail with a large wind, is the same as with a fair wind.

WINDAGE of a gun, mortar, or howitzer. The difference between the diameter of the bore, and the diameter of the barrel or shell.

In England, the great number of the shot supposed to be divided into 20 equal parts, and the diameter of the bore into 21 of those parts. The French divide the shot into 20, and the bore into 27. The Prussians divide the shot into 24, and the bore into 29. The Dutch nearly the same as the English. The general windage of shells in England is a quarter of an inch, let them be large or small, which is contrary to all reason. It is evident, that the less windage a shot or shot should have and true it will go; and having less room to bonsie from side to side, the gun will not be spoiled soon.

It is true that some artillery-officers say, that the windage of a gun should be equal to the thickness of the blade; because, when it has been loaded for a while, the shot will not come out without being loosened thereby, in order to unload it; and when this cannot be done, it must be fixed away, and so lost, but the most advantageous windage would be in dividing the shot in 24 equal parts, and the bore into 23, on account of the convenient scale it affords, not only to construct guns by, but also their carriages. Hence, according to this plan, the windage of a 9-pounder will be 160 of an inch, consequently a sufficient thickness for a blade; and those of a higher calibre become still thicker in proportion; but suppose this thickness is not enough, then, it is a mere trifle, in respect to the advantage otherwise gained.

WINDING STAIRS. See STAIRS.

WINDLASS, or Windlass, a machine used to raise large weights, as guns, stones, &c. See MECHANICS.

WINDLASS, in a ship, is a instrument, in small ships placed upon the deck, just about the foremost. It is made of a piece of timber six or eight feet square, in form of a tree, whose length is placed horizontally upon two pieces of wood at the ends, and upon which it is turned about by the help of handspikes put into holes made for that purpose. This instrument serves for raising goods, or hoisting of any weight in or out of the ship, and will purchase much more than any capstan, and that without any danger to those who have; for if in heaving the windlass about, any of the handspikes should happen to break, the windlass would fall of itself.

WINDOW. See ARCHITECTURE.

WINES. It is known that 10 substances, except such as contain the saccharine principle, except the granulated fermentation, and that in order to be susceptible of it, these saccharine substances must always contain a certain portion of extractive matter; for Lavosier has proved, that sugar cannot ferment, unless there be something obliged to add it to it a quantity of yeast in order to make it undergo this change.

The principles of which yeast consists are oxygen, hydrogen, carbon, and azote. The process of fermentation decomposes them, and gives rise to new products, namely: Water, carbonic acid, alcohol, acetous acid, saccharine residuum, and a residuum of the yeast.

The effects of the vinous fermentation consist, therefore, in separating the sugar, which is an oxide, into two parts; in oxygenating the one, at the expense of the other, to form carbonic acid; in deoxygenating the other in favor of the first, to form a combustible substance termed alcohol; so that was it possible to combine the two substances, the alcohol and the carbonic acid, one might reproduce sugar. It is necessary to remark, that the hydrogen of sugar does not exist in the state of oil in alcohol, being combined with a portion of oxygen, which
renders them miscible with water. These three principles, therefore, the oxygen, the hydrogen, and the carbon, are here in a kind of equilibrium; and, in fact, by making them pass through a red-hot tube of glass or porcelain, we may re-combine them two and two together, and the product will be water, hydrogen, carbonic acid, and carbon.

The analysis of wine commences in the cask, after which it successively deposits tar, lees, and its colouring principle, till at length hardly any thing remains besides alcohol and a small quantity of extractive matter, dissolved in a proportion of water more or less abundant. But this accurate analysis, which exhibits to us the principles of wines in their separate states, throws very little light upon their real nature, a deficiency which we shall endeavour to supply by a more rigorous method of investigation.

We shall distinguish in all wines an acid, alcohol, tartar, an extractive matter, aroma, and a colouring principle; the whole being diluted or dissolved in a smaller or larger proportion of water.

1. The acid. An acid exists in all wines; and we have never met with any in which we could not discover some traces of its presence, as well as the most watery wines, impart a red tinge to blue paper that is kept for some time immersed in them; but all wines are not acid in the same degree. Some wines, a natural acidity is the principal characteristic; those produced from grapes not perfectly ripe, or that grow in most climates, are of this kind; whilst such as are the product of the fermentation of grapes that have attained complete maturity and sweetness, contain but a very small quantity of acid. The proportion of acid appears, therefore, to be in the inverse ratio of the saccharine principle, and consequently of the alcohol, which is produced by the decomposition of the sugar.

This acid exists in great abundance in verjus; it is also found in must, though in less quantity. All fermented liquors, such as cider, perry, beer, and fermented farinaceous substances, contain this acid in a greater or less manner. It is even found in melasses. Indeed, it is only for the purpose of completely saturation it, that fins, ashes, and other earthy or alkaline bases, are used in refining sugar; otherwise the very presence of the acid would impede the crystallization of this salt.

If we concentrate wine by distillation, the extract which remains is in general of a sour pungent taste. Water, or even alcohol, poured upon this extract, will be sufficient to dissolve and raise the acid. This acid has a slightly empyreumatic smell, leaves a bitterish taste in the mouth, &c.

This acid, well filtered and left to stand in a flask, deposits a considerable quantity of extractive matter; it afterwards becomes covered with mould, and seems to approach to the nature of the acetic acid; by distillation it may be purified of a great quantity of the extractive matter, after which it becomes less liable to be decomposed by the putrefactive fermentation.

This acid precipitates the carbonic acid in its combinations; it dissolves most of the metallic salts with facility; forms the insoluble salts with lead, silver, and mercury; and separates the metals from all their solutions by acids.

This acid forms also an insoluble salt with lime. When we mix a large quantity of lime-water with wine, the acid is precipitated from it, and carries with it the whole of the colorizing principle.

This acid, therefore, is of the nature of the malic acid; it is always mixed with a small proportion of nitric acid; for, if it is digested upon the oxide of lead, besides the insoluble precipitate that is formed, a citrate is always produced which can be demonstrated by the known methods.

This malic acid disappears when the wine is converted into vinegar; it no more exists in well-prepared vinegar than it does in the acetic acid. This transformation of the malic acid into acetic acid, affords a natural explanation why that wine which has begun to sour cannot be employed in the preparation of the acetic of bread; in this case an insoluble precipitate is produced.

The existence, in different proportions, of the malic acid in wine, enables us to account for a phenomenon of the utmost importance, relative to the distillation of wines, and the properties of the vinous spirits which result from this process. Every one knows, not only the best but the worst of wine, the proportion of spirit, but likewise that the distilled spirits produced from different kinds of wine differ very widely from each other in their quantities. It is also well known that wines of a sour, pungent, and fermented farinaceous substances, yield but a small quantity of spirit, and that always of a bad quality. Careful and repeated distillations may indeed correct these faults to a certain degree, but they can never take them away altogether. These constant results, from a long course of experience, have been attributed to the superabundance of the extractive matter contained in these weak spirituous liquors; the composition of a portion of this matter, by distillation, seemed to be the immediate consequence, and the acid empyreumatic taste its natural effect. But, upon a more accurate investigation of this phenomenon, it is found that, besides the cause which is operated upon the superabundance of the extractive principle, another ought to be attended to, namely, the presence of the malic acid in almost all these cases.

Those wines which contain the largest proportion of malic acid, afford the worst-conditioned spirit. It appears even that the quantity of alcohol is less in proportion as that of the acid is more considerable. If we separate this acid by means of lime-water, lime, chalk, or some fixed alkali, we can only draw off a very small quantity of alcohol by distillation; and, in every case, the spirit acquires a very sour pungent taste, which does not tend to meliorate its quality.

The difference of the spirits obtained by distillation from different wines, depends, therefore, principally upon the different proportions in which these wines contain malic acid; but no process has been hitherto discovered by which we can with certainty destroy the bad effects which the admixture of this acid with vinous spirits produces.

This acid, which we find in the grape at the utmost period for which they appear in wines till they have completely degenerated into vinegar, ought in preference to be denominated the vinous acid; however, for the sake of avoiding confusion, we shall retain the usual term of malic acid.

2. Alcohol. Alcohol forms the true characteristic of wine. It is the product of the decomposition of sugar, and its quantity is always proportionate to that of the sugar that has been decomposed.

Alcohol abounds more in some wines than it does in others; those of hot climates contain a large quantity of it, whilst those of cold climates contain scarcely any. Ripe and sweet grapes produce it in abundance; but the wines made of grapes that are unripe, watery, and sour, yield very little.

Some wines produced in the southern parts of our hemisphere, yield alcohol in the proportion of one-third of their quantity; whilst many of those manufactured in more northern latitudes contain not more than one-fifteenth. It is the proportion of alcohol contained in them that renders wines more or less generous; and upon the same circumstance depends their disposition or resistance to the acetic fermentation. The less a wine contains of alcohol it turns sour; the proportion of extractive matter contained in it being supposed the same in both cases.

The richer in spirit a wine is, the less it contains of malic acid; and this is the reason why the best wines, in general, furnish the best brandies; as they are then exempt from the presence of this acid, which gives them a disagreeable flavour.

It is by distillation that we extract from wines the whole of the alcohol they contain.

When wines are distilled, the operation is carried on till the liquor which passes over is no longer inflammable.

Wines furnish more or less brandy in proportion to their different degrees of spirituosity. A very generous wine furnishes about a third of its weight: the mean proportion of the brandy, furnished by the wines of the southern provinces of France, is about one-fourth of the whole; some even yield as much as one-third.

Old wines yield better brandy than new ones, but in less quantity, particularly when the decomposition of the saccharine principle has been completely accomplished and subjected to the process of distillation.

That which remains in the boiler, after the brandy has been extracted, is called vinasse; and is a confused mixture of tartar, malic acid, &c. This residuum is generally thrown away as useless; nevertheless, after drying it in the air, or by means of a stove, a tolerably pure alkali may be extracted from it by combustion.

In some distilleries the vinasse is suffered to turn sour, in order afterwards to distill, and extract the small quantity of vinegar that has been formed in it.

Brandy is the more spirituous in proportion as it is mixed with a smaller proportion of water; and as it is of importance in commerce, that we should be able easily to ascertain the degrees of spirituosity, attention is being paid to the means by which this may be performed.

The distiller judges of the spirituosity of brandy by the number, the magnitude, and the permanency, of the bubbles which form themselves upon agitating the liquor. With this view it is customary to pour the vessel into another, or suffered to fall from a certain height, or, which is the more general practice,
WINE.

It is inclosed in an oblong flask, as to fill about two-thirds of the whole, and violently agitated, the mouth of the flask being kept tightly closed with a thickness of the thumb. This last apparatus is called the sound.

The test by combustion, in the manner it is usually practised, is very faulty. The regulation of the year 1799 directs to put gunpowder into a boiler, and, after covering with the lid, apply the pressure of the thumb. The burning must be of good quality if it sets fire to the powder, and bad in the contrary event.

But the same quantity of liquor either does, or does not, set fire to gunpowder, according to the method in which it is employed: a small proportion always does it, and a large one never; for, in the last case, the water contained in the liquid is sufficient to wet the powder, and prevent its taking fire.

Salt of tartar (carbonat of potash) is also employed as a test for brandy. This alkali is soluble in water, but not in alcohol; so that upon dissolving it in brandy, the alcohol swims at the top of the solution.

The defective nature of these processes has rendered it necessary to have recourse to means capable of determining the spirituosity of a liquor by ascertaining its specific gravity.

A drop of oil poured upon alcohol fixes itself upon the surface, or falls to the bottom, according to the degree of spirituousness which the liquor possesses. This method has been adopted and proposed by the Spanish government in the year 1770; but it is subject to inaccuracy, as the effect depends upon the height from which it falls, the weight of the oil, the proportion in which it is employed; and the temperature of the atmosphere, the dimensions of the vessel, &c.

In the year 1772, this important subject was resumed by two able philosophers, namely, Karie and Projet de Cetie, who introduced in Languedoc, an hydrometer, to which they adapted a thermometer, the different degrees of which constantly indicate the corrections requisite to be made in the graduation of the hydrometer, on account of the very variable temperature of the atmosphere. By the aid of this hydrometer, one may not only ascertain the degree of spirituousness, but also bring the brandy to any degree that may be thought necessary.

For this purpose different weights are used, the heaviest of which is marked Holland-proof, and the highest 3—7; so that if we see, at the lower extremity of the scale of the aræometer, Holland-proof, and plunge the instrument into a liquor 3—7, it sinks much too deep; but we may raise it again to the level of Holland-proof, by adding four-sevenths of water.

If, on the contrary, we have the weight 3—7, and plunge the aræometer into a liquor Holland-proof, it will rise in the liquor above this last term, to which it may easily be reduced by adding alcohol of a higher degree of spirituousness.

When brandies are to be distilled for the purpose of extracting their alcohol, the compound bath is usually employed. The heat is then more gentle and equal, and the product of the distillation of a better quality. This is what is called spirit of wine in commerce.

3. The tartar. Tartar exists in verjusce, as also in must; it contributes to facilitate the formation of alcohol, as we have already observed, according to the experiments of Baltis. It deposits itself upon the sides, forming a crust, more or less thick, with crystals of irregular forms. Some time before the vintage, when the casks are to be got ready for receiving the juice, they are stored away in tartar detached from them, in order to be employed in the different uses of commerce.

Tartar is not furnished in equal quantity by all wines; the red wines yield a larger proportion of it than the whites; those of the deepest colour and thickest consistence generally yield the most.

Its colour likewise varies very much; and it is distinguished into white and red tartar, according to the colour of the wines from which it has been deposited.

This salt has little solubility in cold water, but considerably more in boiling water. It scarcely dissolves at all in the mouth, and it resists the pressure of the teeth.

It is deprived of its colouring principle by a simple process, and it is then termed cream of tartar. For this purpose it is dissolved in boiling water, and as soon as the solution is saturated, it is put into a Earthen pot to cool.

In cooling, it deposits a layer of crystals, which are already very nearly deprived of their colour. These crystals are again dissolved in boiling water, and the solution mixed in the proportion of five parts to a hundred, with a sandy argillaceous earth, which is dug at Morveil, near Montpellier. This mixture is evaporated till a pellicle forms upon it; in cooling it deposits white crystals, which, after being exposed for some days to the air, upon cansa, acquire that whiteness by which cream of tartar is distinguished. The original water is preserved in order to be employed in new solutions.

Tartar is purified also by calcination. By this operation its acid is decomposed and destroyed, so that nothing remains besides the alkali and the carbon. The alkali is dissolved in water; and by filtering and evaporating the solution, we obtain the salt well known in pharmacy by the name of salt of tartar, or carbonat of potas.

Tartar furnishes not more than about a fourth part of its weight in crystals. The extractive principle. The extractive principle abounds in must, where it appears to be dissolved by the aid of the sugar: but when the saccharine principle is decomposed by means of fermentation, the quantity of extractive matter sensibly diminishes; a part of it deposits itself in a fibrous form; and this deposit, which principally constitutes the lees, is the more considerable in proportion as the fermentation is more gentle, and the alcohol more abundant. This deposit is always mixed with a considerable quantity of tartar.

There always exists in wine a proportion of extractive matter in a state of dissolution, which may be separated from it by means of evaporation. It abounds more in new wines than in old ones; and the older the wine grows, the more completely is it freed from the extractive principle.

The lees, after being well pressed, are dried in the sand, or in stoves, and then burnt, in order to extract that species of alkali known in commerce by the name of pearl-ashes. The resinum, after the combustion, is a porous mass, of a greenish-grey colour, and forms about a third part of the whole quantity of leaves that have been burnt.

5. The aroma. All natural wines have an odour more or less agreeable to the smell. Some of the latter owe it to volatile substances, either because it is conventions the strong smell of the alcohol, or because it has been destroyed or dissipated by the violent fermentation that was requisite to develop the spirit.

This aroma does not appear to be capable of being extracted and communicated to pleasure to other substances. Even heat seems to destroy it; for, excepting the first liquid that passes over in distillation, which still retains something of the odour peculiar to the wine, the brandy which follows after has only those properties that essentially belong to it.

6. The colouring principle. The colouring principle of wine belongs to the residue of the vegetable ferment, which is left unchanged in fermenting, except when it is kept in a state of ferment, without it, the wine is white. This colouring principle does not dissolve till the alcohol is developed; it is only then that the wine acquires its colour, which is deeper in proportion to the violence of the fermentation.

A portion of the colouring principle deposits itself in the cask, together with the tartar and the lees; and, as the wine grows old, it is not unfrequent to see it entirely lose its colour: the colouring principle then deposits itself in pellicles on the sides or bottom of the cask, and is seen floating in the liquid in the form of films, which injure its transparency.

If we expose bottles filled with wine to the rays of the sun, a few days are sufficient to precipitate the colouring principle in large pellicles; the wine losing neither its perfume nor its strength.

By adding a large quantity of lime-water to wine we precipitate its colouring principle. In this case the lime combines with the malic acid, and forms a salt which appears in light flakes in the liquid. These flakes gradually sink to the bottom, carrying with them the whole of the colouring principle. The deposit is black or white, according to the colour of the wine on which we operate. It frequently happens, that a wine is still susceptible of a new precipitation, although it had been completely discolorated by the first deposit, which proves that the colouring principle has a very strong affinity with the malate of lime. This coloured precipitate is not soluble either in cold or in hot water. Alcohol has scarcely any effect upon it, except that it acquires a slight brownish tinge. The nitric acid dissolves the colouring principle of this precipitate.

When wine is reduced to the state of extract, alcohol purified purifies it of a deep tinge, in the same manner as water does, though not in an equal degree. But, besides the colouring principle which then dissolves itself, there is also a saccharine extractive principle present, which facilitates the solution.
The colouring principle, therefore, does not appear to be of a resinous nature; it exhibits the characteristic of belonging to the numerous class of vegetable products, which approach to the nature of the lees of wine, though without possessing all its properties. The greater number of colouring principles and all topazuline; they are soluble by the action of the extractive matter, and, upon cooling, tend to form a solid form.

**WINE-SPRINT.** A term used by our distillers, and which may seem to mean the same thing with the phrase of spirit of wine; but they are taken in very different senses in the trade.

Spirit of wine is the name given to the common malt spirit, when reduced to an alcohol, or totally inflammable state; but the phrase wine-spirit is used to express a very clean and fine spirit, of the ordinary proof strength, and made in England from wines of foreign growth.

The way of producing it is by simple distillation, and it is never rectified any higher than common bubble-proof. The several wines of different names yield very different proportions, but, in general, the strongest yield one-fourth, the weakest in spirits one-eighth part of proofspirit; that is, they contain from a sixteenth to an eighth part of their quantity of pure alcohol.

**WINNOWING-MACHINES.** Machines of this sort are in pretty general use, where threshing-mills, to which they may be attached, are not erected: they are made on different principles according to particular circumstances. Those contrived by Mr. Cor. of Leicester, or on Mr. Winlow's plan, are good implements, and will dress grain with much dispatch. And there are others which are employed in the northern districts, which are made by Rodgers, that are also upon good and convenient principles; as well as many more in different places which have great merit in their construction, and do their work well and expeditiously. They are made of different sizes, from three to five or six persons will gain last many years when the materials of which they are formed are of a proper kind.

**WINTER.** A genus of plants of the class polymen; and in the natural system arranged under the 12th order, holarabian. The calyx is three-lobed; there are six or twelve petals; there is no style; the fruit is a berry, which is club-shaped as well as the genmer. There are three species, the aromatica, grandis, and ancilla.

Winter aromatic is one of the largest forest-trees upon Terra del Fuego; it often rises to the height of 50 feet. Its outward bark is on the trunk grey and very little wrinkled, on the branches quite smooth and green. The branches do not spread horizontally, but are bent upwards, and form an elegant head of an oval shape. The leaves come out without order, of an oval elliptic shape, quite entire, obtuse, flat, smooth, shining, of a golden yellow; they are softly downy on the upper side of a lively deep-green colour, and of a pale bluish colour underneath, without any nerves, and their veins scarcely visible; they are somewhat narrower near the foot-stalks, and there their margins are bent downwards. In general, the leaves are from three to four inches long, and between one and two broad; they have veined four short football stalks, seldom half an inch long, which are smooth, concave on the upper side, and convex underneath. From the seeds of the old foot-stalks the branches are often tuberculated.

**WIRE.** A piece of metal drawn through the hole of an iron into a thread of a fineness answerable to the hole it passed through. Wires are frequently drawn so fine as to be wrought along with other threads of silk, wool, flax, &c.

The metals most commonly drawn into wire, are gold, silver, copper, and iron. Gold wire is made of cylindrical agosts of silver, covered over with a skin of gold, and thus drawn successively through a vast number of holes, each smaller and smaller; till at last it is brought to a fineness exceeding that of a hair. That admirable ductility which makes gold wire so useful is so small, that no wire other than gold wire is made of it.

Silver wire is the same with gold wire, except that the latter is gilt, or covered with gold, and the former is not.

There are also gold-covered and silver wires: the first made of a cylinder of copper, silvered over, and then covered with gold; and the second of a like cylinder of copper, silvered over, and drawn through the iron, after the same manner as gold and silver wire.

Brass wire is drawn after the same manner, as the former. Of this there are divers sizes, suited to different sorts of works. The finest is used for the heads of musical instruments, as harpsichords, &c.

The pin-makers likewise use vast quantities of brass wire, to make their pins of.

Iron wire is drawn of various sizes, from half an inch to one-eighth of an inch diameter, and even smaller.

The first iron that runs from the stone when melting, being the softest and toughest, is preserved to make wire of. Iron wire is made from bars of iron, called electrode-iron, which are first drawn out to a greater length, and to whatever the thickness of the little finger, at a furnace, with a hammer gently moved by water; one, two, or three pieces are bored round, and put into a furnace to anneal for 12 hours. A pretty strong fire is used for this operation. After this they are laid under water for three or four months, the longer the better; then they are delivered to the workmen, called rippers, who draw them into wire through two or three holes. After this they anneal them again for six hours, and water them a second time for about a week, and then draw them again to the rippers, who draw them into wire of the thickness of large packthread. They are then annealed a third time, and then watered for a week longer, and delivered to the small wire-drawers, called overhouse-men.

In the mill where this work is performed, there are several barrels hooped with iron, on each of which hang two links, which stand across, and are fastened to the two ends of the tonge which catch hold of the wire, and draw it through the hole. The axis on which the tonge runs does not run through the centre, but is placed on one side, which is on which the hooks are placed; and underneath there is fastened to the barrel a spoke of wood, which they call a swingle, which is drawn back a good way by the cogs in the axis of the wheel, and draws back the barrel, which falls to again by its own weight. The tongs hanging on the hooks of the barrel, are by the workmen fastened to the end of the wire, and by the force of the wheel, the hooks being pulled back, draw the wire through the holes. The plate in which the holes are, is iron on the outside, and steel on the inside; and the wire is anointed with train-oil, to make it run the easier.

**WIRE OF LAPLAND.** The inhabitants of Lapland have a sort of shining slender substance in use among them on several occasions, which is made of the thickness and structure of a well-fed hair, yet smaller. They are called by those who do not examine its structure or substance, Lapland wire. It is made of the sinews of the reindeer, which being carefully separated in the eating, are, with the sinew, after sucking the sinews, fastened directly with tin, and being spun, formed into a thread, or small silver, and of admirable fineness and strength, when wrought to the smallest filament; but when longer, is very strong, and fit for the purposes of strength and ornament. Their wire, as it is called, is made of the finest of these threads, covered with tin. The women do this business; and the way they take it is to melt a piece of tin, and placing at the edge of it a horn with a hole through it, they draw these sinews threads, covered with the tin, through the hole, which prevents their coming out too thick covered. This drawing is performed with their teeth; and there is a single piece of bone placed at the top of the horn, and the wire is made flat, so that we always and it rounded on all sides but one, where it is flat.

This wire they use in embroidery their clothes, as we do gold and silver; they often sold it to strangers for the notion of having certain magical virtue.

**WITCHCRAFT.** By 9 G. II, c. 5, no prosecution shall be commenced or carried on against any person for witchcraft, sorcery, enchantment, or conjuration; or for charging another with any such offence.

But if any person shall pretend to exercise or use any kind of witchcraft, sorcery, enchantment, or conjuration, and undertake to tell fortunes, or pretend from his skill or knowledge in any occult or crafty science, to discover where, in what manner, any goods supposed to have been stolen or lost, may be found; he shall be imprisoned for a year, and once in every quarter of that year stand openly on the pillory for an hour; and further shall be bound to 'good behaviour' as the court shall award.

**WITENA-MOT, or WITENA-GEMOT, among the Saxons.** A term which literally signified the assembly of the wise men, and was applied to the great council of the nation, of latter days called the parliamet.
WITHERINGIA, a genus of plants of the class and order triandra monogynia. The corolla is sub-campanulate; calyx very small, four-toothed; perianthium twofold. There is one species, herb of South America.

WITZENIA, one of the plants of the class and order triandra monogynia. The corolla is one-petalled; stigma emarginate; capsule superior. There is one species, herb of the Amazon.

WITTERNAM, in law, a writ that lies where a distress is driven out of the county, and the sheriff cannot make delivery to the party distrained for; in that case this writ is directed to the sheriff, commanding him to take as many of the beasts, or goods, of the party into his keeping, till he make delivery of the first distress.

WITNESS, one who is sworn to give evidence in a cause.

A man is subpoenaed as a witness upon a trial, he must appear in court on pain of 100l., to be forfeited to the king, and 10l. together with damages equivalent to the loss sustained, by the want of his evidence to the party aggrieved.

But witnesses ought to have a reasonable time, that their attendance upon the court may be of as little prejudice to themselves as possible; and the court of king's-bench held, in that notice given in the forenoon to attend the sitting that evening at Westminster was too short a time. Str. 510.

Where a witness cannot be present at a trial, he may, by consent of the plaintiff and defendant, and by a rule of court, be examined upon interrogatories at the judge's chambers, and covered by oath.

No witness is bound to appear to give evidence in a cause unless his reasonable excuse is tendered him, and if he appears till such charge is actually paid him, except he be excused and is summoned to give evidence within the bills of mortality.

WOAD, in botany. See Isatis, and Indigo.

WOLF. See Canis.

WOLFHOLES, in the defence of places, are round holes, generally about two or three feet in diameter at the top, one at bottom, and two a half deep, dug in the front of any work. Sometimes a sharp-pointed stake or two are placed at the bottom, and covered with very thick planks, and green sods; consequently the enemy, on advancing, fall in, and are put into confusion.

WOLFRAM, a ore of tungsten, is found in different parts of Germany, in Sweden, Britain, France, and Spain; and almost constantly accompanied by ores of tin. It occurs both massive and crystallized. The primitive form of its crystals, according to the observations of Mr. Huy, is a rectangular parallelopiped, whose length is 8.06, whose breadth is 5.1, and thickness 4.33. It is not common, however, to find crystals of this perfect form in many cases: the angles, and sometimes the edges, of the crystal are wanting; as, Mr. Huy has shown, to the superposition of plates, whose edges or angles decrease according to a certain law.


WOOL.

greenish globule, and with microcrystalline salt a transparent globule of a deep red.

The specimen of this ore, examined by Messrs. d'Elhuyart, was composed of

- 65 oxide of tungsten
- 22 oxide of manganese
- 13 oxide of iron

Wool.

Another specimen from Puy-les-Mines in France, analysed by Vaquelin and Hecht, contained

- 67 oxide of tungsten
- 18.00 black oxide of iron
- 6.35 black oxide of manganese
- 1.50 silica
- 7.25 oxide of the iron and manganese

100.00

WOMEN. By the 26. G. II. c. 33, no suit shall be had in any ecclesiastical court, to compel a celebration of marriage in large ecclesiary, by reason of any contract of marriage whatsoever, whether per verba de præsentacil, or per verba de futuro: and the marriage of any person under the age of twenty-one, without the consent of parents or guardians, shall be null and void.

By 20. H. VI. c. 9 peers shall be tried as peers for treason or felony.

And by stat. 3 W. c. 9, a woman being convicted of an offence, for which a man may have his clergy, shall suffer the same punishment that a man should suffer, who has the benefit of his clergy allowed; that is, shall be burnt in the land, and further kept in prison until the court shall think fit, not exceeding one year.

But she shall be only once entitled to the benefit of the said statute.

WOOD, a solid substance, wherein the trunks and branches of trees consist. See the articles Tree, Trunk, Branch, Underwood, Plants, physiology of; Timber, &c.

The wood lies immediately under the bark, and forms by the greatest part of the trunk and large branches of trees. It consists of concentric layers, the number of which increases with the age of the part.

Each of these layers, as Mr. Duhamel ascertained, is separate from the others, and these are composed chiefly of longitudinal fibres. Hence the reason that wood may be much more easily split asunder than cut across.

The wood, when we inspect it with attention, is not, through its whole extent, the same: the part of it next the bark is much softer and whiter, and more juicy than the rest, and has for that reason obtained a particular name; it has been called the alburnum or aubier. The perfect wood is browner, and harder, and denser, than the alburnum, and the layers increase in density the nearer they are to the centre. Sir John Hill gave to the innermost layer of wood the name of corona; or rather he gave this name to a thin zone which, according to him, lies between the wood and the pith.

Mortimer observes that all kinds of wood are preserved from insects and from many other occasions of decay, by oily substances, particularly the essential oils of vegetables. Oil of spike is excellent; and oil of juniper, turpentine, or any other of this kind, will serve the purpose; these will prevent tables, instruments, &c. from being eaten by pieces by these vermin; and linseed-oil will serve, in many cases, to the same purpose; probably nut-oil will do also, and this is a sweeter oil, and a better varnish for woods. Some of the West Indian trees afford a sort of timber which, if it would answer in point of size, would have great advantages over any of the European wood in ship-building for the merchant-service, no worm ever touching this timber. The acacan, or tree which produces the cashew-nut, is of this kind; and there is a tree of Jamaica, known by the name of the white wood, which has exactly the same property; and so have many other of their trees.

To season wood expeditiously for sea-service, Mr. Boyle observes, that it has been usual to bake it in ovens.

The art of moulding wood is mentioned by Mr. Boyle as a desideratum in the art of carving. He says, he had been credibly informed of its having been practised at the Hague; and suspects that it might have been performed by some men who that softens the wood, and afterwards allows it to harden again, in the manner that was known; or moulded; or perhaps by reducing the wood into a powder, and then uniting it into a mass with strong but thin glue. And he adds, that, having mixed saw-dust with a fine glue made of isinglass, slightly straining out what was superfluous through a piece of linen, the remainder, formed into a ball, and dried, became so hard as to rebound when thrown against the floor.

The people who work much in wood, and about small works, find a very surprising difference in it, according to the different seasons at which the tree was cut down; and this not regularly the same in regard to all species, but different in regard to each. The button-mould makers find that the wood of the pear-tree, cut in summer, works toughest; holy, on the contrary, works toughest when cut in winter; box is mellowest when it has been cut in summer, but hardest when cut about the Easter; hawthorn works mellow when cut about October, and the service is always tough if cut in summer.

WOOD STAINING.

To stain wood yellow. Take any white wood, and brush it over several times with the tincture of turmeric root, made by putting an ounce of turmeric, ground to powder, to a pint of spirit, and after they have stood for some days, straining off the tincture. If the yellow colour is desired to have a reddish cast, a little dragon's blood must be added.

A cheaper, but less strong and bright yellow is, by the tincture of French berries made boiling-hot.

Wood may also be stained yellow by means of aqua fortis, which will sometimes produce a very beautiful yellow colour, but at other times a browner. Care must be taken, however, that the aqua fortis is not too strong; otherwise a blackish colour will be the result.

To stain wood red. For a bright red stain for wood, take a strong infusion of Brazil wood in stale urine, or in water, coloured with pearl-ashes, in the proportion of an ounce to a gallon; to a gallon of either of which, the proportion of Brazil wood must be
pound, which being put to them, they must stand together for two or three days, often stirring the mixture. With this infusion strained, and made boiling-hot, brush over the wood to be stained till it appears strongly colored; then, while yet wet, brush it over with alum-water made in the proportion of two ounces of alum to a pint of water.

For a less bright red dissolve an ounce of dragon's blood in a pint of spirit of wine, and brush over the wood with the tincture till the stain appears to be as strong as is desired; but this, in fact, rather lacquering than staining.

For a pink or rose red, add to a gallon of the above infusion of Brazil wood two additional ounces of the pearl-ashes, and use it as was before directed: but it is necessary, in this case, to brush the wood over with alum-water. By increasing the proportion of pearl-ashes, the red may be rendered yet paler; but it is proper, when more than this quantity is added, to make the alum-water stronger.

A stain wood blue may be stained blue by means of either copper or indigo.

The method of staining blue with copper is as follows: Make a solution of copper in aqua fortis, and brush it while hot several times over the wood; then make a solution of pearl-ashes in the proportion of two ounces to a pint of water, and brush it over the wood stained with the solution of copper, till it is of a perfectly blue colour.

Dissolve verdigris in vinegar, or crystals of verdigris in water, and with the hot solution brush over the wood till it is duly stained.

To stain wood purple. Brush the wood to be stained several times with a strong decoction of logwood and Brazil, made in the proportion of one pound of the logwood, and a quarter of a pound of the Brazil, to a gallon of water, and boil for an hour or more. When the wood has been brushed over till there is a sufficient body of colour, let it dry, and then be slightly passed over by a solution of one drachm of pearl-ashes in a quart of water. This solution must be carefully used, as it will very much change the colour from a brown red, which it will be originally found to be, to a dark blue purple, and therefore its effect must be restrained to the due point for producing the colour desired.

To stain wood mahogany colour. The substances used for staining mahogany colour are madder, Brazil wood, and logwood: each of which produces reddish brown stains, and they must be mixed together in such proportions as will produce the tint required.

To stain wood black. Brush the wood several times over with a hot decoction of logwood. Then having prepared an infusion of galls by putting a quarter of a pound of powdered galls to two parts of water, and setting them in the sunshine, or any other gentle heat, for three or four days, brush the wood over three or four times with it, and it will be a beautiful black. It may be polished with a hard brush and shoemakers' black wax.

Wood, fossil: whole trees, or parts of them, are very frequently found buried in the earth, and that in different strata; sometimes in stone, but more usually in earth, but sometimes in small pieces loose among gravel. See PETRIFICATION.

WOODCOCK. See the article Scolo-

WOODCOCK-SHELL, in natural history, the varnished yellow purpura, with tuber-
cles, and a long book; and the thorny wood-
cock-shell is the yellow long-beaked purpura, with long and crooked spines.

WOODCOCK-WOOD. See Oniscus.

WOODCOCK-WOOD, or Yellow wood. See the article Scolo-

WOOD, among manufacturers, the threads which the weavers shoot across with an instru-
ment called the shuttle. The wood is of dif-
f erent matter, according to the piece to be wrought. In taffety, both wood and warp are silk. In mohair, the wood is usually wool, and the warp silk. In satins, the warp is frequently flax, and the wood silk.

WOOL, a kind of long, soft, curly hair (see the article Hair), which covers the skin of several of the ruminating animals, but which is particularly cut or torn from that of the sheep, is in such universal use, that we should think it must be one of those animal substances most accurately known; it is, however, only within the last few years, that chemists have occupied themselves with examining it. Formerly, they contented themselves with considering it as diffusing a disagreeable smell when it was burned. As it yields a much richer spirit of ammonia, by dis-
tillation. It had been remarked in common life, that it did not inflame without great dif-
culty, and that it exhaled a very faint smoke, instead of taking a bright flame. Eventually, it was known, that the caustic alkalies easily corroded it, and that it quickly received, and forcibly retained, the colouring matters that were impressed upon it, so that it deserved the first rank amongst the substances to be dyed. It is eminently useful, to which it has been appropriated in a number of arts from time immemorial, has brought all its useful properties to light; but chemis-
try had considered it only under its most gen-
eral relation with all the animal matters, without ascertaining any thing specific in it. Berthollet began to occupy himself particu-
larly with it in 1784 and 1785. He has shewn that the caustic alkali less dissolves and entirely destroys it from this solution; in combination, he has sought the mode of action which the alka-
lies exert upon animal substances, and he has par-
ticularly availed himself of it, for explain-
ing the dyebility which exists between these two matters. In this manner he has especially accounted for the action of the lapis causticus, upon the bodies of the animals. He has, moreover, shown that the wool of wool was difficult to be burned, like that of all the animal compounds; that wool, treated by the nitric acid, afforded azotic gas, and oxalic acid, with a fatty matter. Chap-
tal, applying this solution of wool in the alka-
lies, to the processes of the manufacture of cloth, has represented it as a soap of great utility for these manufactures, and very well adapted for being substituted instead of that which is fabricated with vegetable oil. Wool has, moreover, been considered as a very bad conductor of calor; and upon this principle, it has been explained, bow, by retaining that which exudes from our bodies, it forms the warmest clothing, the best adapted for moder-
ating the severity of the winters. See Hair.

The facts contained in the article to which we refer, will explain all the phenomena, and all the properties which wool presents, in the frequent and advantageous uses to which it is constantly applied. The warmth which it affords as clothing or covering, its imperme-
ability by water, its fine colouration, the durabil-
ity and solidity of its dyes, its destruction by the alkalis, the facility with which grease is removed from the wool, and the elasticity and the best extension of the spots which are formed upon it, even the use which it has, and the functions which it per-
forms upon the bodies of those animals which are covered with it, and from which we take it in order to clothe ourselves; the adherent hair of the cat and fowl oil; the exudation with which it is impregnated upon the bodies of sheep; the manner in which it defends them against the rain and the water, which are so hurtful to it; its slow combustion; the yellowness and loss of tenacity that are produced in it by long exposure to the air: in a word, all that appertains to its characters, its formation, its use, its so various properties, its destruction, becomes clear and easily conceivable by the distinct determination of its nature, and of its composition.

WOOD, either in a raw or manufactured state, has always been the principal of the materials used in manufacture. The price of wood was in very early times much higher in proportion to the wages of labour, the rent of land, and the price of butcher's meat, than at present. It was before the time of Edward III., always exported raw, the art of working it into cloth and dyeing being so imperfectly known, that no persons above the degree of working people could go dressed in cloth of English manufacture.

The first steps taken to encourage the manufacture of woollen cloths was by Edward the Third, who procured some good workmen from the Netherlands by means of protection and encouragement. The value of wood was considered as so essentially solid, that taxes were voted in that commodity, reckoning by the number of sacks, and in proportion to the price of the necessaries of life and value of silver, wool was at least three times dearer than it is now. The manufacturing of cloth was everywhere within a few years, the policy of preventing the exportation of the raw material was soon evident; and the first act, was that of H. IV. c. 2, by which the exportation of sheep, lambs, or rams, is forbidden under heavy penalties.

By stat. 28. Geo. III. all former statutes respecting the exportation of wool and sheep are repealed, and numerous restrictions are consolidated in that statute.

By this act, if any person shall send or re-
cive any sheep on board any vessel, to be carried out of the kingdom, such vessel shall be forfeited, and the person so offending shall forfeit 3l. for every sheep, and suffer solitary imprisonment for three months. But when sheep, by a licence from the collector of the customs, may be taken on board for the use of the ship's company; and every person who shall export any wool, or woollen articles slightly made up, so as easily to be reduced again to wool, or any fuller's earth or tobaco-
pipe clay, and every carrier, ship-owner, com-
mander, mariner, or other person, who shall knowingly assist in exporting, or at-
tending to export, these articles, shall forfeit three shillings for every pound weight, or the sum of 50l. in the whole, at the election of the prosecutor, and shall also suffer solitary imprisonment for three months. But wool
may be carried coastwise upon being duly entered, and security being given according to the directions of the statute, to the officer of the port whence the same shall be conveyed; and the owners of sheep within five miles of the sea, and two miles in Kent and Sussex, cannot remove the wool; without giving notice to the officer of the nearest port, as directed by the statute.

WOollen Cloth, interment in. By 30 G. II. c. 3. (an act which is required to be given in charge at the assizes and sessions, and to be read four times publicly each year in the church by every person,) no corpse of any person (except of those who die of the plague) shall be buried in any shirt, shift, sheet, or shroud, or any thing made or mingled with flax, hemp, silk, hair, gold, or silver, or in any stuff or thing not made of sheep's wool only; or be put into any coffin lined or faced with any sort of clothier-stuff, or any other thing, made of any other material than sheep's wool only, under penalty of $L. to be recovered by distress and sale of the goods and chattels of the party deceased.

Woot-cloths. By 33 G. III. c. 104, all those who have served an apprenticeship to the trade of a wool-comber, or who are by law entitled to exercise the same, and also their wives and children, may set up and exercise such trade, or any other trade or business they are apt and able for, in any town or place within this kingdom, without any molestation; nor shall they be removable from such place by the poor laws.

The singular, signifies signal, token; for, as watch-word, &c.

The Word, is a peculiar word that Watch Word, serves for a token and mark of distinction, given out in the orders of the day in times of peace, but in war every evening in the field, by the general who commands, and in garrison by the governor, or other officer commanding in chief, to prevent surprise, and hinder an enemy, or any treacherous person, from passing backwards or forwards. This watch-word is generally called the parole, and to it is added the countersign. The first is known to all officers and non-commissioned officers; the latter only to the sentinel and such guards that go to the rounds, or patroles, exchange the word with the officers on duty; nor must the sentinels let any one pass who has notgot the countersign.

Words of command, certain terms which have been adopted for the exercise and movement of military bodies, according to the nature of each particular service. Words of command are classed under two principal heads, and consist of those which are given by the chief of command, that is, by a general, or division, or division of, and those which are uttered by the subordinate leaders of troops, &c.

WORD, in language, an articulate sound, representing some idea or conception of the mind.

The copiousness of the English language is proved by the following enumeration of the words in Johnson's Dictionary:

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<th>Category</th>
<th>Words</th>
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</thead>
<tbody>
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<tr>
<td>Adjectives</td>
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<td>41</td>
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<tr>
<td>Verbs</td>
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In the military sense, signifies signal, token; for, as watch-word, &c.

Verbal noun

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<td>1000</td>
<td>36</td>
<td>48</td>
<td>80</td>
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</tbody>
</table>

It must be remarked, however, that in this list many of the compound words are not reckoned; that the participles are those only having no verbs to which they may be referred, as behold; though so few verbal and participal nouns are stated by Johnson, yet every active verb may supply one of the former description, and every verb one of the latter; and that both these (verbal and participal nouns) seem to be merely different applications of a true gerund.

WORDS, which may be taken or interpreted by law in a general or common sense, ought not to receive a strained or unusual construction; and ambiguous words are to be construed so as to make them stand with law and justice, and not to be wrested to do wrong.

WRECK, is a judicial writ that issues out of the sheriff, upon a judgment by default, in action of the case, covenant, trespass, trover, &c; commanding him to summon a jury to inquire what damages the plaintiff has sustained occasioned by the original is returned, after the suit begins. The original bear date in the name of the king; but the judicial writs bear teste in the name of the chief justice.

WRIT of Asssistance, issues out of the exchequer, to authorize any person to take a constable, or other public officer, to seize goods or merchandise prohibited and uncustomed. It is also a writ issuing out of the chancey, for the summoning a defendant to appear, and are granted before the suit is begun, to begin the same; and judicial writs of this sort cannot be quashed till the original is returned, after the suit begins. The original bear date in the name of the king; but the judicial writs bear teste in the name of the chief justice.

WRIT of Assistance, issues out of the exchequer, to authorize any person to take a constable, or other public officer, to seize goods or merchandise prohibited and uncustomed.

WURMBA, a genus of plants of the class and order Dianthrea monogynia. The corolla is tubular, ligulate, with the upper lip small, the lower lip three-lobed, the outer lobe five-parted, the inner lobe two-parted, the tube four-valved. There is one species, herb of Carinthia.
X or x, the twenty-second letter of our alphabet. In numerals it expresses 10, whence in old Roman manuscripts it is used for denarius; and as such seems to be made of two V's placed one over the other. When a dash is added over it, thus X, it signifies ten thousand.

XANTHELE, a genus of plants of the class and order dioecia syngenemia. The flowers are dioecious; the calyx five-parted; corolla 5-6-petalled. There are two species, shrubs of Guatemala.

XANTHIB, a genus of plants of the class monocotyledon, order pentandria, and arranged in the natural classification under the 49th order, composita. The male flowers are composite, common calyx, fructified; corolla monopetalous, tubular, quinquelocular. Female: calyx involucre of two leaves, containing two flowers; corolla 0; drupa dry, prickly; nucleus bilocular. There are five species, only one of which is a native of Britain, the strumarium or less burdock. The stem of this plant is a foot and a half high, thick, often spotted; leaves heart-shaped, lobed, on long footstalks. Flowers, male and female, many together, in the axil of the leaves. The leaves are bitter and astringent. A decoction of the whole plant affords a showy yellow colour, but it is better if only the flowers are used. Horses and goats eat it; cows, sheep, and swine, refuse it.

XANTHIONYX, a genus of plants of the class and order pentandria polypogonia. There is no calyx; the petals five; nectaries five, pedicelled; capsules five, one-seeded. There is one species, a shrub of North America.

XANTHORZA, a genus of plants of the class and order pentandria polypogonia. There is no calyx; the petals five; nectaries five, pedicelled; capsules five, one-seeded. There is one species, a shrub of Jamaica.

XANTHEUM, a genus of the syn-

genesia polypogonia superful class of plants; the compound flower of which is unequal, and consists of many tubulous hermaphrodite floscles placed on the disc, and also a few female tubulolated ones on the verge; the seeds are oblong, coronated, and contained in the cup. There are twenty-seven species.

XIMENIA, a genus of plants of the class and order pentandria monogyne. The calyx is perianthium, composed of a small, corollated, and deciduous leaves; the corolla is formed of four petals, of a campanulate figure, divided at the edge into three erect, oblong, obtuse segments; the germen is small, and of a suboval figure; the fruit is an oval drupe, containing a cell; the seed is oval, microlocular, and smooth. There are three species, trees of the West Indies.

XIPHIAS, in zoology, the sword-fish, a genus of fishes belonging to the order of apodes. The upper jaw terminates in a long sword-shaped rostrum, from which it is called the sword-fish: there are no teeth in the mouth; the gill membrane has eight rays; and the body is somewhat cylindrical. There is but one species, viz. the gladius, found in the European ocean. This fish sometimes attains a length of one-third of a mile; and as occasion in the Mediterranean sea, especially in the part that separates Italy from Sicily, which has been long celebrated for it: the promontory Pelorus, now Capo di Faro, was a place noted for the resort of the vigiles, and possibly the station of the speculatores, or the person who watched and gave notice of the approach of the fish.

The ancient method of taking them is particularly described by Strabo, and agrees exactly with that practised by the moderns. A man ascends one of the cliffs that overhang the sea; as soon as he spies the fish, he gives notice, either by his voice or by signs, of the course it takes. Another, that is stationed in a boat, climbs up the mast, and on seeing the sword-fish, directs the rowsers towards it. As soon as he thinks they are got within reach, he descends, and taking a spear in his hand, strikes it into the fish; which, after wearying itself with its agitation, is seized and drawn into the boat. It is usually esteemed by the Sicilians, who buy it up eagerly, and at its first coming into season, give about six-pence English per pound. The season lasts from May till August. The antients used to cut this fish very fine, and called Tomus Thurianus, from Thuris, a town in the bay of Tarentum, where it was taken and cured.

The sword-fish is said to be very voracious, and that it is a great enemy to the tuna, who (according to Belon) are as much terrified at it as sheep are at the sight of a wolf. It is a great enemy to the whales, and frequently destroys them.

XIPHYDIDUM, a genus of plants of the class and order triandria monogyne. This corolla is scapellated, equal; capsules superior, three-celled, many-seeded. There is one species, a herb of the West Indies.

XYLO ALOES, or ALO-WOOD, in pharmacy. See Excercaria.

XYLOGCARUS, a genus of plants of the class and order octandria monogyne. The calyx is four-toothed; the corolla four-petalled; nectaries eight-cleft; filaments inserted in nect. drupes four or five-grooved; nuts eight or ten. There is one species, a tree of the East Indies.

XYLOLUM, a genus of plants of the class and order tetrandria monogyne. The ament, is with a simple scale; petals four, staminuliferus; stigma club-shaped, obtuse. There is one species, of no note.

XYLOPHYLLA, a genus of plants of the class and order polyanthra trigrina. The calyx is five-toothed, coloured; corolla none; one stigma, jagged; capsule three-celled; seeds two. There are seven species, shrubs of the West Indies.

XYLOFLA, a genus of plants of the class and order polyanthra polygynia. The calyx is three-leaved; petals six; capsule one or two seeded, four-cornered, two-valved; seeds arilled. There are three species, trees of the West Indies.

XYLOSMA, a genus of plants of the class and order dioecia polyanthra. The calyx is four or five parted; corolla none; male stamnia twenty to fifty; female style scarcely any; stigma trifid; berry dry; seeds two, three-seeded. There are two species.

XYRIS, a genus of the triandria monogyne class of plants, the flower of which consists of three plain, patent, large, crested petals, with narrow unguis, of the length of the cup. The fruit is a roundish, triloclar, trivalvular capsule, within the cup, with a great number of very small seeds. There are three species.

Y.

Y, the twenty-third letter of our alphabet. Y is a numeral, signifying 150, or according to Baronius, 159; and with a dash at top, as Y, it signified 150,000.

YACHT: This word is taken from the Dutch, from the Yacht, a small boat with one deck, carrying four, eight, or twelve guns, and thirty or forty men. Yachts, in general, are from thirty to 160 tons; contrived and adorned both withside and without, for carrying state pageants, etc. They answer the purposes of business as well as pleasure, being remarkably good sailers.

YARD. See Measure.

YARDS of a ship, are those long pieces of timber which are made a little tapering at each end, and are fitted each athwart its proper mast, with the sails made fast to them, so as to be hauled up, or lowered down, as occasion serves. They have their names from the masts to which they belong. As for the length of the main-yard, it is usually five-sixths of the length of the keel, or six-sevenths of the length of the main-mast. Their thickness is commonly three quarters of an inch for every yard in length. The length of the main-top-yard is two-thirds of the main-yard; and the fore-yard four-fifths of it. The spitsail-yard, and cross-sails yard, are half the main-yard; and the thick-knives, or the main-yard and spitsail-yard is half an inch for every yard in length. All small yards are half the great yards from cleat to cleat. When a yard is down a portail, it gives the length of all top-sail sheets, lifts, ties, and bunt-lines, as also of the leech-lines and halliards, measuring from the hounds to the deck; and when it is hoisted, it gives the length of clew-linens, clew-garnets, braces, tackles, sheets, and bow-lines.

There are several sea-terms relating to the management of the yard; as square the rounds, that is, see that they hang right across the ship, and no yard-arm traversed more than another; top yard, that is, make them stand even. To top the main and foreyards, the clew-linens are the most proper;
YAR

YAR, in the full extent of the word, is a system or cycle of several months, usually 12. Others define year, in the general, a period or space of time, measured out by the revolution of some celestial body in its orbit. In the heavens, the stars make but one revolution, is called the great year; and the times in which Jupiter, Saturn, the Sun, Moon, &c. complete their courses, and return to the same point of the zodiac, are respectively called the years of Jupiter and Saturn, and the solar and lunar years, &c.

As year denoted originally a revolution, and was not limited to that of the Sun; accordingly we find by the oldest accounts, that people have, at different times, expressed other revolutions by it, particularly that of the Moon; and consequently that the years of some accounts, are to be reckoned only months, and sometimes periods of 2, or 3, or 4 months. This will help us greatly in understanding the accounts that certain nations give of their own antiquity, and perhaps of the age of men. We read expressly, in several of the old Greek writers, that the Egyptian year, at one period, was only a month; and in another, it was a period of 3 months, or four months; and it is probable that the children of Israel followed the Egyptian account of their year. The Egyptians talked, almost 2000 years ago, of having accounts of events, 43,000 years distant. A great deal must be allowed to fallacy, on the above account; but beside this, the Egyptians had, in the time of the Greeks, the same ambition which the Chinese have at present, in which the fixed stars upon which people, as these do upon us, for the oldest inhabitants of the earth. They had recourse also to the same means; and both the present and the early impostors have pretended to ancient observations of the heavenly bodies, and recounted eclipses in particular, to vouch for the truth of their accounts. Since the time in which the solar year, or period of the earth's revolution round the Sun, is to be reckoned with certainty; but for those remote ages, in which we do not know with certainty what is meant by the term year, it is impossible to form any conjectures of the duration of time. The Egyptians pretend to an antiquity of the same romantic kind; they talk of 47,000 years in which they had kept observations; but we may judge of these as of the others, and of the observations as of the years. The Egyptians speak of the stars having four times altered their courses in that period which they claim for their history, and that the Sun set twice in the east. They were not such perfect astronomers, but, after a roundabout voyage, they might perhaps mistake the east for the west when they came in.

Year, or solar year, properly, and by way of eminence so called, is the space of time in which the Sun moves through the twelve signs of the ecliptic. This, by the observations of the best modern astronomers, contains 365 days, 5 hours, 48 minutes, 48 seconds; the quantity assumed by the authors of the Bible, and by all nations with regard to their periods, upon which the division is founded. By this, the various forms of civil years that have formerly obtained, or that do still obtain, in different nations, are to be examined. Civil year is that form of year which every nation has contrived or adopted, for compu-
ing their time by. Or the civil is the tropical year, considered as only consisting of a certain number of whole days; the odd hours and minutes, aside, to render the computation of time, in the common occasions of life, more easy. As the tropical year is 365 days, 5 hours, 49 minutes, or almost 365 days, 6 hours, which is 356 days and a quarter; but if the civil year is made 365 days, every fourth year it must be 366 days, to keep nearly to the course of the sun. And hence the civil year is either common or bissextile. The

Common civil year, is that consisting of 365 days; having seven months of thirty-one days each, four of thirty days, and one of twenty-eight days; as indicated by the following well-known memorial verses:

Thirty days hath September, April, June, and November;
February twenty-eight alone,
And all the rest have thirty-one.

Bissextile or leap-year, consists of 366 days, having one day extraordinary, called the intercalary, or bissextile day, which takes place every fourth year. This additional day to every fourth year, was first introduced by Julius Caesar; who, to make the civil year keep step with the tropical year, contrived that the six hours which the latter exceeded the former, should make one day in four years, and be added between the 23rd and 24th of February, which was their sixth of the calends of March; and so they then counted this day twice over, or had six sexto calenda, hence the year itself came to be called bis sextus, and bissextile.

Among us, however, the intercalary day is not introduced by counting the 23rd of February twice over, but by adding a day at the end of that month, which therefore in that year contains 29 days.

The civil or legal year, in England, formerly commenced on the day of the anunciation, or 25th of March; though the historical year began on the day of the Circumcision, or 1st of January; on which day the German and Italian year also begins. The part of the year between these two terms was used by the ancients both ways; as 1745, or 1744. By the act for altering the style, the civil year now commences with the 1st of January.

Antient Roman year. This was the lunar year, which, as first settled by Romulus, contained only ten months, of unequal numbers of days, in the following order: viz.

March 31, April 30, May 31, June 30, Quintilis 31, Sextilis 30, September 30, October 31, November 30, December 30, in all 304 days, which came short of the tropical lunar year by 50 days, and of the solar by 61 days. Hence the beginning of Romulus's year was vague, and unfixed to any precise season; to remove which inconvenience, that prince ordered so many days to be added yearly as would make the state of the heavens correspond to the first month, without calling them by the name of any month.

Numa Pompilius corrected this irregular constitution of the year, containing two new months, January and February, not belonging to the days that were used to be added to the former year. Thus Numa's year consisted of twelve months, of different days, as follow; viz.

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This is in effect a solar year, commonly containing 365 days; though the civil year, is called bissextile, it contains 366. The months of the Julian year, with the number of days in each, are as follows:

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This is called the Gregorian, or New Style, and the Julian, or Old Style.

As the Egyptian year, by neglecting the 6 hours, in every 4 years loses a whole day of the Julian year, its beginning runs through every part of the Julian year in the space of 1460 years; after which, they meet again, for which reason it is called the erratic year. And because this return to the same day of the Julian year, in the space of 1460 Julian years, this circle is called the Sothic period.

This year was applied by the Egyptians to civil uses, till Anthony and Cleopatra were defeated; but the mathematicians and astronomers used it till the time of Ptolomy, who made use of it in his Almagest; so that the knowledge of it is of great use in astronomy, for comparing the ancient observations with the modern.

The antient Egyptians, we are told by Diodorus Siculus, measured their years by the course of the moon. At first they were only one month, then 3, then 4, like that of the Arcadians; and then 6, like that of the people of Arcamania. Those authors add, that it is on this account that they reckon a vast number of years from the beginning of the world; and that in the history of their kings, we meet with some who lived 1600 or 1200 years. By such means many account for the great ages of the ancient patriarchs; expounding the gradual decrease in their ages, by the successive increase of the numbers.
although with some alteration; for they still retained their ancient months, with the five additional days; and every fourth year they intercalated, for the 6 hours, at the end of the year, or between the 28th and 29th of August. Also, the beginning of their year, or the first day of the month Thoth, answered to the 29th of August of the Julian year, or to the 29th if it happened to be leap-year.

The ancient Greek year, was a lunar year, consisting of 12 months, which at first had each 30 days, then alternately 29 and 30 days, corresponding to the first appearance of the new moon; with the addition of an embolic month of 30 days, every 3d, 5th, 7th, 11th, 14th, 16th, and 19th year of a cycle of 19 years; in order to keep the new and full moons to the same terms or seasons of the year.

Their year commenced with that new moon which was nearest to the summer solstice. And the order of the months, with the number of their days, were as follows: 1. Apros; 2. Bounymus; 29 of 29 days; 3. Hahase; 4. Mascaram; 5. Jornada; 6. Sabat; 7. Ty; 8. Rabia; 9. Tisri; 10. Jacatil; 11. Di mel; 12. Assirer.

The Athenian, Macedonian, and Turkish year, called also the year of the Hegira, is a lunar year, equal to 334 days, 8 hours, 48 minutes, and consists of 12 months, containing alternately 30 and 29 days; although sometimes it contains 13 months; the names &c. being as follows: 1. Muharram of 30 days; Saphar 29; Rabia 30; 4. Latt-er Rabia 29; 5. Jomada 30; 6. Lutter Jomada 30; 7. Rajab 30; 8. Shaaban 29; 9. Ramazan 30; 10. Shwav; 11. Dulkahat 30; 12. Dhulhijja 29, in the embolic month 30. An intercalary day is added every 2d, 5th, 7th, 10th, 13th, 16th, 18th, 21st, 24th, 29th, 30th, in a cycle of 29 years. This day is reckoned from the first appearance of the new moons after the conjunction.


YEADEGERDIC YEAR. See Persian Year.

YEAR and DAY, it is a time that determines a right in many cases; and in some works an usurpation, and in others a prescription; as in case of an estray, if the owner, proclamation being made, challenges it not within the time, it is forfeited.

No is the year, and day a day given in case of appeal; in case of descent after entry or claim, if no claim upon a fine or writ of right at the common law. So of a villain remaining in ancient demesne; of a man sore bruised or wounded; of protections; essuins in respect of the king's service; of a wreck; and divers other cases. Co. 6. Rep. Foi. 107.

YEAR BOOKS, reports in a regular series, from Ed. II. inclusive, to the time of Henry VIII., which were taken by the prothonotaries of the court, at the expense of the crown, and published annually.

YEAR DAY and WASTE, is a part of the king's prerogative whereby he challenges the profits of their lands and tenements for a year and a day, that are attainted of petty treason or felony; whoever is lord of the manor where the lands or tenements belong; and not only so, but in the end may waste the tenements, destroy the houses, root up the woods, garden, and pasture, and plough up the meadows, except the lord of the fee agrees with him for redemption of such waste, after having 20 days' notice, or the lord of the fee. Stann. Probat. c. 16.

YEARS, estate for. Tenant for term of years, is where a man lets lands or tenements to another, for a certain term of years agreed upon between the lessor and lessee; and when the lessee enters by force and the lessor is at the time to be liable, then he is tenant for term of years. Litt. Sect. 38.

If tenements are let to a man for the term of half a year, or for a quarter of a year, or any less, it is not for a certain term for years, and is styled in some legal proceedings, a year being the shortest term, which the law in this case takes notice of. Litt. Sect. 67.

Generally, every estate which must expire at a period certain and prefixed, by whatever words created, is an estate for years; and therefore this estate is frequently called a term; because its duration or continuance, is bounded, limited, and determined. 2 Black. 143.

For every such estate must have a certain beginning, and certain end. If no day of commencement is named in the creation of this estate, it begins from the making, or delivery of the lease. A lease for so many years as such an one shall live, is void from the beginning; for it may determine sooner, or it can ever be reduced to a certainty, during the continuance of the lease. Id.

And the same doctrine holds, if a person makes a lease of his glebe for so many years as he shall continue parson of such a church, for this is still more uncertain. But a lease for twenty or more years, if the parson shall so long live, or if he shall so long continue parson, is good; for there is a certain period fixed, beyond which it cannot last, though it may determine sooner, on the parson's death, or his ceasing to be parson there. 2 Black. 143.

An estate for years, though ever so many, is inferior to an estate for life. For an estate for life, though it should be only for the life of another person, is a freehold; but an estate, though for a thousand years, is only a chattel, and reckoned part of the personal estate. Id.

Hence it follows, that a lease for years may be made to continue in futuro, though a lease for life cannot. As if I grant lands to one from Michaelmas next for twenty years, this is good; but to hold from Michaelmas next for the term of his natural life, is void. 2 Black.

For no estate of freehold can commence in futuro, because it cannot be created at common law without livery of seisin, or corporal possession of the land; and corporal possession cannot be given of an estate now, which cannot commence now, but hereafter. And because no livery of seisin is necessary for a lease for years, such a lessee is not said to be seized, or to have true legal seisin of the lands. Nor indeed does the bare lease vest any estate in the lessee, but only gives him a right of entry on the tenement, which right is called his interest in the term; but when he has actually so entered, and thereby accepted the grant, the estate Michaelmas next vested in him; and he is possessed, not properly of the land, but of the term of years, the possession or seisin of the land remaining still in him who has the freehold. 2 Black.

YELLOW. See DOLPHIN-HAMMER. See EMERIZA.

YEMAN, is defined to be one that has fee land of 40/- a year; who was thereby hereafter qualified to serve on juries, and
can yet vote for knights of the shire, and do any other act where the law requires one that is probus et leges homo. Below yeomen are ranked tradesmen, artificers, and labourers. 2 Inst. 668.

Yeoman of the guard, one belonging to a sort of foot guards, who attend at the palace. The yeomen were uniformly required to be six feet high. They are in number 100 on constant duty, and 70 off duty. The one half carry arquebuses, and the other pertas. Their attendance is confined to the sovereign's person, both at home and abroad. They are clad after the manner of king Henry VIII.

The yeomen of the guards were anciently 250 men of the next rank, under gentry. This corps was first instituted by king Henry VII, anno 1466.

YEST, YEAST, or BARM, a head or scum, rising upon beer or ale, while working or fermenting in the vat. See Fermentation.

YOK, or Yoke, in agriculture, a frame of wood, fitted over the necks of oxen whereby they are coupled together, and harnessed to the plough. See Plough.

It consists of several parts: as the yoke, properly so called, which is a thick piece of wood, lying over the neck; the bow, which compasses the neck about; the stirrups and forwarding, which hold the bow fast in the yoke; and the yoke-rings and ox-chain.

The Romans made the cannon they subdue, pass under the yoke, which they called sub jugum mittere, that is, they made them pass under a sort of furca pustulare, or gallow, consisting of a piece of iron or some weapon, laid across two others, planted upright in the ground.

YORK. In the county of York, only one panel of 48 jurors shall be returned to serve on the grand jury at the assizes; and at the quarter-sessions not above 40, either upon the grand jury or other service there. 7 and 8 W. III, c. 32.

And no person having 100l. a year, shall be summoned to the sessions, but only persons less liable to bear the expense of attending at the assizes. 1 Anne, c. 13.

By stat. 4 W. III, c. 2, the inhabitants of the province of York, have power to dispose of the crown's estate by will which before they had not, further than the testator's own proportionable part, called the dead man's or death's part. For if the testator had a wife, and a child, or children, the wife should have one third, the child or children another third, and the remaining third was all that the testator had to dispose of. If he had a wife and no child, then she should have one moiety, and the other moiety remained to him to dispose of by his testament; so if he left a child or children, and no wife. But if he had neither wife or child, he might dispose of the whole. In case of intestacy, the same proportion continue to the wife and children to this day; but the dead man's part shall be distributed according to the stat. 22 and 23 Car. II, c. 10, commonly called the statute of distributions.

YTRIA. Some time before 1788, Captain Arhenius discovered in the quarry of Ytterby in Sweden, a peculiar mineral different from all those described by mineralogists. Its colour is greenish-black, and its fracture like that of glass. It is magnetic, and generally too hard to be scratched by a knife. If it is opaque, except in small pieces, when it transmits some yellow rays. Its specific gravity is 4.237. Professor Gadolin analysed this mineral in 1794, and found it to form a new earth; but though his analysis was published in the Stockholm Transactions for 1794, and in Cleel's Annals for 1796, it was some time before it drew the attention of chemical mineralogists. The conclusions of Gadolin were confirmed by Ekeberg in 1797, who gave to the new earth the name of yttria. They were still farther confirmed and extended by Vauquelin in 1800, and likewise by Lavoisier about the same time; and Ekeberg has published a new dissertation on the subject in the Swedish Transactions for 1802. We may therefore consider the peculiar nature of yttria as sufficiently established.

TTROANTALITE, a mineral found in the same place with gadolinite. It is in small kidney-form masses of the size of a hazel-nut. Fracture granular, iron-grey, and of a metallic lustre. Hardness inconsiderable. May be scratched with a knife, and gives a grey-coloured powder. Not magnetic. Specific gravity 5.130. It is composed of the oxides of tantalum and iron united to yttria.

YUCCA, Adam's needle, a genus of plants of the class hexandria and order monogynia. The corolla is campanulate and patent, there is no style, the capsule is trilocular. There are four species, none of which are natives of Britain. All of them are exceedingly curious in their growth, and are therefore much cultivated in gardens. The Indians make a kind of bread from the roots of this plant.

YUNX, in zoology, a genus of birds of the order picex. The bill is short, roundish, and pointed; the nostrils concave and naked; the tongue very long and cylindrical; there are two fore and two hind claws. There is only one species, the torquilla, wry-neck, which is a native of Europe, Asia, and Africa, and is often seen in Britain. It is ash-coloured above, with light black and brown strokes; beneath light-brown, with black spots; tail ash-colour, with four black bars; weight 1 oz.; irides hazl; length seven inches; migrates.

Z.

Z, the twenty-fourth and last letter of our alphabet.

In abbreviations this letter formerly stood as a mark for several sorts of weights; sometimes it signified an ounce and a half, and very frequently it stood for half an ounce; sometimes for the eighth part of an ounce, or a dram troy weight; and it has in earlier times been used to express the third part of an ounce, or eight scruples. ZZ were used by some of the ancient physicians to express myrrh, and at present they are often used to signify zincifer, or ginger.

ZAFFRE, the oxide of cobalt, employed for painting porcelain and cobalt of a blue colour. See Cobalt.

ZAMIA, a genus of the natural order of palmaceae. The amant is shiobe-shaped; scales with pollen underneath; frut. amant shioblé-shaped with scales at each margin; berry solitary. There are five species.

ZANNICHHELLA, horaced pond-weed, a genus of the monoece monandria class of plants, the male flower of which consists only of a single stamen, it is calyce nor corolla. In the female flower the calyx is composed of a single leaf; there is no co-
The peculiar the calyx Is Way, rumale
of its crystal is a rectangular prism, whose bases are squares. The most common variety is a long four-sided prism, terminated by low four-sided pyramids.

Its texture is strated or fibrous. Its lustre is silky. Reflects double. Absorbs water. Specific gravity 2.0833. Colour white, often with a shade of red or yellow. When heated it becomes electric, like the tournamule. Before the blow-pipe it frotts, emits a phosphorescent light, and pellets into a white semi-transparent enamel, too soft to cut glass, and soluble in acids. In acids it dissolves slowly and partially without effervescence; and at last, unless the quantity of liquid is too great, it is converted into a jelly. A specimen of zeolite, analysed by Vauquelin, contained

53.00 silica
27.00 alumina
9.48 lime
10.00 water
90.46.

ZEUS, in mythology, a genius of fires of the order of thoracite. The heat is compressed and declines, the upper lip being vaulted over by a transverse membrane; the tongue is subulate; there are seven rays in the Gill-membrane; and the body is compressed. The species are eight, of which the most remarkable is the faber or doree. It is of a hideous form; its body is oval, and greatly compressed on the sides; the head large; the snout vastly projecting; the mouth very wide, the teeth very small; the eyes great, the inles yellow; the lateral line oddly distorted, sinking at each end, and rising near the back in the middle; beneath it on each side is a round black spot. The tail is round at the end, and consists of fifteen yellow rays. The colour of the sides is olive, varied with light blue and white, and white living is very perceptible, and as if gilt; for which reason it is called the dorree. The largest fish we have heard of weighed twelve pounds. See Plate Nat. Hist. fig. 421.

ZIERIA, a genus of plants of the class monotaca, order tetradiatra monocaulon. The calyx is four-parted; styles simple; carpels four; seeds arilled: There is one species, not deserving notice.

ZINC. The antients were acquainted with a mineral to which they gave the name of cadmia, from Cadmus, who first taught the Greeks to use it. They knew that when melted with copper it formed brass; and that when burnt, a white spongy kind of ashes was volatilized, which they used in medicine. This mineral contained a good deal of zinc; and yet there is no proof remaining that the antients were acquainted with that metal. The word zinc first occurs in the writings Paracelsus, who died in 1534. He informs us very gravely, that it is a metal, and not a metal, and that it consists chiefly of the ashes of copper. This metal has also been called spelter. Zinc has never been found in Europe in a state of purity, and it was long before a method was discovered of extracting it from its ore. Henkel pointed out one in 1721; Von Swab obtained it by distillation in 1742; and Margraf published a process in the Berlin Memoirs in 1746.

Zinc is of a brilliant white colour, with a shade of blue, and is composed of a number of thin plates adhering together. When this metal is rubbed for some time between the fingers, they acquire a peculiar taste, and a very perceptible pervious smell; to which, however, is six and a half. When rubbed upon the fingers it tingles of a black colour. Its specific gravity, after it has been melted, is 6.61; after it has been compesed 7.1908; whilst its density is increased 1.987. This metal forms in a manner the limit between the brittle and the malleable metals. Its malleability is by no means to be compared with that of some of the metals; yet it is not brittle, like others. When struck with a hammer, it does not break, but yields and becomes somewhat flatter; and by a cautious and equal pressure, it may be reduced to a pretty thin plate, which are supple and elastic, but cannot be folded without breaking. This property of zinc was first ascertainment by Mr. Sage. When heated to about 400°, it becomes so brittle, that it may be reduced to powder in a mortar.

Zircone. It is not described. Zircon has not been ascertained. When heated to the temperature of about 700°, it melts; and if the heat is increased, it evaporates, and may be easily distilled over in close vessels. When allowed to cool slowly, it crystallizes into any of quadrangular prisms, disposed in all directions. If they are exposed to the air while hot, they assume a blue changeable colour.

When exposed to the air, its lustre is soon tarnished, but it scarcely undergoes any other change. When kept under water its surface soon becomes black, the water is slowly decomposed, hydrogen gas is emitted, and the oxygen combines with the metal. If the heat is increased, the decomposition goes on more rapidly; and if the steam of water is made to pass over zinc at a very high temperature, it is decomposed so rapidly, that very violent detonations take place.

When zinc is kept melted in an open vessel, its surface is soon covered with a grey-coloured pellicle, in consequence of its combination with oxygen. When this pellicle is removed, another soon succeeds, in which the whole of the zinc be oxidized. When these pellicles are heated and agitated in an open vessel, they soon assume the form of a grey powder, often having a shade of yellow. The powdered has been called the grey oxide of zinc. When zinc is raised to a very strong red heat in an open vessel, it takes fire, and burns with a brillian white flame, and at the same time emits a vast quantity of very light white flakes. These are merely an oxide of zinc. This oxide was well known to the antients. Dioscorides describes the method of preparing it. The antients called it pomptus; the early christians gave it the name of nihil album, and the flowers of zinc. Dioscorides compares it to wool. Two different oxides of zinc are present known.

The peroxide, or white oxide of zinc, is the oxide usually formed in the different processes to which the metal is subjected. We are indebted to Mr. Proust for an exact analysis of this oxide and its combinations. It is composed of eighty parts of oxygen and four parts of zinc. This oxide is formed not only by burning zinc, but also by dissolving...
it in diluted sulphuric or nitric acid, and precipitating it by potassa. This oxide is used as a paint; but its colour must be perfectly white so that the zinc happens to contain a little iron, which is often the case with the zinc of commerce, the oxide obtained has a tinge of yellow, because it is mixed with a little yellow oxide of iron.

The protoxide, or zinc combined with a minimum of oxygen, is obtained by exposing the peroxide to a strong heat in an earthenware retort or covered crucible. From the experiments of Desormes and Clement, it appears that by this process zinc loses a portion of its oxygen, and assumes a yellow colour. According to the analysis of these chemists, the protoxide of zinc is composed of eighty-eight parts of zinc and twelve parts of oxygen. The reduction of the oxides of zinc is in operation of difficulty, in consequence of the strong affinity which exists between zinc and oxygen. It must be mixed with charcoal, and exposed to a strong heat in vessels which screen it from the contact of the external air.

Most of the simple combustibles combine with zinc.

Hydrogen gas dissolves a little of it in certain cases. It is not to be procured by hydrogen gas by dissolving zinc in diluted sulphuric acid. The gas thus obtained is as pure as any which can be procured. It carries along with it however a little zinc in solution; hence it is composed of the sides of the glass jars, and on the surface of the water over which it stands. This gas, if we believe the French chemists, contains often a little carburetted hydrogen gas; a proof that zinc frequently contains carbon. When this metal is dissolved in sulphuric acid, it deposits a black insoluble powder, which the French chemists found to be carburet of iron. It is uncertain whether it is carburet, or carbon combined with zinc, which gives occasion to the production of the carburetted hydrogen gas.

It is believed at present that sulphur does not combine with zinc in the metallic state; lead is said to form the combination artificially has succeeded. Sulphur unites with the oxide of zinc when melted along with it in a crucible. This was first discovered by Delsin in 1781. The experiment was afterward repeated by Moreau. The sulphurated oxide of zinc is of a dark-brown colour, and brittle. It exists native in great abundance, and is known by the name of black. Mr. Proust, however, has announced it as his opinion, that blende is a sulphuret of zinc, or a compound of sulphur and zinc in the metallic state.

Zinc may be combined with phosphorus, by dropping small bits of phosphorus into it while in a state of fusion. Pelletier, to whom we are indebted for the experiment, added also a little resin, to prevent the oxidation of the zinc. Phosphuret of zinc is of a white colour, and metallic splendour, but resembles lead more than zinc. It is somewhat malleable. When hardened or filed, it emits the colour of phosphorus. When exposed to a strong heat, it burns like zinc.

Phosphorus combines also with the oxide of zinc, and the salt which Margraf had obtained during his experiments on phosphorus. When twelve parts of oxide of zinc, twelve parts of phosphoric acid, and two parts of charcoal-powder, are distilled in an earthenware retort, and a strong heat applied, a metallic substance sublimes of a silver-white colour, which when broken has a vitreous appearance. According to Pelletier, the phosphuret of oxide of zinc. When heated by the blowpipe, the phosphorus burns, and leaves behind a glass, transparent while in fusion, but opaque after cooling. Phosphuret of zinc is oxidized by zinc obtained also when two parts of zinc and one part of phosphorus are distilled in an earthen retort. The products are, 1. Zinc; 2. Oxide of zinc; 3. A red sublimate, which is phosphuret of oxide of zinc; 4. Needle-shaped crystals of metallic brilliancy, and a bluish colour. These also Pelletier considers as phosphuret oxide of zinc.

Zinc does not combine with azote. Mutaric acid readily converts it into an oxide. Zinc combines with almost all the metals, and some of its alloys are of great importance.

Elective affinity may be united to gold in any proportion by evolution. The alloy is the whiter and more brittle, the greater quantity of zinc it contains. An alloy, consisting of equal parts of these metals, is very hard and white, receives a fine polish, and does not tarnish readily. It was therefore been proposed by Mr. Malouin as very proper for the spectrum of telescopes. One part of zinc is said to destroy the ductility of 100 parts of gold.

Platinum combines very readily with zinc. The alloy is brittle, pretty hard, very inodorous, of a bluish-white colour, and not so clear as that of zinc.

The alloy of silver and zinc is easily produced by fusion. It is brittle, and has not been applied to any use.

Zinc may be combined with mercury, either by triturating the two metals together, or by dropping mercury into melted zinc.

This amalgam is solid. It crystallizes when melted, and cooled slowly into lamelated hexagonal figures, with cavities between them. They are composed of one part of zinc and two and a half of mercury. It is used to rub on electrical machines, in order to excite a current of electricity.

Zinc combines readily with copper, and forms one of the most useful of all the metallic alloys. The metals are usually combined together by stratiifying plates of copper and zinc, or the oxide of zinc combined with carbolic acid, called calamine, and applying heat. When the zinc does not exceed a fourth part of the copper, the alloy is known by the name of brass. It is of a beautiful yellow colour, more fusible than copper, and not so apt to tarnish. It is malleable, and so ductile that it may be drawn into wire. Its density is greater than the mean. It ought to be by calculation 7.6395, but it actually is 8.3958; so that its density is increased by about 1/10th. When the alloy contains three parts of zinc and four of copper, it assumes a colour nearly the same with gold, but it is not so malleable as brass. It is then called pinbeck, and is used for the crown and prince Rupert's metal. Brass was known, and very much valued, by the antients. They used an ore of zinc to form it, which they called cadmia. Dr. Watson has proved that it was brass that the ancients used according to Columella. Their ass was copper, or rather bronze.

It is very difficult to form an alloy of iron and zinc. Wallerius has shown that iron is capable of combining with a small portion of zinc; and Malouin has shewn that zinc may be used instead of tin to cover iron plates, a process which indicates there is an affinity between the two metals.

Tin and zinc may be easily combined by fusion. The alloy is, much harder than zinc, and scarcely less ductile. This alloy is often the principal ingredient in the compound called pewter.

The alloy of lead and zinc has been examined by Wallerius, Gelert, Muthenbrock, and Gniein. This last chemist succeeded in forming the alloy by fusion. He put some into the mixture, and covered the crucible in order to prevent the evaporation of the zinc. When the zinc exceeded the lead very much, the alloy was malleable, and much harder than lead. A mixture of two parts of zinc and one of lead formed an alloy more ductile and harder than brass. A mixture of equal parts of zinc and lead, formed an alloy differing little in ductility and colour from lead; but it was harder and more susceptible of polish, and much more sonorous. When the mixture contained a smaller quantity of zinc, it still approached nearer the ductility and colour of lead; but it continued harder, more sonorous, and susceptible of polish, till the proportions approached to 1 zinc and 1 lead, when the alloy differed from the last metal only in being somewhat harder.

ZINIA, a genus of plants of the class Syngenia, order polygama superflua, and in the natural system arranged under the 40th order, composita. The receptacle is paleaceous, the pappus consists of two erect awns, the calyx is ovato-cylindrical and imbricated; the rays consist of five persistent entire florets. There are 5 species, some of them natives of Britain.

ZIRCON. This stone is brought from Ceylon, and found also in France and Spain, and other parts of Europe. It is commonly crystallized. The primitive form of its crystals is an octahedron, composed of two four-sided, pyramids applied base to base, whose sides are isoceles triangles. The inclination of the sides of the same pyramid to each other is 124° 52'; the inclination of the sides of one pyramid to those of another 82° 50'. The angle at the apex is 72° 44'. The varieties of the crystalline forms of zircon amount to seven. In some cases there is a foursided prism interposed between the pyramids of the primitive form; sometimes all the angles of this prism are wanting, and two triangular faces in place of each; sometimes the crystals are dodecahedrons, composed of a flat four-sided prism with hexagonal faces, terminated by four-sided summit with rhomoidal faces; sometimes the edges of this prism, sometimes the edges where the prism and summit join, and sometimes both together, are wanting, and we find small faces in their place. For an accurate description and figure of these various forms, we refer to Haeckel.

The texture of zircon is foliated. Fracture imperfectly conchoidal. Causes a very great double refraction. Specific gravity from 4.615 to 4.383. Colours various, from reddish or yellowish, sometimes it is limpid. Before the blowpipe, it loses its colour, but not its transparency. With borax
ZOO with The species formerly called hyacinth is of a yellowish-red color, mixed with brown. Its surface is smooth. Its lustre 3 to 4.

2. The variety formerly called jargon of Ceylon is either grey, greenish, yellowish brown, reddish brown, or violet. It has little external lustre. It is sometimes nearly opaque.

The variety, according to the analysis of Vanheulgen, is composed of 64.5 zirconia 32.0 silica 2.0 oxide of iron

ZIZANIA, a genus of plants of the class monocotyledon, order caryophylli; and in the natural system arranged under the 4th order, graminia. There is no male calyx; the corolla is a bivalved heartless globe, intermixed with the female flowers; there is no female calyx; the corolla is an univalved, cucullated, and aristated globe; the style is bipartite, and there is one seed covered with the plaited corolla. There are 2 species; the aquatica and terrestris, none of which are native of Britain.

ZODIAC, See ASTRONOMY.

ZODIACAL light, a brightness sometimes observed in the zodiac, resembling that of the galaxy, or milky way. It appears at certain season, viz. towards the end of winter and in the spring after sunset, or before his rising in autumn and beginning of winter, resembling the form of a pyramid, lying lengthways with its apex along the zodiac, its base being placed obliquely with respect to the horizon. This phenomenon was first described and named by the elder Cassini, in 1683. It was afterwards observed by Fatio, in 1684, 1685, and 1686; also by Kirch and Eimmart, in 1685, 1689, 1691, 1693, and 1694.

ZOEIA, or a genus of plants of the class strutters, and order polygama. The receptacle is bristly; the pappus setaceous; the corolline of the radius liguilated; the calyx imbriicated. There is one species, the lentago.

ZONE, in geography and astronomy, a division of the terrestreal globe, with respect to the different degree of heat found in the different parts.

A zone is the fifth part of the surface of the earth, contained between two parallels. The zones are denominated torrid, frigid and temperate.

The torrid zone is a band surrounding the terrestrial globe, and terminated by the two tropics. Its breadth is 46° 59'. The equator, running through the middle of it, divides it into two equal parts, each containing 23° 29'. The ancients imagined the torrid zone uninhabitable.

The temperate zones are two bands, environing the globe, and contained between the tropics and the polar circles: the breadth of each is 43° 2'.

The frigid zones are segments of the surface of the earth, terminated, one by the antarctic, and the other by the arctic circle. The breadth of each is 46° 59'.

ZOONIS, a genus of insects of the order Coleoptera. The generic character is, antennae tectaceous; feelers four, filiform; jaw entire, longer than the feelers; lip emarginate. There are eight species.

ZOOLOGY, is that part of natural history which relates to animals. In order to divide the study of zoology, many methods of reducing animals to classes, genera, and species, have been invented: but as that of Linneus is undoubtedly the best, the most extensive, and the most generally adopted, we shall give a brief account of it.

Linneus divides the whole animal kingdom into six classes. The characters of these six classes are taken from the internal structure of animals, in the following manner:

Class I. Mammalia, or animals that suckle their young. The characters of this class are these: The heart has two ventricles and two auricles; the blood is red and warm; and the animals belonging to it are viviparous.

Class II. Aecte, or birds. The characters are the same with those of class I. excepting that the animals belonging to it are oviparous.

Class III. Amphibia, or amphibious animals. The heart has but one ventricle and one auricle; the blood is red and cold; and the animals belonging to this class have the command of their lungs, so that the intervals between the act of respiration and expiration are in some measure voluntary.

Class IV. Pisces, or fishes. The heart has the same structure, and the blood the same qualities, with those of the amphibia; but the animals belonging to this class are easily distinguished from the amphibia, by having no such voluntary command of their lungs, and by having external branchial or gills. Class V. Insecta, or insects. The heart has one ventricle, but no auricle; the blood is cold and white; and the animals are furnished with antennae or feelers. See Insect.

Class VI. Pauces, or worms. The characters are the same with those of class V. only the animals have no antennae, and are furnished with tentacula.

The first class, Mammmalia, is subdivided into seven orders; the characters which are taken from number, structure, and situation of the teeth.

Order I. The primates have four incisors, or fore-teeth, in each jaw, and one dog-tooth, N. B. By one dog-tooth, Linneus means one on each side of the fore-teeth in both jaws. This order includes four genera, viz. homo, simia, lemur, vesperilfo.

Order II. The bruta have no fore-teeth in either jaw. This order includes seven genera, viz. rhinoceros, elephas, tichocerus, bradypus, myrmecocystis, manis, dasypus.

Order III. The fera have, for the most part, six conical fore-teeth in each jaw. This order includes ten genera, viz. phoca, canis, felis, viverra, mustela, ursus, deldphus, tapir, siren, erinaceus.

Order IV. The glires have two fore-teeth in each jaw, and no dog-teeth. This order includes ten genera, viz. hystric, lepus, castor, mus, sciurus, myoxus, cavia, aratomy, dipus.

Order V. The pectora have no fore-teeth in the upper jaw, but six or eight in the under jaw. This order includes eight genera, viz. camelus, moschus, graffus, cervus, antilope, capra, ovis.

Order VI. The belæve have obtuse fore-teeth.

Order VII. The cete, or whale kind, have no upper character in the teeth, being very different in the different genera; before sufficiently distinguished from the other orders of mammalia, by living in the ocean, having pectoral fins, and fins and spiracles upon the head. This order includes four genera, viz. monodon, balaen, physeter, delphinus.

The generic characters of the mammalia are, like those of the orders, almost entirely taken from the teeth, excepting the vesperillo, which, besides the character of the order derived from the teeth, has this further mark, that there is a membrane attached to the feet and sides, by means of which the creature is enabled to fly: the hystric, whose body is covered with sharp spines; and the whole order of pectora, whose genera, besides the characters taken from the teeth, are distinguished into those which have horns, those which have no horns, and by peculiarities in the horns themselves.

The specific characters are very various, being taken from any part of the body which possesses a peculiar uniform mark of distinction. As examples of these characters are to be found in a description of each genus; it is unnecessary to say any thing further concerning them in this place.

The second class, Aecte, is subdivided into six orders; the characters of which are taken from the structure of their teeth: and the whole order of pectora, whose genera, besides the characters taken from the teeth, are distinguished into those which have horns, those which have no horns, and by peculiarities in the horns themselves.

The specific characters are very various, being taken from any part of the body which possesses a peculiar uniform mark of distinction. As examples of these characters are to be found in a description of each genus; it is unnecessary to say any thing further concerning them in this place.
The generic characters of this class are taken from peculiarieties in the head, the mouth, the teeth, the nostril, the rays of the gill in the membrane of the gills, the eyes, the general figure of the body, the nature of the tail, the situation of the spiral.

The specific characters are taken from peculiarieties in all the parts above enumerated, and many others.

The fifth class, Fascea, is subdivided into seven orders, the characters of which are taken from the wings. See the article Insect.

Order I. The coleoptera have four wings, the two superior ones being crassuscoxous, and furnished with a straight spine. This order comprehends forty-seven genera, viz. scarabaeus, lucanus, dernestes, melrythus, buphis, tritonea, hippocrepis, lyon, panus, bostrichus, anturhens, nitidula, coccinella, curculio, brenus, atelacius, erodium, staphylinus, scarus, zygia,模拟, teobus, baccinio, cophra, paras, hippus, hydropis, vespa, vespa, cantharida, criocerus, elater, catorus, alopus, carabus, ylita, serropalpus, cerambyx, lepura, rhinocerous, zonitis, cindelida, dyctious, torficula.

Order II. The nemiptera have four wings, the two superior ones being semi-tergosternal, and incumbent, i.e. the interior edges lie above one another. This order includes fourteen genera, viz. blatta, pneumonia, minutis, grylius, fulgora, cida, notocopa, nepa, cicada, macrocephalus, sphix, cherus, coccus, thrips.

Order III. The lepidoptera have four wings, all of them imbricated with scales. This order contains three genera, viz. papilio, sphinx, phaenala.

Order IV. The neuroptera have four wings, interwoven with veins, like a piece of network, and no stig in the anus. This order includes seven genera, viz. libella, hiperbenacis, myrmex, phycnus, panocy, rophidia.

Order V. The hymenoptera have the same characters with the former, only the anus is armed with a stig. But this mark is peculiar to the females and nesters; for the males have no sting. This order comprehends fifteen genera, viz. cynips, tentrelo, sirex, ichneunon, sphex, scolia, thynnus, leucopis, tipula, chalcis, carypis, vespa, apis, formica, mutilla.

Order VI. The diptera have two wings, and two clavated halteres or balances behind each wing. This order contains twelve genera, viz. diops, tipula, musca, tabanus, ennis, concept, oestra, asilus, stenomyxus, culex, bonbyllus, hippobosca.

Order VII. The aptera have no wings. This order contains fifteen species, viz. lepisma, podura, termes, pediculus, pules, acarus, hydracina, aranea, plagni, scorpio, cancer, monocolus, oniscus, scolopendria, julus.

The sixth class, Pernes, is divided into five orders.

Order I. The intestina are the most simple animals, being perfectly naked, and without limbs of any kind. This order contains twenty-one genera, viz. acaris, trichocopa, luscinia, tilia, syclor, ligula, linguaster,strongylus, cinchohynilus, harca, cecirrounded, caryophyllus, fasciata, terrama, furia, myrme, gordius, hirundo, liricdens, sipunculus, planaria.

Order II. The mollusca are likewise simple naked animals, without any shell; but they are brachiated, or furnished with a kind of limbs. This order comprehends thirty-one genera, viz. actinia, clava, mannnertia, pedicularia, asidica, salpa, dagys, pterochilus, limax, sphylla, dentes, tethis, holothuria, terbellia, triton, cepha, ceps, libara, lema, sceylh, glaucus, alpisdrita, amphitrite, spone, neris, nia, physophora, medua, bocernia, asteria, eccenia.

Order III. The testacea have the same characters with those of order II. But are covered with a shell. This order includes thirty genera, viz. chiton, lepon, phalos, mya, solen, tellenia, cardium, naetera, donax, venus, spondylus, chama, arca, ostrea, anoxia, mytilus, pinna, argonauta, nautilus, conus, cyprca, bulla, voluta, sacchurn, stransbus, murex, trochus, turbo, helix, moria, bollus, patella, denulatum, scalaria.

Order IV. The zoophyta, are compound animals, furnished with a kind of flowers, and having a vegetating root and stem. This order contains fifteen genera, viz. tubipora, madrepora, millepora, acelopora, isis, antipathes, gorgonia, oleye, siphonga, flusta, tubularia, corallia, serpulaita, pernula, hydra.

Order V. The tunicata consists of very small simple animals. This order contains nine genera, viz. brachionus, vorticella, trichoda, ceraria, leucopeora, gonium, copoda, paramecium, cycloidium, bursaria, virbio, enchelis, bacillaria, volvox, monas.

For more particular information concerning the several branches and subjects of zoology, the reader may consult the various articles above referred to, and he will find most of the genera described in their order in the alphabet.

ZOOPHYTA, in natural history, the 4th order under the class of Vermin. See Zoology.

ZOSTERA, a genus of plants of the class: gynandria, order polyanthia; and in the natural system arranged under the second order, pipirica. The spadix is linear, and fertile only in the last flower; the calyx is five-parted; petals five; capsules five. There is one species, the amasa, resembling quassia, a shrub of Guiana.

ZYG. See SQUAMUS.

ZYGIA, a genus of insects of the order Coleoptera. The generic character is, antennae moniliform: feelers equal, filiform: lip elon-gated, membranes: jaw one-toothed.

ZYGOPHILYUM, bean-caper, a genus of plants of the class of decanaria and order monogyna, and in the natural system arranged under the 14th order, gramineae. The calyx is five-leaved; petals five; nectarium ten-leaved, covering the germ; envelopes five-celled. There are 14 species, partly shrubby, and some of them natives of warm climates, though some of them are hardy enough to endure the open air in this country.
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ERRATA.

Vol. I. Page 15, col. 2, under Action, line 2 of from the top, for against read by.
19, col. 3, under Adoxia, for Adoxia read Adoxa.
23, col. 3, under Ather, line 3 from the bottom, for rarefed read rectified.
47, col. 3, under Alehouses, line 8 from the top, for 40l. read 20l. and dele the rest of the sentence.
48, col. 1, under Alexandrian MS. line 23 from the head of the article, for Dr. Warde read Dr. Woide.

Vol. II. Page 37, col. 2, under Lord's Day, line 14 from the head of the article, for 20l. read 20s.
28, col. 3, under Mortman, line 2 from the bottom, for debt read death.
243, col. 3, under Musk, line 9 and 10 from the top, for into a kind read in a gland.
253, col. 3, under Natural Philosophy, line 7 from the head of the article, for compounded read confounded.
Ditto, line 2 from the bottom of ditto, for astronomy read astronomy.
280, col. 2, under Nymphs, third article in the column, for Nymphs read Nymphae.
327, line 1, dele See Plate II. figs. 1 and 2.
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